ABSTRACTS

Plenary Sessions (Abstracts 001–019)

001 | Plenary Session 1 – Aesthetics: Clinical Guidelines

Hard tissue characteristics affecting aesthetic outcomes

Botticelli D
Ariminum Research and Dental Education Center (ARDEC), Rimini, Italy

Alveolar bone crest characteristics will affect soft tissue adaptation around implants. The lecture will focus on some of these characteristics and their impact on marginal soft tissue, both at implant installed in healed alveolar bone crest as well as at implants installed into alveolar sockets immediately after tooth extraction. Implant positioning, bone crest width, platform configuration as well as their effect on the surrounding marginal soft tissue will be discussed.

002 | Plenary Session 1 – Aesthetics: Clinical Guidelines

Soft tissue characteristics affecting aesthetic outcomes

Zuhr O
Germany

The achievement of long-term aesthetic and stable peri-implant soft tissues is a difficult and demanding task. With regard to the definition of soft tissue characteristics that affect aesthetic outcomes, it is necessary to distinguish between ''quantity-'' and ''quality-aspects'': while it is desirable to completely reconstruct existing tissue defects or prevent defect formation after extraction (soft tissue quantity) it is in addition necessary to achieve all attributes of a natural and healthy gingiva – colour, keratinization and surface-characteristics of the peri-implant mucosa need to match with the neighbouring natural dentition, scar formation and exceeding tissue must be avoided (soft tissue quality). Beside the description of relevant aesthetic parameters, this presentation will focus on scientific methods to analyze and measure these parameters. The potential of existing clinical concepts with a view to optimum peri-implant soft tissue aesthetics will be outlined.

003 | Plenary Session 1 – Aesthetics: Clinical Guidelines

The optimal timing and positioning of implant placement for improved aesthetics

Chen S
Australia

The clinician has the option of placing implants ate the tie of tooth extraction (immediate or Type 1 placement), soon after tooth extraction (early implant placement or Types 2 and 3 placement) or after the site has fully healed (late or Type 4 placement). Each of these approaches of the timing of implant placement has its advantages and disadvantages. In aesthetic sites, biological and post-surgical events have a significant effect on the stability of the mucosa, and the resultant soft tissue aesthetic results. Based on recent clinical and experimental evidence, this lecture will discuss the advantages and disadvantages of each approach, and provide recommendations for the optimal timing of implant placement of improved aesthetic outcomes.

004 | Plenary Session 1 – Aesthetics: Clinical Guidelines

The influence of provisional restorations on final aesthetics

Belser U
University of Geneva, Switzerland

Various clinical approaches for the replacement of extracted teeth with implant-supported restorations have emerged in recent years. This presentation will focus on treatment protocols currently used to predictably restore aesthetics and function in the partially edentulous anterior maxilla. In this context, provisional restorations play a major role for both soft tissue conditioning and diagnostics. The fundamental difference between single tooth sites, two adjacent missing anterior maxillary teeth, and more extended edentulous segments, often accompanied by significant horizontal and vertical tissue deficiencies, will be addressed, including the related clinical/laboratory step-by-step procedures.

005 | Plenary Session 2 – CAD–CAM in Implant Dentistry – Current and Future Applications

Surgical guidance using CAD CAM technology

Jung RE
Department of Fixed and Removable Prothodontics and Dental Material Science, University of Zurich, Switzerland

Current dental implantology aimed to develop techniques that can provide optimal three-dimensional (3D) implant positioning with respect to both prosthetic and anatomical parameters. Important achievements in this field have undoubtedly been the introduction of cone beam technique (CBCT), 3D implant planning software, and CAD/CAM technology in implant dentistry. As many of these techniques are already available in clinical practice, it is of great importance to evaluate the possibilities and limitations of computer-assisted implant dentistry in clinical applications. Hence, the aim of this lecture is to discuss the clinical procedure of computer-assisted implant dentistry, the clinical indications, and the accuracy and clinical performance of computer technology applications in surgical implant dentistry.

006	Plenary Session 2 – CAD–CAM in Implant Dentistry – Current and Future Applications

The role of the prosthodontist in optimising the aesthetic result of restorations designed with CAD CAM techniques

Fradeani M
Pesaro, Italy

A predictable esthetic final result in the anterior region is often largely dependent upon close co-operation between prosthodontist, and implantologist, especially in the case of patients with high smile line. Tissue management procedures on implants during the provisional phase will be discussed and their importance emphasized in order to integrate anterior restorations into the oral environment in such a way as to achieve esthetic and biological predictability. Selection of the appropriate ceramic material is fundamental to obtain an excellent result. Nowadays, the undeniable role played by CAD–CAM technology allows the clinician to achieve an ideal abutment shape and final restoration contour, either in the case of single restorations and full-mouth rehabilitations.

007	Plenary Session 2 – CAD–CAM in Implant Dentistry – Current and Future Applications

Fine-tuning the precision of full arch immediately loaded dental implant treatment

Wismeijer D
Academic Center for Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands

The precision of full arch immediately loaded dental implant restorations with prefabricated CAD CAM-designed superstructures has been proven by the literature to have shortcomings. The CAD-planned implant position does not always match that which is realized in the patient. This automatically leads to problems concerning the fit of the superstructure. In this presentation, we will show how we circumnavigated these problems by fine-tuning the planning and surgery techniques. We have tested the misfit of the superstructures using a strain gauge technique as well as a scanning technique. Results of our research in this area focused on fit and misfit will be presented.

008	Plenary Session 2 – CAD–CAM in Implant Dentistry – Current and Future Applications

The present and future for CAD/CAM technologies

Mehl A
Switzerland

Computer-assisted fabrication of dental restorations plays a growing role in clinical practice. A variety of CAD/CAM systems and concepts is now available for applications of this type. Especially, new intraoral scanning systems and new developments in software will shift the work flow of the fabrication process closer to the dental office, hence changing the conventional way of treatment and diagnosis. This lecture will give an overview of the actual state concerning the clinical impact of present systems and will show and discuss research results that point out the possibilities of CAD/CAM for the near future.

009	Plenary Session 3 – Possibilities for Conventional Dental Treatment: How Far Can We Go?

Conventional crown and bridge treatment

Youngson C
University of Liverpool, UK

Implant-retained prostheses are often the ideal treatment option in the case of missing teeth. However, there remain a significant number of people who, for one reason or another, cannot obtain this mode of treatment. While preparing the natural dentition for fixed prosthodontic treatments, significant changes may be induced in the pulpal tissues that can affect the long-term survival of the teeth and prosthesis. This plenary will consider the factors which affect the longevity of crown and bridgework affixed to teeth and compare the data with those of implant-retained fixed prostheses.

010	Plenary Session 3 – Possibilities for Conventional Dental Treatment: How Far Can We Go?

Periodontal therapy

Wachtel H
München, Germany

A substantial body of evidence has implicated that teeth with advanced loss of attachment and substantial bone destruction due to periodontal disease can be maintained over a long period of time. Advances in regenerative procedures and improvements in flap design have greatly influenced clinical treatment outcomes even in esthetically demanding areas. Regenerative periodontal therapy will dramatically change the long-term prognosis of the so-called ''hopeless'' teeth with deep intrabony defects and increased tooth mobility. Molars and premolars with advanced furcation involvement do not respond as well to periodontal therapy including regenerative procedures. Data from recent clinical trials suggest that furcation involvement present a poorer long-term prognosis that will be further modulated by local factors (probing depths > 5 mm) and patient specific risk factors such as smoking. All these factors will influence the clinicians' choice of the appropriate treatment strategy: removing the periodontally involved tooth and replacing it with implants is one treatment alternative but in a lot of clinical situations it is not the best solution. The presentation will illustrate the possibilities and limits of periodontal therapy: how far can we go?

011	Plenary Session 3 – Possibilities for Conventional Dental Treatment: How Far Can We Go?

Endodontic therapy

Reit C-E
Sweden

The last 10–15 years have seen a tremendous technological development that facilitates endodontic treatment and enhances the

potential to increase its overall standard. For example, the advent of super-flexible nickel–titanium alloy has made it possible to fabricate instruments that can follow the root canal and make it easier to produce good quality canal preparations and root fillings. The surgical microscope has brought light and vision into the pulp chamber and working under high magnification has made it far easier to control intracanal procedures. Also, the microscope in combination with new tools and retro filling materials has increased the healing potential of surgical endodontics.

012 | Plenary Session 3 – Possibilities for Conventional Dental Treatment: How Far Can we Go?

Removable prosthodontics

Jepson N
University of Newcastle, UK

This presentation will focus on the use of removable partial dentures (RPDs). Important changes in the partially dentate population, both demographic and individual, have and continue to occur. Advances in the use of implant-supported prostheses and adhesive techniques together with an increasing patients' awareness of newer technologies appear to be associated with a substantial reduction in the use of RPDs in many parts of Europe. This presentation will describe these changes, present evidence for the effectiveness of the current provision of RPDs and describe challenges to the traditional use RPDs. On the basis of this evidence, a re-evaluation of the role of RPDs in the restoration of the partially dentate patient will be presented together with speculation as to future trends in the use of RPDs.

013 | Plenary Session 4 – Controversial Issues

Implant placement adjacent to and within endodontically infected sites

Quirynen M
Belgium

Several recent case reports reported on ''retrograde peri-implantitis'', a bone destruction (radiolucency) around the apical part of an osseointegrated implant. It often develops within the first months after implant insertion, without major clinical signs. Within the limitations of case reports, one can conclude that retrograde peri-implantitis is provoked by remaining scar or granulomatous tissue at the recipient site: endodontic pathology of extracted tooth (scar tissue-impacted tooth) and/or endodontic pathology from a neighbouring tooth. Several treatment strategies have been proposed. A profound curettage of the defect seems sufficient to stop the bone destructive process, but a resection of the apical part of the implants might further improve the outcome, with good long-term survival data.

014 | Plenary Session 4 – Controversial Issues

Diagnosis and management of nerve damage following implant surgery

Renton T
UK

Background: Implant treatment has the potential to damage the inferior alveolar nerve via direct trauma, pressure or neurotoxicity.
Methods: The authors reviewed all cases of involvement of the inferior alveolar nerve resulting from root canal therapy in patients seen in a tertiary referral centre during a 3-year period.
Results: Forty patients presenting to the specialist nerve injury clinic at Kings Health Partners with implant-related neuropathy. A high number of these patients presented with persistent neuropathic pain. As a result, the clinical presentation of these patients was often complex causing confusion to both patient and clinician.
Conclusion: It is imperative that dental practitioners are aware of the incidence of neuropathic pain that may result from iatrogenic nerve injury and the significant ensuing disability. Practitioners should have an awareness of risk factors relating to inferior alveolar nerve injury. By understanding the risk factors and modification of intervention as a result, more of these injuries will be prevented.

015 | Plenary Session 4 – Controversial Issues

When and how to connect implants to teeth

Pjetursson BE
Iceland

In daily practice, dentists routinely face the challenge of making fast and difficult decisions. These are mostly influenced by paradigms dictated by basic dental education and many years of clinical practice. Scientific evidence provided by well-controlled studies is rarely available to influence and/or determine the treatment plan. When planning a fixed reconstruction, the options are solely tooth-supported or solely implant-supported fixed dental prostheses (FDPs) or combined tooth-implant-supported FDPs. These treatment options have various documented longevities and biological as well as technical risks that should be considered during treatment planning. During this lecture, the question whether teeth and implants should been connected in a single reconstruction will be addressed. Several common clinical situations will by discussed and attempts will by made to perform evidence-based treatment planning. Special considerations will be given to the how to connect teeth and implants in a combined tooth-implant-supported FDPs. Should the connection be rigid, or is there a need for a non-rigid connection to compensate for the differences in mobility of teeth and implants. Finally, clinical conclusion based on the available evidenced will be presented.

016 | Plenary Session 4 – Controversial Issues

Choice of abutments

Sailer I
Switzerland

Today, several types of implant abutments are available in order to fulfill all clinical needs resulting in a high number of possibilities for the choice of the restorative implant components. On the one hand, a choice has to be made between standardized and customized abutments. On the other hand, different abutment materials like titanium or various high-strength ceramics (alumina, zirconia) are being offered. This huge variety of abutments may complicate the clinical decision-making. For the choice of abutment, several factors have to be considered. Most of those are esthetical. The crucial factors for the decision-making are the visibility of the region (e.g. high vs. low smile line), the biotype of the gingiva (high scalloped, thin vs. low scalloped, thick), the color of the neighboring teeth and, finally, the esthetic expectations of the patient. Clinical studies showed that in esthetically demanding situations, customized ceramic abutments are indicated in order to avoid problems with soft tissue discoloration. However, these ceramic abutments are prone to fracture over time due to the brittleness of ceramics. A decision tree for the choice of abutment type and material will be given in the lecture.

017 | Plenary Session 5 – Soft Tissue Surgical Procedures

Soft tissue engineering – how far have we come?

Feinberg S
University of Michigan School of Dentistry, Ann Arbor, Michigan

In the field of tissue engineering/regenerative medicine, most investigators focus on the area of hard tissue, bone and/or cartilage, regeneration. In this presentation we will, instead, talk about some of the basic principles of soft tissue engineering in craniomaxillo-facial surgery. We will discuss the use of scaffolds, cells and growth factors. We will (1) use as an illustration the fabrication of a human tissue-engineered oral mucosa suitable for intraoral grafting, (2) show results from our Phase I clinical trial, (3) discuss the role of epithelial stem cells in tissue regeneration and their identification and isolation from oral mucosa and (4) present preliminary data on the manufacture of muco-cutaneous constructs that could be used to form human lips for facial reconstruction.

018 | Plenary Session 5 – Soft Tissue Surgical Procedures

The application of periodontal soft tissue surgery techniques to peri-implant defects

Zucchelli G
University of Bologna, Italy

The recession of the buccal soft tissue margin is a frequent complication of well-integrated dental implants. The appearance of metallic structure or even their transparency through the thin buccal soft tissues is the most common reason for patient aesthetic complains. Soft tissue plastic surgical procedures and bilaminar techniques in particular can be successfully used to treat buccal gingival recessions around dental implants and to increase the thickness of buccal soft tissue before implant installation.

019 | Plenary Session 5 – Soft Tissue Surgical Procedures

Peri-implant recession defect management

Stiller M
Berlin, Germany

Contrary to the positive results in dental implantology, the surgical and prosthetic treatment of functionally and aesthetically impaired implants has only been marginally discussed in literature. Corrections of impaired implants in the upper-anterior-region face compared with the impaired implants in the upper and lower lateral regions constitute more difficulties and surgeon's challenge. Besides the frequent necessity of osseous augmentation, the mucogingival complex needs to be harmonized or, respectively, reconstructed in most cases. There is often a lack of keratinized gingiva, disturbing cicatrice tracks, discolorations of the gingival and recessions. Quite frequently the mucogingival appearance is also unsatisfactory due to preceding operations and attempted plastic coverages. At the first, the aim of the presentation will describe the successful treatment of aesthetically and functionally impaired implants in the upper anterior region. The possibilities of hard and soft tissue transplantation techniques will be discussed in detail depending on the soft and hard tissue defect morphology and the hard and soft tissue biotype. At the second, the presentation will describe tissue changes at implant recessions in cases where the aesthetic challenge is not center of attention. This concept is primary important for the reduction of peri-implantitis in cases, where implant recessions occurred and a progression of peri-implant bone loss is observed.

Parallel Sessions (Abstracts 020–035)

020 | Parallel Session 1 – Options for Implant Restorations

Overdenture designs

Müller F
Division of Gerodontology and Removable Prosthodontics, University of Geneva

The potential benefits from an implant treatment in elderly adults are well documented. Implant-supported overdentures may ease some of the functional, psychological and psychosocial disabilities following tooth loss and thus increase the oral health-related quality of life until late in life. However, what overdenture design is the most adequate and how many implants are required in which clinical situation? ''There is now overwhelming evidence that a 2-implant overdenture should become the first choice of treatment for the edentulous mandible'' is the conclusion of the McGill consensus statement published in 2002. The question arises whether more recent treatments concepts with more or less implants replace this statement. With the population ageing and more and more persons losing their natural dentition later in life, there is also an increasing need for age-adequate overdenture designs that meet the clinical, functional and socio-economic context of old and oldest old patients. These treatment concepts need also taking into account the growth of the ageing population and thus the considerable challenge for health care systems with limited funds.

021 | Parallel Session 1 – Options for Implant Restorations

Fixed rehabilitation of the edentulous maxilla

Strub JR
Associate Dean for Clinical Affairs, Professor and Chair, Department of Prosthodontics, Dental School, University Hospital of Freiburg, Germany

The aim of this presentation is to describe the different treatment approaches available for the fixed rehabilitation of the edentulous maxilla in the presence of varying hard and soft tissue conditions and to review the clinical outcome of each treatment approach.

022 | Parallel Session 1 – Options for Implant Restorations

Fixed partial dental prostheses: cement vs. screw retained

Taylor T
Farmington, CT, USA

Everyone who restores dental implants has an opinion as to what the best method of retention for fixed prostheses is. The advantages of screw-retained and cement-retained prostheses have frequently been discussed but with little scientific evidence to support those discussions. This presentation will attempt to clarify the current evidence and give some guidelines based on that evidence.

023 | Parallel Session 1 – Options for Implant Restorations

Metal-ceramics vs. all ceramic restorations

Gracis S
Milan, Italy

Up to now, metal ceramics has been considered the standard for fabricating fixed prosthesis because it reconciles excellent mechanical and physical properties with the ability to deliver good esthetics. The advent of new metal-free materials and systems attempts to challenge this standard. This lecture will analyze the indications and requirements for the metal-ceramic prostheses vs. a number of all ceramic restorations, and it will address the dilemmas facing the clinician when deciding which materials to use for the implant-supported restoration.

024 | Parallel Session 2 – Quality of Life Factors

Psychological and psychiatric factors influencing implant treatment

Newton T
UK

A consideration of psychological and psychiatric factors is imperative in the assessment, planning and evaluation of implant treatment. Patients may have expectations of the process and outcome of implant treatment that are unrealistic and likely to lead to dissatisfaction. Such unrealistic expectations may be sufficiently extreme to warrant a diagnosis of body dysmorphic disorder. The importance of identifying such patients before treatment will be emphasized. In addition, this talk will explore patients' motivation for treatment, their preferred treatment experiences and their valued treatment outcomes.

025 | Parallel Session 2 – Quality of Life Factors

How to meet our patient's expectations in aesthetic treatments. What are the psychological determinants?

Sanz M
University Complutense of Madrid, Madrid, Spain

Aesthetics is defined as the study of beauty in all forms and expressions, but when we are dealing with human beauty, aesthetics is always associated with physical attractiveness and we doctors as providers of aesthetic treatments are always confronted

with how to deal with the patient's aesthetic expectations. We must know the psychological bases of human beauty and try to understand whether beauty is in the eye of the beholder, or rather is inbred in our brains. In this presentation, I shall try to answer some of these issues reviewing the current aspects of research on beauty from the anthropological, psychosocial and neurophysiologic aspects.

026 | Parallel Session 2 – Quality of Life Factors

Speech implications of implant prosthodontics

Fürhauser R
Wien, Austria

Establishment of correct articulatory phonetics is a challenge in conventional prosthodontic restoration, but is even more challenging in implant dentistry, especially in maxillary implant-supported fixed prosthesis. This is due to the fact of alveolar process deficiency, premolarisation of occlusion or malpositioned implants compromising the airflow. Speech sounds are created by modifying the airflow on the way from the lungs through the oral and nasal cavities. Only when there is intimate knowledge of the prerequisites of each sound can one adequately restore patient's speech. This knowledge should lead to standardised protocols in daily treatment. Especially the s-sound is one of the most misarticulated. To form this sound correctly, the sides of the tongue touch the sides of the teeth, the air travels over the center of the tongue passing the interincisal space. As a consequence, five key factors for the articulation of the s-sound have been defined. As a result, a standardised check list has been developed that would be useful in patients with challenging maxillary implants needs.

027 | Parallel Session 2 – Quality of Life Factors

Masticatory efficiency after implant therapy

Bakke M
Københavns Universitet, Denmark

The masticatory function has been shown to be dependent on the number of posterior teeth, occlusal contacts and bite force. This report deals with the effect of treatment with 1–4 implant-supported single crowns (mainly premolars) on masticatory function and related parameters in 18 subjects with tooth agenesis. The treatment was associated with significant increases in the masticatory ability and performance as well as the contact area and the bite force. Thus subjects with agenesis may benefit from this type of treatment. However, as the functional parameters before replacement of the teeth corresponded to values in subjects with complete dentitions, the functional importance of the increase may be questioned. *Clin Oral Impl Res* 2010; 21: 108–14.

028 | Parallel Session 3 – Cone Beam CT Imaging in Implant Dentistry

Indications for conventional radiography in implant dentistry

Gröndahl K
Professor, Department of Oral and Maxillofacial Radiology, Institute of Postgraduate Dental Education, Jönköping, Sweden

Computed tomography and cone beam-computed tomography provide detailed information about the three dimensions in potential implants sites making implant surgery a safe procedure. Nevertheless, in many cases sufficient information can be obtained with a combination of a thorough clinical examination and conventional two-dimensional radiography as represented by intraoral and panoramic techniques. The former can, for example, often suffice in the case of the single implant and the latter when implants are to be placed in the lower anterior region. Advantages are lower costs and radiation doses and the availability of these techniques in most dental offices. However, as soon as there is doubt about the width of the jawbone a tomographic technique should be used.

029 | Parallel Session 3 – Cone Beam CT Imaging in Implant Dentistry

Indications for cone beam CT imaging in implant dentistry

Dawood A
London, UK

CBCT technology has radically transformed access to three-dimensional imaging for implant dentistry. Should CBCT be used routinely for pre-surgical assessment? While examining the indications for cone beam CT, this presentation will attempt to reconcile the desire for exemplary imaging, with the range of scanner types and scan protocols available. Recommendations will be made as to how each scan can be optimised for the particular needs of the patient and the particular intervention that is required.

030 | Parallel Session 3 – Cone Beam CT Imaging in Implant Dentistry

Radiation dose implications for cone beam CT investigations

Gröndahl H-G
Professor, Department of Oral and Maxillofacial Radiology, The Postgraduate Dental Institute, Jönköping, Sweden

According to the International Commission of Radiation Protection (ICRP), every radiological examination must be both justified and optimized. It is the clinical need of radiological information that makes a radiological examination justified. It becomes optimized when it is performed so that the clinically necessary information from the region of interest is obtained with a radiation dose that is as low as reasonably achievable. Cone beam-computed tomography can be made with a large variety of different CBCT units that show large

variations in many different aspects, not least radiation dose and image quality. Against this background the presentation will demonstrate how CBCT investigations can be made so that a good balance between radiation dose and clinically necessary information will be obtained.

031 | Parallel Session 3 – Cone Beam CT Imaging in Implant Dentistry

Accuracy and artefacts of cone beam CT imaging

Jacobs R
Katholieke Universiteit Leuven, Belgium

During the last decade, there has been an upward trend in using three-dimensional information as an aid to dentomaxillofacial diagnostics and surgical planning. This is further strengthened by the introduction of dental cone beam CT allowing volumetric jaw bone imaging at reasonable costs and doses. CBCT imaging may offer numerous diagnostic potentials and even change treatment strategies in oral health care. Yet, an exponential growth of the different CBCT machines available and fast evolutions with respect to dose and image quality have created an almost unbridgeable time gap between reporting of scientific evidence and the actual clinical use of CBCT. Recent studies in the framework of the SedentexCT Euratom project indicate crucial differences in accuracy and artefact expression depending on both equipment and patient factors. The relative contribution of those variables to the resulting clinical image dataset will be discussed.

032 | Parallel Session 4 – Sinus Surgery

The diagnosis and management of sinus pathology prior to sinus augmentation

Valentini P
France

According to the literature, it is well known that the occurrence of post-operative chronic sinusitis appears to be limited to patients with a predisposition for this condition. In order to prevent post and also per operative complications, it is very important to be able to precise anatomical particularities and to diagnose the health status of maxillary sinus. The possibility for the right management of those parameters is essential for the case selection.

033 | Parallel Session 4 – Sinus Surgery

Graft materials for predictable outcomes

Jensen SS
Copenhagen, Denmark

Different graft materials for sinus floor elevation procedures have been studied extensively and a large series of grafting protocols may be considered well documented. The grafting possibilities ranges from merely elevating the Schneiderian membrane leaving the space created beneath to be filled with coagulum to augmenting the sinus cavity with autogenous bone blocks. The presentation will focus on the predictability of the different grafting protocols based on the available clinical evidence. Healing times for different clinical scenarios will be suggested based on the biologic behaviour of autografts and bone substitute materials.

034 | Parallel Session 4 – Sinus Surgery

Future developments for sinus grafting

Watzek G
Universitätsklinik für Zahn-, Mund- und Kieferheilkunde Ges.m.b.H., Vienna, Austria

Future developments in sinus lift procedures in clinical practice must definitely include a reliable preoperative assessment of the complete surgical region – in particular the maxillary sinus region – for absence of inflammations, a three-dimensional imaging of the skeletal situation, minimisation of surgical efforts and expenses by employment of improved percrestal techniques, employment of a sinus-mucosa preserving bone perforation technique, e.g. using piezo, laser or stop drill, improved measures for avoiding mucosal ruptures on elevation, reliable osteoregenerative potential of the augmentation material even with large-scale defects and applicability with minimally invasive access as well as postoperative radiological evaluation of the complete surgical region including the maxillary sinus. Additional measures would include reliable demonstration of potential mucosal perforation and development of appropriate therapeutic measures as well as three-dimensional planning of implant insertion to ensure precise and accurate positioning of implants in the augmented region.

035 | Parallel Session 4 – Sinus Surgery

Avoiding sinus graft surgery

Haas R
Wien, Austria

Worldwide increase of sinus lifts procedures lead to a rapid increase of negative adverse effects and complications. Therefore, alternative treatment methods have to be considered. The lecture will deal with numerous kinds of treatment modalities like tilted implants, guided implantation, short implants, zygoma implant, tuber implant and palatal implants. Advantages and disadvantages of those methods will be discussed extensively shown in case cohort studies. Retrospective studies and analysis of a single implant centre will be given as well as treatment trees to show exact indications for different treatments with special regard to implant success.

Pre-Congress Courses (Abstracts 036–039)

036 | Pre-Congress Course 1 – "Step-by-Step" Clinical Masterclasses

Staged lateral augmentation for implant surgery

Simion M
Italy

The prime dictate prerequisite to predict long-term success for osseointegrated implants is a sufficient volume of healthy bone at recipient sites. However, a sufficient amount of bone volume is frequently lacking as a result of trauma or infectious diseases such as advanced periodontitis. A number of different techniques, like guided bone regeneration and autogenous bone grafts, have been developed to reconstruct deficient alveolar ridges to allow dental implant placement in either a simultaneous or staged approach. Advances in tissue engineering may offer solutions that resolve bone volume deficits while at the same time eliminating some of the concerns posed by current techniques. The recombinant platelet derived growth factor (rh-PDGF-BB) has been extensively used as a potent regenerating factor in orthopeadics and periodontics with success. The principal aim would be to eliminate the need for autogenous bone harvesting and possibly eliminate the use of a barrier membrane. The presentation will present the available techniques and future trends for lateral-staged ridge augmentation to allow implant placement.

037 | Pre-Congress Course 2 – "Step-by-Step" Clinical Masterclasses

Sinus grafting for implant surgery

Ten Bruggenkate CM, Wallace S
Netherlands and USA

This presentation will present the standard techniques for maxillary sinus elevation for the year 2010. These surgical techniques and grafting decisions have been determined by the evolved evidence-base of the past 30 years. Both, autogenous bone as well as bone substitutes, as grafting procedures will be presented. Special attention will be paid to the anatomy of the lateral maxilla and the maxillary sinus. Possible complications of sinus augmentation surgery will be discussed. Having this information as a platform, newer techniques and technologies will be presented that are presently available or currently being evaluated in controlled studies.

Objectives: Upon completion of this presentation, participants should be able to (1) identify the most predictable sinus elevation techniques, (2) understand the rationale for decision making, (3) discuss current innovative technologies, (4) identify common causes of surgical complications, (5) understand the management of complications.

038 | Pre-Congress Course 3 – "Step-by-Step" Clinical Masterclasses

Provisionalisation in implant dentistry

Wittneben J
Switzerland

The possibilities and expectations of achieving a successful functional and esthetic outcome have been raised with the evolution of implant designs, prosthetic components and dental materials. Even after a successful surgical approach, the prosthodontic finalization remains challenging. The provisional phase can be the most important aspect in the implant prosthodontic therapy as it finalises the peri-implant soft tissue architecture. This lecture will focus on the selection of the type of provisional depending on the indication – from single to multiple tooth gaps up to edentulous situations and the loading time options. Focusing on the esthetic zone, soft tissue conditioning with fixed implant supported provisionals is essential for soft tissue sculpturing, creating an accurate emergence profile, reconstructing the gingival zenith, achieving papillae height/width and establishing proper tissue profile at the mucosa level.

039 | Pre-Congress Course 4 – "Step-by-Step" Clinical Masterclasses

Complex case management – treatment strategies for long-term success

Zitzmann N
Clinic for Periodontology, Endodontology and Cariology, University of Basel, Basel, Switzerland

Clinicians face the difficult task of judging the influence and significance of multiple risk factors of periodontal, endodontic or prosthetic origin, which can affect the prognosis of an abutment tooth. The purpose of this overview is to summarize the crucial factors involved in deciding whether a questionable tooth is treated and maintained, or extracted and possibly replaced by dental implants. A consensus view of specialists in periodontology, endodontics and reconstructive dentistry (prosthodontics) is presented based on their clinical expertise and the best external evidence available. Tooth maintenance and the acceptance of risks is suitable when the tooth is not extensively diseased, the tooth has a high strategic value particularly in patients with implant contraindications, the tooth is located in an intact arch, and the preservation of gingival structures is paramount. When complete-mouth restorations are planned, the strategic use of dental implants and smaller units (short-span FDPs) either tooth- or implant-supported, as well as natural tooth abutments with good prognoses for long-span FDPs is recommended to minimize the risk of failure of the entire reconstruction.

Basic Research Competition (Abstracts 040–049)

040 | Basic Research Competition

Spontaneous progression of experimental peri-implantitis at implants with different surface characteristics

Presenter: Albouy J-P
Department of Periodontology, Sahlgrenska Academy, Gothenburg, Sweden
Co-authors: Albouy J-P, Abrahamsson I, Berglundh T
Department of Periodontology, Sahlgrenska Academy, Gothenburg, Sweden

Background: Findings from experimental studies have revealed that spontaneous progression of peri-implantitis occurred following ligature removal and that progression varied between different types of implants.

Aim: The aim of the present study was to analyze spontaneous progression following ligature removal in experimental peri-implantitis around implants with similar geometry but with different surface characteristics.

Methods: All premolars in one side of the mandible and the three anterior premolars of the corresponding side of the maxilla were extracted in five Labradors dogs. After 3 months, four implants with similar geometry but with two different surface types, i.e. turned (Nobel Biocare AB) and TiUnite (Nobel Biocare AB), were placed in a randomized order in the edentulous side of the mandible. Three months after implant installation experimental peri-implantitis was initiated by placement of ligatures and plaque formation. When about 40% of the supporting bone was lost, the ligatures were removed. No oral hygiene was performed during the following 5-month period. Clinical and radiographic examinations were performed during and at the end of this period.

Results: The results from the radiographic measurements revealed that the mean bone loss that occurred during the plaque accumulation period after ligature removal was 0.03 (0.5) mm at the implants with a turned surface and 1.47 (0.65) mm at the implants with a TiUnite surface. This difference was statistically significant ($P < 0.05$).

Conclusions and clinical implications: It is suggested that implant surface characteristics influence spontaneous progression of experimentally induced peri-implantitis.

041 | Basic Research Competition

Effect of rhPDGF-BB on localized bone regeneration

Presenter: Thoma DS
Clinic for Fixed and Removable Prosthodontics and Dental Material Science, Zurich, Switzerland
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Background: The regeneration of missing bone before implant placement presents challenges in daily practice. The use of a platelet-derived growth factor (rhPDGF-BB) in combination with an osteoconductive carrier material may solve issues associated with current techniques.

Aim: The aim was to test whether or not rhPDGF-BB promotes and enhances bone regeneration in combination with β-tricalciumphosphate (β-TCP) granules or demineralized bovine bone mineral (DBBM) granules compared with the bone formation in empty defects and defects with β-TCP granules alone.

Methods: In each of seven rabbits, four titanium cylinders were placed on the external cortical bones of their calvaria. The following four treatment modalities were randomly allocated: (i) empty, (ii) β-TCP granules, (iii) β-TCP granules plus rhPDGF-BB, and (iv) DBBM plus rhPDGF-BB. The animals were sacrificed 8 weeks later and ground sections were obtained for histological analysis. The histomorphometric analyses included the area fraction of bone, the percentage of newly formed bone (%), the percentage of bone substitute (%), the percentage of non-mineralized tissue, and the bone-to-bone substitute contact (%). A linear mixed-model analysis together with Bonferroni correction for main effects comparisons was performed for each measurement ($P < 0.05$).

Results: The mean area fraction of bone amounted to 3.2% (± 8.4%) for empty, 24% (± 14.8%) for β-TCP, 37.1% (± 8.9%) for β-TCP/rhPDGF-BB, and 64.4% (± 5.4%) for DBBM/rhPDGF-BB. Statistically significant differences were observed between DBBM/rhPDGF-BB and all other groups ($P < 0.01$), and between β-TCP/rhPDGF-BB and empty ($P < 0.05$). The remaining amount of bone substitute material varied between 48.3% (± 9.3%; DBBM/rhPDGF-BB), 53.1% (± 10.6%, β-TCP/rhPDGF-BB), and 58% (± 14.8%; β-TCP) with statistically significant differences between DBBM/rhPDGF-BB and β-TCP ($P < 0.05$). The respective values of non-mineralized tissue measured between 89.7% (empty) and 28.6% (β-TCP) with statistically significant differences between empty and all other groups ($P < 0.001$). The parameter bone-to-bone substitute contact and mean percentage of regenerated bone did not reveal any statistically significant differences between the groups.

Conclusions and clinical implications: The combination of rhPDGF-BB and DBBM was the most effective treatment modality in this animal model. RhPDGF-BB may speed up the turnover rate of the carrier material (remaining amount of bone substitute material) and the formation of new bone.

042 | Basic Research Competition

Intermittent PTH fails to stimulate osseointegration in diabetic rats

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Background: Diabetes is considered a risk factor in the osseointegration of dental implants suggesting that these patients might benefit from anabolic therapies. Preclinical studies including ours revealed that intermittent administration of parathyroid hormone (PTH) stimulates bone formation on the surface of titanium implants under physiologic conditions.

Aim: Aim of the study was to answer the question if PTH exerts an anabolic effect on osseointegration under pathologic conditions of diabetes.

Methods: To answer that question, 40 female Wistar rats where randomly divided into four groups as follows: controls, controls plus PTH, diabetes, and diabetes plus PTH. Diabetes was induced by intraperitoneal injection of streptozotocin at 45 mg/kg 2 weeks before implantation. Rats received PTH at 60 μg/kg or a vehicle by subcutaneous injection starting at the day of implant insertion in the tibia. Histomorphometric analysis was performed after 4 weeks.

Results: We demonstrate that the medullary peri-implant bone area was significantly increased in rats receiving PTH as compared with the control group (20.4 ± 11.9% vs. 40.9 ± 12.1%; $P < 0.01$). Moreover, there was a trend towards an increased bone-to-implant contacts in animals treated with PTH (26.8 ± 16.2% vs. 47.0 ± 17.7%; $P = 0.09$). In contrast, diabetic rats failed to benefit from the anabolic treatment. In the diabetes models, a similar peri-implant bone area was found, independent of the treatment with PTH (12.7 ± 8.8% vs. 14.7 ± 5.8%; $P > 0.05$). Also, PTH did not change the bone-to-implant contacts under these pathological conditions (16.4 ± 11.9% vs. 16.3 ± 8.3%; $P > 0.05$). No significant changes were observed in the cortical compartment of all groups.

Conclusions and clinical implications: These results demonstrate that the metabolic changes in the diabetic rats cause a situation where the anabolic capacity of PTH fails. These findings led us to hypothesize that metabolic control might be a critical determinant when diabetic patients are undergoing anabolic therapy to enhance osseointegration.

043 | Basic Research Competition

Effects of STZ-induced diabetes and tetracycline impregnation on the degradation of Collagen membranes in rats

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Background: Little data are available on collagen membrane (CM) degradation in patients with uncontrolled diabetes (DM). CM survival may be compromised due to increased collagenolytic activity, characteristic of DM. In contrast, tetracyclines (TTC) possess anti-collagenolytic properties and were found to delay the degradation of CMs in healthy animals. The effect of TTC on collagen degradation in uncontrolled diabetes has not been evaluated before. Therefore this study evaluated the degradation of TTC-immersed and non-immersed CMs in diabetic and healthy rats.

Aim: To evaluate the degradation of TTC-immersed and non-immersed CMs in diabetic and healthy animals.

Methods: Thirty 12-week old male Wistar rats were divided into two equal groups: healthy and diabetic. Diabetes was induced by a single intraperitoneal injection of 65 mg/kg streptozotocin in citrate buffer (0.01 M, pH 4.3). Hyperglycemia was confirmed after 7 days; animals with serum glucose levels > 270 mg/dl were considered diabetic.

Sixty native collagen membrane discs (Geistlich, Switzerland), 5 mm in diameter, were labeled with Aminohexanoyl-Biotin-N-Hydroxysuccinimide Ester. Before implantation, 30 discs were immersed in Tetracycline HCl (50 mg/ml) and 30 in PBS only (control). Two mid-sagittal shallow calvarial defects, 5 mm in diameter, were made in the parietal bone of each rat using a high-speed water-cooled diamond wheel-shaped bur. A TTC-immersed disc was placed in one defect, and a PBS-immersed, control disc in the other. Three weeks after membrane implantation, animals were euthanized with CO_2 and the calvaria with its overlying soft tissues were demineralized in EDTA and subjected to histological processing. Sections (5 mm) were stained with H&E or HRP-conjugated Avidin. The area of residual collagen within the membrane discs was measured using histomorphometric software (Bioquant). Two unimplanted (one PBS-immersed and one TTC-immersed) discs were sectioned and stained to serve as respective baseline collagen content.

Results: After 3 weeks, the amount of residual collagen of PBS-immersed discs in diabetic rats was much lower than that in healthy rats (86,095 ± 11,881 pixels/field [= ~ 69% of baseline] vs. 117,655 ± 6070 [= ~ 93%], respectively, $P < 0.0001$), and was associated with marked inflammatory infiltration. TTC-immersion significantly increased the residual collagen content in diabetic animals (to 113,489 ± 10,818 pixels/field [= ~ 83% of baseline, $P < 0.0001$]) as well as in healthy animals (to 135,575 ± 8364 [= ~ 97.5%, $P < 0.0001$]).

Conclusions and clinical implications: Degradation of collagen membranes is markedly enhanced in Type 1 Diabetic rats, compared with healthy rats. Immersion of collagen membranes in 50 mg/ml of TTC significantly delays their degradation in diabetic animals. Collagen membrane resorption could be enhanced in uncontrolled diabetic patients.

044 | Basic Research Competition

Rough titanium topography upregulates FoxO/β-catenin signaling in mesenchymal cells and protects them from oxidative stress

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Background: It is widely accepted that rough surfaces induce the commitment of mesenchymal precursors to the osteoblastic lineage, and facilitate the expression of a mature phenotype in osteoblastic primary cells and cell lines. However, it is still uncertain how surface topography can modulate the responses of mesenchymal cells to oxygen-related stress stimuli, which often occur in the early phases of tissue wound healing, with age or during chronic inflammation processes. To antagonize reactive oxygen species (ROS) cells resort to several defense mechanisms that heavily rely on β-catenin, an important molecular switch between the TCF-mediated pathway, which promotes cells proliferation and commitment, and an alternative pathway controlled by FoxO, which induces quiescence and defenses against ROS.

Aim: In the present study, we investigated how surface topography modulates TCF/β-catenin, FoxO/β-catenin pathways and cell defenses against oxidative stress.

Methods: The murine mesenchymal uncommitted cell line C2C12 was plated on smooth and acid-etched/sand-blasted titanium discs and stimulated with 0.1 mM H_2O_2 to induce ROS generation. Cell survival to ROS was measured by MTT assay and gene expression was assessed by quantitative real time PCR. To investigate the activation of Wnt and FoxO/β-catenin signaling, we transfected C2C12 cells on titanium with a reporter vector system carrying the Firefly Luciferase gene under the control of a regulatory promoter sequence binding the TCF/β-catenin or the FoxO/β-catenin dimer and a control vector constitutively expressing Renilla Luciferase.

Results: We showed that C2C12 viability was less affected by oxidative stress when they grew on SLA surfaces although the generation of ROS was the same between the groups. The expression of FoxO target genes, Catalase, Mn Superoxide Dismutase and Gadd45, which antagonize ROS, was higher on SLA than on smooth titanium, and FoxO/β-catenin signaling was also increased on SLA surfaces. We also showed that TCF/β-catenin signaling was higher on SLA surfaces and that TCF-mediated transcription in C2C12 cells on smooth or SLA titanium was inhibited by ROS.

Conclusions and clinical implications: Our results demonstrate that resistance of cells to ROS in enhanced on SLA surfaces, and that the balance between the molecular pathways that regulate cell growth and cell defense against oxidative stress is modulated by surface topography.

045 | Basic Research Competition

Association of IL4 genetic polymorphisms with dental implant loss

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Background: Osseointegration failure is a complex trait that in part is impacted by the inflammation host response. Genetic polymorphisms that regulate the inflammatory process have been considered a genetic risk factor for dental implant loss. Interleukin-4 (IL-4) downregulates pro-inflammatory cytokines and enhances immunoglobulin G and E secretion in the presence of oral bacteria lipopolysaccharides. In periodontal tissues, those pathways may lead to bone resorption. Three polymorphisms in the IL-4 gene (rs2243250, rs2070874 and a VNTR in the third intron) form haplotypes and have been associated with inflammatory and autoimmune diseases.

Aim: The purpose of this study was to investigate the association between IL-4 polymorphisms/haplotypes and dental implant loss.

Methods: Two-hundred and seventy-eight (278) unrelated patients, mean age 54.7 ± 11.3 years, were divided into two groups: (i) control group (C), 186 individuals presenting at least one osseointegrated implant, in function for 6 months or more and without any implant failure, and (ii) study group (S), 92 individuals presenting at least one implant loss. After DNA collection and purification, IL-4 polymorphisms/haplotypes analysis was performed by PCR–RFLP and only by PCR for the VNTR. Interferences of clinical and local parameters related with implant loss were also evaluated.

Results: No association between genotypes/alleles of rs2243250 ($P = 0.9704/P = 0.5992$) and VNTR ($P = 0.7155/P = 0.8789$) polymorphisms and implant loss was found between the groups. Regarding rs2070874 polymorphism, no difference was found in genotype frequencies ($P = 0.1288$), but the allele T was associated with osseointegration achievement ($P = 0.0236$, OR = 0.62, IC = 0.42–0.92). Haplotype analysis showed no statistical differences between the groups.

Conclusions and clinical implications: Alleles of rs2070874 polymorphism may influence the osseointegration process. The determination of genetic polymorphisms associated with implant loss may help understand biological mechanisms involved in implant loss and also contribute to determining a genetic risk profile in implant treatment.

046 | Basic Research Competition

Biomimetic, BMP-2-functionalization of Bio-Oss® confers osteoinductivity and improves biocompatibility

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Background: The repair of critical-sized bony defects remains a challenge in the fields of implantology and orthopaedics. Although healing can be aided by the transplantation of autologous bone, the supply of this tissue is limited and its removal is associated with donor-site morbidity. Hence, alternative bone-defect-filling materials – both natural and synthetic – have been sought for commercial production on a large scale. Bio-Oss® represents one such material. However, this deproteinized, bovine-bone derivative is neither osteoinductive nor well tolerated within the bony compartments.

Aim: To functionalize Bio-Oss® with a BMP-2-bearing calcium-phosphate coating, and to evaluate the osteogenicity and inflammatory activity of the end product *in vivo*.

Methods: Four groups were established: (i) Bio-Oss® alone, (ii) Bio-Oss® bearing a calcium-phosphate coating (no BMP-2), (iii) Bio-Oss® bearing an adsorbed depot of BMP-2 (no coating), and (iv) Bio-Oss® bearing a co-precipitated layer of calcium phosphate and BMP-2.

Coatings were prepared using a well-established biomimetic procedure. The release kinetics of a coating-incorporated and a directly adsorbed fluorescently tagged protein depot were monitored *in vitro*.

Bio-Oss® granules (Geistlich) were implanted at an ectopic (subcutaneous) site in rats ($n = 6$ animals per group), and retrieved 5 weeks later for a histomorphometric analysis of the volume densities of the bone, bone marrow, fibrous capsule and foreign-body giant cells (a gauge of inflammatory reactivity and thus of biocompatibility).

Results: The coating-incorporated protein depot was released more gradually than the adsorbed one (52% depletion after 35 days vs. 100% depletion after 13 days). Five weeks after implantation, the volume densities of the fibrous capsular tissue and foreign-body giant cells were significantly lower in the BMP-2-bearing-coating group than in the two non-coated groups. Consistent with these findings, the volume densities of bone and bone marrow were higher in this group than in that in which BMP-2 was adsorbed directly onto the Bio-Oss® granules. In the two non-BMP-2-bearing groups, no bone was deposited.

Conclusions and clinical implications: Functionalization of Bio-Oss® with a co-precipitated layer of calcium phosphate and BMP-2 not only renders the material osteoinductive, but also suppresses the inflammatory reactivity that is associated with the native product. Moreover, the gradual liberation of a coating-incorporated depot of BMP-2 is more conductive to sustained bone formation that is the burst-release profile of an adsorbed one. The attributes that are acquired by coating native Bio-Oss® with a BMP-2-functionalized layer of calcium phosphate greatly enhance the material's clinical potential in the repair of critical-sized bony defects.

047 | Basic Research Competition

Influence of space filling materials in sub-sinusal bone augmentation: clot vs. autogenous bone chips vs. bovine hydroxyapatite

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Background: Long-term three-dimensional stability of sub-sinusal bone regeneration is inadequately explored and might compromise long-term implant success. After tooth extraction in the posterior maxilla the alveolar bone is subjected to a repneumatisation. A re-expansion of the sinus could also hypothetically occur when a regeneration procedure was performed with autogenous bone.

Aim: The aim of the present study was to assess the short- and long-term volume stability of sub-sinusal bone augmentation using different space filling materials in a sinus lift rabbit model. The second objective was to evaluate the regenerated bone quantity obtained with each material at different time points.

Methods: Fourteen rabbits underwent a double sinus lift procedure using three different types of space fillers: blood clot (Clot), autogenous bone chips (Auto) and Bovine hydroxyapatite (BHA). Volumes were calibrated. Animals were sacrificed at 1 week, 5 weeks and 6 months. After dissection, samples were subjected to micro-tomography and subsequently to undecalcified histological processing. The three-dimensional images collected from MicroCT allowed to calculate the total volume of regenerated bone at different time points. Qualitative analysis was performed using seven micron sections stained with Goldner Trichome and quantitative histomorphometric analyses was made using SEM.

Results: Results from the volumetric analyses displayed a similar amount of space filling material at baseline (1 week). After 5 weeks, the regenerated volumes dropped to 17.3% (Clot), 57.6% (Auto) and 90.6% (BHA). Regenerations reached 19.4% (Clot) and 31.4% (Auto) of the initial volume after 6 months, while 84% was observed in the BHA group.

At 1 week, the amount of new bone was inferior at 0.1 mm² in the three groups. Osteogenesis started in the anterior part of the sinus and along the bone walls. After 5 weeks, newly formed bone invaded the space under the membrane and displayed a bone surface area of 5.95 (Clot), 11.6 (Auto) and 6.95 mm² (BHA). After 6 months, the bone quantity and density dropped drastically to 1.3 and 1 mm² in the Clot and Auto groups while it remained stable in the BHA group (7.02 mm²).

Conclusions and clinical implications: A simple blood clot, autogenous bone chips or BHA alone allowed bone formation in sub-sinusal bone regeneration. Nevertheless, bone density and bone volume dropped in the Clot and Auto groups while it remained stable with BHA. A slowly resorbable biomaterial might be suitable for sub-sinusal bone augmentation to prevent a repneumatisation process.

048 | Basic Research Competition

Functional magnetic resonance imaging shows cortical activation following mechanical stimulation of oral implants

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Background: Rehabilitation of edentulism by means of osseointegrated implants results in an improvement in both the sensory and motor functions that has been coined ''osseoperception'' (Brånemark 1997). It is not known if this process is associated with some plasticity of the cortical sensorimotor network. Recently, functional magnetic resonance imaging (fMRI) was successfully applied to map the cortical projections of periodontal mechanoreceptors. We propose to use this method to explore the neural correlates of osseoperception.

Aim: The aim of this study was to identify the possible sensorimotor cortical adaptive processes associated with tooth loss and their replacement with oral osseointegrated implants.

Methods: Nine healthy right-handed subjects (four females) were selected for an fMRI study. All had a complete natural dentition with the exception of upper left incisor missing and rehabilitated with an osseointegrated implant. A specifically designed device allowed to deliver calibrated mechanical punctuate stimuli to the teeth or the implant at a rate of 1 Hz using von Frey filament filaments N° 6.65 (300 g) for the implant and 6.45 (180 g) for the canine used as reference. Gradient echo echo-planar images were acquired at 3 T (TR/TE: 3000/50 ms) during a block design paradigm consisting in three runs alternating active and rest periods of 24 s, six active epochs/run, one activated site/epoch, the two sites being interleaved within each run. Individual statistical maps of activation were first computed in the referential defined by Talairach in SPM5. Significant activations were then examined at the group level in random-effect (RFX) analyses.

Results: The RFX group analysis ($P < 0.005$, uncorrected for multiple comparisons, extent threshold of 20 contiguous voxels,) showed that tactile stimuli applied to osseointegrated implants induced bilateral activations of the secondary somatosensory cortex, more extended on the contralateral side. In addition, large active clusters were observed in the contralateral inferior frontal gyrus and inferior parietal lobule. These latter were not found when stimulating the canine in the same subjects or a central incisor tooth in dentate volunteers.

Conclusions and clinical implications: These cortical projections originating from stimuli applied to an implant may be regarded as a compensatory mechanism by recruiting additional brain areas after implant placement. These findings demonstrate that osseoperception is based on the true activation of the somatosensory cortex. It also indicates that some plasticity may occur in the brain sensory network after amputation. These finding may help in the design of bone-anchored prosthetic appliances and bionic limbs.

049 | Basic Research Competition

Relative contributions of the osteogenic surfaces involved in periosteal distraction: An experimental study in rats

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Background: A controlled, gradual distraction of the periosteum is expected to result in the formation of new bone between the original bone surface and the cambial layer of periosteum. The precise origin of the newly-formed bone is unknown. We postulate that it arises from one of the three potentially osteogenic surfaces: the original bone surface, the lateral or apical periosteal layer.

Aim: The proposed study is designed to locate the source of the new bone and to identify the relative contributions of the relevant osteogenic surfaces in a calvarium model of rat.

Methods: Eight experimental groups with 6 rats each were established to assess the osteogenic contributions of the three tissue surfaces. The cortical bone was either perforated or left intact. The influence of the apical periosteum was investigated using a perforated distraction plate instead of occlusive plate.

The contribution of the lateral periosteum was eliminated by excision. All animals were subjected to a 7-day latency period, distraction rate at 0.2 mm/24 h for 10 days and a consolidation period of 7 days. The amount of new tissue generated relative to the areas bound by the parent bone, the periosteum and the distraction plate was determined histologically.

Results: Distraction of either lateral or apical periosteum may result in formation of new bone. This was affected by the vicinity of periosteum to the intact old bone surface. Perforations of the bone marrow, but not the cortex alone enhanced the new bone formation.

Conclusions and clinical implications: The viable periosteum induced by distraction was able to trigger the formation of new bone. The amount of new bone formation was influenced by the distance between the old bone surface and perosteum. A knowledge of the relative contributions made to bone formation will direct future therapeutic manipulations to improve the outcome of periosteal distraction osteogenesis.

Clinical Research Competition (Abstracts 050–057)

050 | Clinical Research Competition

Single implants in the aesthetic zone: a randomized clinical trial to different implant neck designs

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Background: Over the past years, several implant modifications have been introduced aiming at establishment of an optimal soft tissue appearance. Preservation of the marginal peri-implant bone is a major factor on which these modifications are founded.
Aim: This trial compared the outcome of implants with different neck designs applied for single-tooth replacements in the maxillary aesthetic zone. It was hypothesized that there are no differences between the different implant designs regarding radiographic and clinical outcome measures and patient satisfaction.
Methods: For this trial, 92 consecutive patients (mean age 39.2 years, range 18–80) with a single missing tooth in the maxillary aesthetic zone were included. Patients were randomly allocated to one of three study groups to receive an implant with a smooth neck and flat platform (NobelReplace Select, smooth neck group), an implant with a rough neck and flat platform (NobelReplace Groovy, rough neck group) or an implant with a rough neck and scalloped platform (NobelPerfect, scalloped neck group). Implants were loaded after 3 months. After provisionalization, a definitive all-ceramic crown was placed. Pre-operatively, 2 weeks, 7 and 18 months after implant placement, clinical data and standardized X-rays and photographs for aesthetic outcome were collected. Patient satisfaction was explored using a questionnaire.
Results: Implant survival rates were 97% for the smooth group (one implant failed) and 100% for the rough and scalloped groups (not significantly different). The scalloped implants showed significantly more radiographic bone loss from implant placement to 18 months thereafter (mean bone loss 1.99 $\pm$ 0.88 mm) compared with the flat platform implants with a rough neck (0.9 $\pm$ 0.71 mm, $P < 0.001$) or smooth neck (1.19 $\pm$ 0.91 mm, $P < 0.05$). Furthermore, the scalloped implants showed deeper probing pocket depths ($P < 0.05$) and Bleeding Index scores ($P < 0.05$). There were no significant differences between the flat platform implants with a smooth neck or rough neck. With regard to changes in soft tissue levels, Papilla Index, Plaque index and aesthetic outcome (using Aesthetic Index and PES–WES), no significant differences between the study groups were found. General patient satisfaction was high in all groups, expressed as mean scores of 8.8 (smooth), 8.9 (rough) and 9.1 (scalloped) on a VAS-scale ranging from 0 to 10.
Conclusions and clinical implications: For single-tooth replacements in the maxillary aesthetic zone, implants with a scalloped roughened neck show more radiographic bone loss, deeper probing depths and more bleeding than flat platform implants with a smooth or rough neck. However, there were no differences in soft tissue level, aesthetic outcome and patient satisfaction.

051 | Clinical Research Competition

Influence of progressive loading on implant ability to withstand overloading forces

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Background: The role of occlusal overload as a causative or contributing factor in late implant failures, in the absence of infection, is still a point of discussion. On the contrary, progressive loading is considered to improve the quality and density of the bone around an osseointegrated implant, as well as its ability to tolerate greater forces.
Aim: To examine the influence of progressive loading on peri-implant bone and its contribution to the ability of osseointegrated implants to withstand overloading forces.
Methods: In seven beagle dogs bilateral edentulous, flat alveolar ridges were created in the maxillary area posterior to the canines. After 8 weeks of healing a total of 52 implants were inserted. Four experimental groups were created. *Progressive loading group*: 12 implants were left to heal for 8 weeks, uncovered, abutments were adapted and connected by pairs with Ni-Ti orthodontic springs. A gradual static force of 100, 200 and 300 g was applied for a 3-week duration each. Thus, a total progressive loading period of 9 weeks was exercised. *Overloading group*: 16 implants were inserted and after 17 weeks of healing were uncovered, impressions were taken and metal crowns were fabricated and fitted on the implants. A supra-occlusal pattern with oblique occlusal planes and premature contacts with the antagonist teeth was created. Implants subjected to dynamic overloading for 16 weeks. *Progressive loading + overloading group*: 16 implants were inserted. After 8 weeks of healing, implants followed the 9-week protocol of the progressive loading group, followed by the 16-week protocol of the overloading group. *Control group*: Eight implants were left to heal undisturbed for 34 weeks. At the end of the experimental period of each group, implants were removed with the surrounding bone. Histomorphometric analysis was performed and bone to implant contact was measured. Student's *t*-test was used by pairs for all experimental groups.
Results: Overloading group and progressive loading + overloading group exhibited significantly higher percentage of bone to implant contact compared with the progressive loading group ($P < 0.05$) as

well as compared with the unloaded control group ($P < 0.05$). On the contrary, progressive loading + overloading group compared with overloading group ($P > 0.05$), and progressive loading group compared with unloaded control group ($P > 0.05$) did not show significant difference.

Conclusions and clinical implications: Dynamic overloading forces cause significant higher bone to implant contact than the static progressive loading forces. However, progressive loading has a positive influence on the ability of implants to withstand overloading forces.

052 | Clinical Research Competition

Different implant surface decontaminating procedures in surgical treatment of peri-implantitis

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Background: Peri-implantitis is an infectious disease that resides in the mucosa surrounding dental implants and affects the supporting bone. Because the number of implants placed in everyday clinical practice is continuously increasing, it is reasonable to anticipate an increasing prevalence of peri-implantitis. This underlines the necessity for a predictable therapy.

Aim: The primary objective of this controlled clinical study was to evaluate the microbiological effect of decontamination of the implant surface during the surgical treatment of peri-implantitis using chlorhexidine or placebo.

Methods: Adult patients ($n = 25$) with at least one endosseous implant in the oral cavity with clinical and radiographical signs of peri-implantitis (BoP +, PPD $\geq$ 5 mm and peri-implant bone loss $\geq$ 2 mm) were consecutively included in this study. Patients were randomly allocated to either one of two treatment options and patients, surgeon and investigator were blind to group assignment. Implants with peri-implantitis lesions were surgically exposed, followed by mechanical cleansing using curettes and gauzes soaked in saline followed by either 1 min of rinsing with a placebo solution (control group) or 1 min of chemical cleansing using 0.12% chlorhexidine +0.05% cetylpyridinium chloride without alcohol (Perio-Aid®) (test group). After 1 min of saline rinsing, the gingival flap was returned slightly apical and firmly sutured. Microbiological samples were taken from the exposed implant surface before and after cleansing using sterile microbrushes. The total bacterial load and the prevalence of seven periodontal pathogens were assessed. Statistical analysis was performed using Pearson's χ^2 test.

Results: Test and control group consisted of 14 and 11 patients, respectively (29 and 37 implants). Cleansing of the implant surface resulted in bacterial reduction below detection level in 11 patients (79%) of the test group vs. 1 patient (9%) of the control group ($P < 0.01$) and in 20 implants (69%) of the test group vs. 16 implants (43%) of the control group ($P < 0.05$). Median CFU before and after cleansing of the implant surface was for test and control, respectively, 2.09E + 05 and 1.40E + 05 at baseline and 0.00E + 00 and 1.00E + 04 after cleansing. Both treatment protocols resulted in reduction below level of detection of *Porphyromonas gingivalis*, *Prevotella intermedia* and other black-pigmenting anaerobes.

Conclusions and clinical implications: Decontamination of the implant surface using 0.12% chlorhexidine +0.05% cetylpuridinium chloride during the surgical treatment of peri-implantitis seems to be more effective in reducing total bacterial load of the implant surface than using a placebo. However, it is unclear whether or not this microbiological effect leads to better clinical results.

053 | Clinical Research Competition

Submerged vs. non-submerged healing of implants for single-tooth replacement in the esthetic zone. Results from a multicenter RCT

Presenter: Cordaro L

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Background: Implants may be inserted with a transmucosal or submerged technique. It is not clear if the transmucosal technique leads to favourable esthetic results in the frontal region.

Aim: To compare the outcomes of submerged and transmucosal placement of implants in the anterior maxilla and mandible.

Methods: A prospective, randomized-controlled multicenter study was performed in 12 centers, based in Switzerland, Germany, Spain, Sweden, Italy, Australia and the United States. Adults over 18 years with planned single implant placement in the anterior maxilla or mandible could be included in the study if they showed no contraindications to implant treatments. Straumann® bone level implants with the SLActive surface of lengths 8, 10, 12 and 14 mm with an external thread diameter of 4.1 mm were placed at least 4 weeks after tooth extraction. After their placement, the randomization envelopes were opened and

the implants assigned to the submerged or the transmucosal group. Guided bone/tissue regeneration procedures were allowed if their healing time did not exceed 12 weeks.

In the submerged group implants were exposed within 12 weeks after insertion.

Final restoration was placed 26 weeks after implantation.

Periodontal parameters, crestal bone levels (on standardized radiographs) and soft tissues measurements were performed 12 months after implant placement, and will be repeated at 24, 36, 48 and 60 follow up periods.

Results: A total of 145 patients were randomized and 127 subjects were included in the efficacy analysis at 12 months ($n = 67$, 52.8% in the submerged group and $n = 60$, 47.2% in the transmucosal group).

Only one implant was lost, belonging to the transmucosal group.

Over 12 months, bone loss was observed in both treatment groups with average values of < 0.5 mm ($P < 0.05$). The majority of the bone loss occurred in the first 6 months after implantation. The difference in bone level changes between the treatment groups was not statistically significant ($P = 0.934$).

Periodontal parameters and patients' satisfaction were excellent and did not differ between the two groups with 99% of the patients that reported good-excellent treatment satisfaction.

Conclusions and clinical implications: Based on the results of the present study, the equivalence of both treatments can be claimed.

The two treatment options could be considered safe and effective clinical procedures. No statistically or clinically significant differences were present between the submerged and transmucosal treatment approaches with respect to marginal bone level, clinical assessment of peri-implant soft tissue parameters or the occurrence of adverse events.

The use of transmucosal technique in the esthetic zone with implants with abutment implant connection at the crestal level is safe and leads to excellent esthetic results and good marginal bone stability.

054 | Clinical Research Competition

Marginal bone remodeling in ''one abutment/one-time'' vs. ''conventional'' implant treatment concept: a 3-year prospective study

Presenter: Younes R
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Background: It is well documented that two-piece implants undergo crestal bone loss within 1 year of loading in conjunction with the biological width establishment. However, several factors (microgap, smooth/rough surface level, etc.) may influence peri-implant soft and hard tissue reactions. A stable implant/abutment connection provides a high degree of abutment stability from the onset reducing marginal bone loss. This could be achieved by tightening the final abutment the day of implant placement, avoiding repetitive placement and removal of abutments and minimize the disturbance of peri-implant hard and soft tissues.

Aim: The aim of the present investigation was to evaluate if the ''1-abutment, 1-time'' new treatment concept could reduce the marginal bone loss when compared with conventional procedure.

Methods: Sixty-four patients were included in a 3-year split-mouth design prospective study using 128 Tapered Screw-Vent Zimmer (Carlsbad, CA, USA) implants (2 per patient). They were restored both through conventional restoration (abutment removal during try-in) (Group 1) and ''1-abutment, 1-time'' procedure (Group 2) where the final pre-contoured abutment was inserted immediately requiring no additional prep work and permanently tightened at 30 N cm after implant placement to avoid abutment removal (snap-on impression technique). Periapical X-rays at time 0, 2, 6, 12 months and 3 years calculated the vertical bone loss based on the well-known implant length. The Student's *t*-test and Pearson's correlation estimated the influence of separate parameters on marginal bone.

Results: A statistically significant difference regarding the mean marginal bone loss was noted at 3 years: 1.7 mm (SD = 0.56) in Group 1 vs. 0.97 mm (SD = 0.37) in Group 2.

Conclusions and clinical implications: Initial gingival attachments to the abutment are no longer destroyed due to repetitive placement and removal of abutments and healing abutments, also helping to minimize potential bone loss. This study supports the hypothesis that the 1-abutment/1-time procedure can minimize the peri-implant hard and soft tissue loss by reducing the disturbance of the biologic width.

055 | Clinical Research Competition

An RCT to evaluate a synthetic gel-membrane for GBR around dental implants – 1- and 3-year results

Presenter: Ramel C
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Background: All currently used membranes are produced in standard sizes and need to be adapted to the patient's individual situation. The availability of a synthetic, therefore certainly not infectious and resorbable membrane that could be directly custom made intra-operatively would, therefore, represent an improvement for future GBR procedures.

Aim: The objective of this randomized, controlled clinical study was to test whether a synthetic bioresorbable polyethylene-glycol (PEG) hydrogel membrane could result in a similar clinical as well as radiographic outcome as a standard collagen membrane, both combined with a membrane supporting material, after a follow-up period of 1 and 3 years.

Methods: This randomized, controlled clinical study enrolled 37 patients requiring implant treatment with an expected osseous defect in the posterior maxilla or mandible. Defects

around implants were grafted with bovine bone mineral and randomly covered with either a collagen membrane (control group) or a PEG membrane (test group), which is applied as a liquid and gelates *in situ*. After a healing period of 6 months, surgical re-entry was performed and fixed partial dentures were inserted. Patients were examined clinically and radiographically after 12, 24 and 36 months. The statistical analysis of the radiographic data was carried out using analysis of covariance models including a factor for study membranes and the covariate baseline value. The respective tests for group differences were carried out at a two-sided significance level of 5%.

Results: All patients could be re-examined except one dropout in the second year revealing a total number of 36. The implant survival rate at 1 and 3 years was 100% for both groups. The peri-implant tissues were healthy without any difference between the two groups. Compared with surgery, the mean change in the distance between the first bone to implant contact to the transition point (i.e. rough implant surface to polished neck portion) at 1 year was 0.43 ± 0.56 mm (test) and 0.21 ± 0.36 mm (control) and 0.61 ± 0.89 mm (test) and 0.33 ± 0.64 mm (control) at 3 years. The respective differences between groups from the analysis of covariance models were 0.13 mm (year 1) and 0.31 mm (year 3). Neither the group difference at year 1 nor the one at year 3 was statistically significant ($P = 0.2232$ and $P = 0.3815$, respectively).

Conclusions and clinical implications: The present PEG hydrogel was as successful as a standard collagen membrane in the treatment of bony dehiscence defects around dental implants after a follow-up period of 1 and 3 years.

056 | Clinical Research Competition

Effectiveness of prophylactic antibiotics at placement of dental implants

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Background: It is still debated whether early failures of dental implants and postoperative infections can be reduced by antibiotic prophylaxis. While it is important to minimize implant failures, there are concerns associated with the widespread use of antibiotics because adverse events may occur. Adverse events are usually minor (diarrhoea, erythema multiforme, urticaria, etc.) but even life-threatening allergic reactions may occur. In addition there is the risk of selecting antibiotic-resistant bacteria.

Aim: To evaluate the efficacy of prophylactic antibiotics for dental implant placement.

Methods: Thirteen dentists working in private practices agreed to participate in this trial, each centre providing 50 patients. One hour before implant placement patients were randomized to assume orally 2 g amoxicillin or identical placebo tablets. Patients needing bone augmentation at implant placement were not included. Outcome measures were prosthesis and implant failures, adverse events and postoperative complications. Patients were seen 1 week, 2 weeks and 4 months postoperatively.

Results: Two centres did not deliver any data, two centres did not manage to include the agreed quota of patients and three patients had to be excluded. Two hundred and fifty-two patients were evaluated in the antibiotic group and 254 in the placebo group, and none dropped-out at 4 months. Four prostheses and seven implants (in five patients) failed in the antibiotics group vs. 10 prostheses and 13 implants (in 12 patients) in the placebo group. Eleven complications were reported in the antibiotic group vs. 13 (in 12 patients) in the placebo group. No side effects were reported. There were no statistically significant differences for prosthesis failures, implant losses and complications. Patients receiving immediate postextractive implants had an increased failure risk than patients receiving delayed implants (9% vs. 2%).

Conclusions and clinical implications: No statistically significant differences were observed thought trends clearly favoured the antibiotic group. Immediate postextractive implants were more likely to fail.

057 | Clinical Research Competition

Immediate vs. delayed implant placement in anteriors: the TIMING randomized-controlled clinical trial

Presenter: Tonetti M
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Background: Benefits and disadvantages of immediate and delayed implant placement have been debated but little evidence is available to guide clinicians.

Aim: The aim of this study was to compare the need for bone augmentation, incidence of adverse events, soft and hard tissue outcomes, esthetics of reconstruction and patient-centered outcomes after immediate (insertion immediately after tooth extraction, test) or delayed (insertion after 3 months of healing in the absence of specific socket preservation efforts, control)

implant placement. This paper reports the surgical and short-term outcomes (3 months after completion of final restoration).
Methods: This was a seven-center, multinational, randomized, parallel design-controlled clinical trial. Patients were randomized by a central study registrar. Allocation was concealed to the surgeon until completion of tooth extraction and evaluation of suitability of the surgical site for immediate implant placement. All measurements were made by investigators blind with respect to treatment. Test subjects received bone augmentation (Bio-Oss and Bio-Gide) if the bone-implant gap was >1 mm. Control subjects received bone augmentation whenever there was an inadequate bone volume (exposed implant surface) for restoratively driven placement. SPI contact tapered implants (Thommen Medical, Switzerland) of appropriate length (root length) and diameter (prosthetic platform) were utilized.
Results: One hundred and thirty-eight patients were enrolled. 7.5% of sockets did not fulfill the surgical indications for immediate implant placement. One hundred and twenty-four patients were randomized. Bone augmentation was necessary in 72% of test and 44% of controls while primary wound closure was achieved in 63% and 78%, respectively. One implant (test) failed due to infection. Wound complications were observed in 23% of test and 14% of controls at 1 week; 17% of test and 9% of controls reported complaints. 22% of test and 10% of controls showed wound dehiscence at 2 weeks. More keratinized tissue was lost on the vestibular side of test implants, but the magnitude of the difference was clinically irrelevant. With respect to adjacent teeth, test and control implants were placed differently with respect to platform depth. Multiple regression analyses showed significant differences between test and controls.
Conclusions and clinical implications: Immediate implants required more frequently bone augmentation than delayed implants. In delayed implants, ridge resorption never required a separate ridge augmentation procedure and no bone augmentation was necessary in the majority of cases. More wound complications and patient morbidity were observed after immediate implants. The surgical risk-benefit analysis of immediate vs. delayed implants needs to be discussed with the individual patient.

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Short Oral Communications (Abstracts 058–086)

058 | Short Oral Communications

How to read, prepare and write a scientific paper

Presenter: Lang NP
The University of Hong Kong

The literature is replete with publications that may only contribute very little to the understanding of an issue. Hence, it is important to know how to select the papers that really contribute to the promotion of the field and to interpret the conclusions of an article regarding its scientific value and clinical relevance. Articles follow a hierarchy of evidence where the randomized-controlled clinical trial (RCT) takes the lead. Systematic reviews may even present higher levels of evidence if enough and homogenous RCTs allow a meta-analysis of data to answer conclusively a focused question. In many fields of dentistry, however, systematic reviews and RCTs are sparse. Consequently, lower levels of evidence, i.e. prospective and retrospective cohort studies have to be interpreted.

In scrutinizing the literature, not only the hierarchy of articles, but also the composition of an article and its reporting the data determine the quality of a paper. Obviously, the well-constructed and descriptive papers that allow reproduction of the study represent articles of great value. Also, conclusions on the basis of a valuable validation process through appropriate statistical analyses contribute to an improved standard in writing the scientific paper.

059 | Short Oral Communications

Response of crestal bone to platform-switched healing abutments

Presenter: Frey R-M
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Background: Maintaining alveolar crestal bone is crucial to the success of dental implants. While numerous factors have been demonstrated to be associated with crestal bone changes adjacent to matched-abutment and platform-switched titanium implants, limited knowledge exists on the response of crestal bone to platform-switched healing abutments with different emergence profiles.

Aim: To evaluate radiographic crestal bone changes around implants with platform-switched healing abutments of varying emergence profiles.

Methods: Twenty-four patients who had satisfied predetermined criteria and who had received two adjacent dental implants unilaterally were consecutively enrolled in this prospective clinical study. All 48 adjacent implants were inserted so that the implant shoulder was level with the alveolar crest. Following insertion, one of the two adjacent implants was assigned a transgingival platform-switched healing abutment with a steep emergence profile ($n = 24$) and the other implant was assigned to one of two procedures: (1) placement of a transgingival platform-switched healing abutment with a flat emergence profile ($n = 11$) or (2) placement of a submerged platform-switched healing abutment with a flat emergence profile ($n = 13$). Radiographs were performed and crestal bone levels were evaluated at implant placement and 3 months postoperatively, with the healing abutments *in situ*. Crestal bone loss below the implant shoulder reference point was regarded as undesirable, and stable crestal bone levels or bone apposition was defined as desirable outcomes. An aggregated data analysis was performed comparing the different abutments using the Fisher's exact test ($\alpha = 0.05$).

Results: Radiographic analysis revealed no crestal bone loss around implants with transgingival steep emergence profiles, and slight bone apposition with submerged flat emergence profile healing abutments. There was no significant difference between these groups. However, statistically significant bone loss occurred at implants with transgingival flat emergence profile healing abutments ($P < 0.05$). These exhibited crestal bone loss at 22 of the 26 (85%) measured sites.

Conclusions and clinical implications: Within the limitations of the present study, the following conclusions can be drawn: (1) the design of the healing abutment affects peri-implant crestal bone levels; (2) submerged platform-switched healing abutments with flat emergence profiles may be recommended for facilitating crestal bone apposition; and (3) transgingival platform-switched healing abutment with steep emergence profiles result in crestal bone loss around implants. Thus, it may be suggested that the use of transgingival platform-switched healing abutment with steep emergence profiles results in unfavourable crestal bone changes around implants.

060 | Short Oral Communications

Influence of subgingivally located margins on amount of undetected cement

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Background: Deep subgingivally placed abutment margins may lead to the insufficient cement removal. That might be associated with clinical and radiographic signs of peri-implant disease.

Aim: To evaluate the amount of the cement left after cementation and cleaning of implant supported restorations. Additional aim was to compare two different methods of evaluation of the cement excess.

Methods: Twenty-five laboratory implants prodigy (BioHorizons, Birmingham, AL, USA) in the casts with contoured soft tissue

imitation were used. The same amount of casted golden abutments with various positions of the shoulder for restoration was fabricated. Twenty-five restorations with occlusal openings (temporarily closed during cementation) were cemented using reinforced glass ionomer luting cement Fuji Plus (GC, Tokyo, Japan). Specimens were divided into five groups: group 1 (control) – bevel 1 mm above the gingival margin, 2 at gingival level, 3–1 mm below, 4–2 mm below and 5–3 mm below the soft tissue level. Cement excess was removed after cementation. Two techniques were selected to evaluate the cement remnants. All quadrants of the specimens were photographed, using a special device with standardized distance and analyzed using Adobe Photoshop. Total area of the specimen and the area of cement remnants were measured in each quadrant. Cement remnants were removed and weightened using analytical balances Vibra (Shinko Denshi, Tokyo, Japan) with a readability of 0.0001 g.

Statistical analysis was carried out using SPSS v. 15. Independent-samples *t*-test performed to analyze the relation between cement remnants and depth of the bevel, bivariate correlation done to compare two methods.

Results: Data consisted of (1) left cement weight and (2) a relation between cement remnants area and total area of the specimen: group 1 (0.00026 ± 0.0001392 g; 0.0111486); group 2 (0.000825 ± 0.0003376 g; 0.0165397); group 3 (0.001325 ± 0.0004583 g; 0.0571789); group 4 (0.0051 ± 0.0013327 g; 0.1158351) and group 5 (0.0063 ± 0.0020591 g; 0.1170964). Results correlated using both evaluation techniques ($r = 0.764$; $P = 0$). The difference between all groups (except 4 and 5) was statistically significant ($P \leq 0.05$).

Conclusions and clinical implications: It is impossible to remove all cement excess if the margins are located subgingivally. The deeper the position of the margin is, the greater amount of undetected cement is left. The greatest amount of the cement remnants was left when the crown margin was 2 or 3 mm below the gingival level. As there was no difference between two cement remnants evaluation techniques it could be advised to use computer software evaluation technique in case of a clinical study.

061 | Short Oral Communications

The effects of enamel matrix derivative on the proliferation and differentiation of human mesenchymal stem cells

Presenter: Kwon Y-D

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Background: Enamel matrix proteins are essential for the formation of acellular cementum and the development of periodontium. The effects of EMD have also been examined in different studies, which found that EMD stimulates cellular proliferation and mineralization of preosteoblasts, periodontal ligament cells, and osteoblasts. However, some studies have reported that it also reduces the differentiation of osteoblasts.

Because of the contrasting results of many studies using osteoblasts, we investigated the effects of EMD on human mesenchymal stemcells (hMSCs).

Aim: This study was designed to investigate the proliferation, mineralization, and differentiation of hMSCs by a viability test, Alizarin red S staining test, and real-time polymerase chain reaction (RT-PCR) for the evaluation of mRNA expression of type I collagen (Col I A2), bone sialoprotein (BSP), and bone g-carboxyglutamate (Gla) protein (BGLAP, osteocalcin).

Methods: For the proliferation assay, water-soluble tetrazolium salt-8 tests were carried out after culturing for 24 and 48 h. For the evaluation of mineralization, ARS tests were performed after 21 days of culturing in an osteogenic medium. In order to investigate some of the bone-related proteins, namely Col I A2, BSP, and BGLAP, RT-PCR tests were carried out after 2, 3, and 4 weeks of culturing, respectively.

Results: The activity of proliferation and mineralization increased significantly depending on the concentration of EMD ($P < 0.05$). In the control group, the expression of Col I A2 decreased, but EMD enhanced its expression over time and was correlated to the concentration. The amount of expression of BSP in this group increased over time, but EMD strikingly suppressed its expression in the fourth week. As well, the amount of expression of BGLAP increased as the culture duration lengthened in the control group. However, the expression of BGLAP was suppressed in the experimental group with EMD.

Conclusions and clinical implications: Within the limits of this study, EMD enhanced the proliferation of hMSCs. After evaluation with ARS staining, EMD seemed to enhance mineralization, and the RT-PCR test revealed that EMD promoted early-stage osteoblast differentiation by enhancing Col I A2 expression, but exerted an inhibitory effect on the mineralization by lowering the gene expression of BSP and BGLAP. Mineralized nodules formed with EMD may be composed of substances other than normal bone. Because most of the organic matrix of bone is Col I A2, which acts as the mineralization site, bone or bone-like mineralized mass might have been formed in spite of the different components of the non-collagenous proteins.

062 | Short Oral Communications

BONITmatrix® for sinus floor augmentation – a randomized controlled histologic investigation

Presenter: Kohal R

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Background: Sinus floor augmentation for increasing bone height in the posterior upper jaw is a predictable procedure. Several materials for augmentation have been described. The use of autogenous bone is combined with an extra donor site and increased morbidity risks. Xenogenic bone grafts may be not accepted by the

patient. Synthetic materials would avoid these disadvantages.

Aim: This prospective randomized-controlled trial aimed to investigate histologically the bone regenerative capacity of a synthetic bone graft material with a bovine bone material.

Methods: This investigation was approved by the Ethics Committee of the University Clinics Freiburg, Germany. Twenty-four patients received bilateral sinus augmentations using either BONITmatrix® (DOT, Rostock, Germany) or BioOss® (Geistlich Biomaterials, Wolhusen, Switzerland). The material allocation was randomized using sealed envelopes. After 3 months of healing, bone biopsies were retrieved through the alveolar bone crest using trephine burs. In the same session the patients received oral implants that were placed into the trephine holes. The biopsies were immediately immersed in buffered formalin and processed for histologic and histomorphometric evaluation. A mixed model was used for statistical analysis (PROC MIXED, SAS 9.1.2; Institute of Medical Biometry and Medical Informatics, Freiburg, Germany) to analyse the mineralized bone as a tissue fraction in the augmented sinus (area of interest) in percentage. The results between the two groups were compared and the level of significance was set to $P < 0.05$.

Results: The biopsies of both groups showed remnants of the bone graft materials. The materials were well integrated into bone and the histology revealed osteoblasts and osteoid in the vicinity of both materials. The histomorphometric results in the augmented area showed a mineralized bone area of 23.5% for the BONITmatrix® group and 23.8% for the BioOss® group ($P = 0.9041$). The amount of remaining bone replacement material was 30.2% for the BONITmatrix® group and 35% for the BioOss® group ($P = 0.074$). The differences for both variables were statistically not significant. All implants placed in the augmented sites after 3 months of healing integrated and were restored prosthetically.

Conclusions and clinical implications: It may be concluded from this study that there is no significant difference in the healing of augmented sinuses when BONITmatrix® or BioOss® is used. Both materials led to similar bone regeneration regarding the mineralized bone area. Implant placement 3 months after sinus augmentation using either material seems to be possible.

This investigation was supported by a grant from DOT GmbH, Rostock, Germany.

063 | Short Oral Communications

Sinus lift with BioOss® and autogenous bone or stem cells

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Background: Promising results from *in vitro* and animal studies (Gutwald et al. 2009) stimulated us to study the potential of bone formation of autogenous stem cell transplantation in human. In a randomized-controlled trial, it was assessed whether differences in bone formation occurred after maxillary sinus floor elevation surgery with either autogenous bone in combination with BioOss® or stem cells in combination with BioOss®.

Aim: To assess whether differences occur in bone formation after maxillary sinus floor elevation surgery with bovine bone mineral (BioOss®) mixed with autogenous bone or autogenous mesenchymalstem cells. The primary endpoint was percentage of new bone 3 months after the elevation procedure.

Methods: In a randomized-controlled split-mouth design, a bilateral sinus floor augmentation procedure was performed in 12 consecutive patients (age 60.8 ± 5.9 years, range 48–69 years) needing reconstruction of their atrophic maxilla. Randomly, on the one side the augmentation procedure was performed with bovine bone mineral (BioOss®) seeded with mononuclear mesenchymal stem cells harvested from the posterior iliac crest (test side) while BioOss® mixed with autogenous bone (harvested from the retromolar area) was applied on the contra-lateral side (control side). Three months after the sinus floor elevation surgery, biopsies from the reconstructed areas were taken at the spots were subsequently the endosseous implants were placed. The biopsies were histomorphometrically analyzed. A total of 66 non-submerged one-piece implants (ITI Straumann®, Institut Straumann, Waldenburg, Switzerland) was placed in the augmented maxillae. A linear mixed model was used for analysis.

Results: Significantly more bone formation was observed in the test side (17.7 ± 7.3%) when compared with the control side (12 ± 6.6%; $P = 0.012$) at 14.8 ± 0.7 weeks after augmentation. In both the test and control sides, all implants could be placed with primary stability. Before the prosthetic phase, three implants (two patients) were mobile on the test side and had to be removed. Healing was uneventful and all patients could be supplied with an adequately functioning implant-supported maxillary overdenture.

Conclusions and clinical implications: Mesenchymal stem cells seeded on BioOss® particles can induce the formation of a sufficient volume of new bone to enable reliable placement of implants within a time frame comparable with that of applying either solely autogenous bone or a mixture of autogenous bone and BioOss®. This technique might serve as an alternative to using autografts meanwhile reducing the morbidity of the grafting procedure.

064 | Short Oral Communications

Electron tomography: a tool for the study of osseointegration in 3D

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Background: Understanding the interfacial structure between implant materials and bone is crucial for osseointegration. Biointerfaces have long been imaged with light, X-rays and electrons. Most of these techniques, however, only provide low-resolution or two-dimensional information.

Aim: With the advances in modern day transmission electron microscopy, high-resolution visualization and analysis of three-dimensional (3D) structures is possible. We present a technique to create 3D reconstructions of the interface between human bone and dental implants using Z-contrast electron tomography.
Methods: Porous hydroxyapatite (HA) scaffolds, implanted in the maxilla of humans for a duration of 7 months, and laser-machined titanium implants were removed with surrounding bone and embedded in plastic resin.

Samples for transmission electron microscopy were prepared using a dual-beam focused ion beam (FIB) microscope with *in situ* lift out method.

Tomographic series were collected on a Titan 80–300 transmission electron microscope (FEI Company, Eindhoven, the Netherlands) operated at an acceleration voltage of 300 kV using a high-angle annular dark-field detector (HAADF). Images of the interface were acquired in increments of 2°, up to tilt angles of ± 60°, and 1°, for further angles up to ± 75°.
Results: Single-axis tomographic tilt-series were collected over the bone-implant interfaces and using back projection, with a simultaneous iterative reconstruction technique, 3D reconstructions with nanometre resolution were created. The reconstructed 3D volume clearly reveals the distinct orientation of HA particles in the fibrous bone structure and in the dense interfacial apatite layers. This important feature could not be deduced directly from the individual images; only with the aid of tomography and the 3D reconstruction is this characteristic visible.
Conclusions and clinical implications: Electron tomography is a valuable tool for investigating implant interfaces to bone in three dimensions. We have demonstrated the ability to produce a reconstructed volume of the nanometre-scaled regions between both titanium and hydroxyapatite implants and human bone. Viewing these structures in three dimensions enabled us to observe the nanometre differences in morphology of the implant surface. Insight into the 3D structure of a vast number of biointerfaces is possible with electron tomography and may transform the approach to device design and the study of osseointegration.

065 | Short Oral Communications

Soft tissues around long-term platform-switching implant restorations in humans: histological evaluation

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Background: Although the literature emphasized appealing short-term radiographic outcomes of implants restored according to platform switching (PS), a lack of evidence on histological soft tissue response in humans was noted.
Aim: This randomized-controlled trial aimed to histologically evaluate the long-term effects of PS restored implants on soft tissue surrounding the implant/abutment interface.
Methods: Forty implants were inserted in posterior maxilla of 15 patients. Implant sites were randomly treated as following: standard diameter implant restored using matching-diameter abutment (control), wide diameter implant restored according to PS (test).

Thirty-six months after prosthetic rehabilitation, subjects underwent a peri-implant soft tissue biopsy. Additionally, peri-implant radiographic bone levels and clinical parameters on implants and adjacent teeth (BoP, PPD, mPlI, Keratinized tissue) were measured. Procedures were approved by an ethical committee.

Sections were stained with hematoxylin/eosin to evaluate the tissue morphology in general and with Sirius red to measure the collagen content in the connective tissue compartment. Immunostaining for CD31 was performed on four sections to highlight blood vessels. All sections underwent histomorphometrical analysis.
Results: Four patients dropped out at the end of the study. A total of 28 samples were analyzed (Control: 7, Test: 21).

Peri-implant radiographic bone levels confirmed statistically significant differences between groups (Control: 1.56 mm [SD: 0.35], Test: 0.8 mm [SD: 0.47]).

In most samples of all groups, a small concentrated population of lymphocytes (ICT) was mainly localized in the connective tissue close to the junctional epithelium (Control: 0.26 mm^2 [SD: 0.04], Test: 0.15 mm^2 [SD: 0.1]). The remaining peri-implant connective tissue presented few scattered lymphocytes and macrophages.

All samples showed microvessels mainly distributed underneath the oral epithelium and the vascular density decreased in the deep connective tissue (Control: 10.66% [SD: 4.5], Test: 10.7% [SD: 3.8]). With polarized light, the collagen fibers under the oral epithelium were thick and closely packed and appeared well oriented in a perpendicular structure of bundles (Control: 60.7 [SD: 14.2], Test: 62.3 [SD: 11.5]).

No difference in ICT, microvascular density and collagen content was evident between groups.

For ICT, microvascular density and collagen content, the correlation coefficients to the clinical variables (BoP, PPD, mPlI, keratinized tissue) resulted not significant.
Conclusions and clinical implications: This study, the first histological one on a relevant implant sample on human being, showed that 36 months after restoration the peri-implant soft tissue around test and control sites had similar histological characteristics, confirming platform switching as a safe prosthetic concept leading to better maintenance of peri-implant bone levels. However, further histological studies are required to longitudinally confirm the present data.

066 | Short Oral Communications

Above 15-year follow-up of single machined Brånemark implants

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Background: Since the late 1980s dental implants have been used in the indication of single-tooth replacement.

Aim: The aim of this study was to evaluate the radiographical and clinical outcome of single-machined Brånemark implants with at least 15 years of follow-up.

Methods: Fifty-one patients who received 63 single implants between 1987 and 1994 were randomly selected. In this patient group three implants failed (4.8%), leaving 60 implants to be clinically investigated. Mean interproximal probing depth, bleeding and plaque index were measured around each implant. Peri-apical radiographs were compared for marginal bone level between baseline (= within 6 months after abutment connection) and 2–4 years, 5–8 years and 15–22 years of follow-up. Mean interproximal bone level was measured from the implant shoulder as a reference point. Overall changes in marginal bone level were analyzed with the Friedman test and 2-by-2 comparison between time points was evaluated with the Wilcoxon signed ranks test.

Results: The group consisted of 29 males and 22 females with a mean age of 24 years (range 14.7–57.4) at implant placement. Mean follow-up time was 18.5 years (range 15–22). Mean probing depth was 3.9 ± 1.27 mm (range 2–10.3). Bleeding and plaque indices were 1.2 ± 0.81 and 0.2 ± 0.48, respectively. Mean bone level after 15–22 years was 1.7 ± 0.88 mm (range − 0.8 to 5). There was no correlation found between radiographic bone level and probing depth. The Friedman test indicated a statistically significant change in marginal bone level between time points ($P < 0.05$). Wilcoxon signed ranks test showed a statistically significant difference between baseline and all other time points. After 2–4 years no statistically significant differences could be found.

All but one implants (98.3%) were within the currently accepted success criteria corresponding to a maximum accepted bone loss of 4.3 mm after 15 years. If one accepts a mean bone level of 2.1 mm from the implant shoulder (= 2nd thread), 81.7% of the implants are successful. If a mean interproximal probing depth of 5 mm is accepted, 91.7% of the implants are successful. If both these criteria are combined, 76.7% are successful.

Conclusions and clinical implications: The machined Brånemark implant used as a single-tooth replacement is a predictable solution with high clinical survival and success rates. In general, a steady state bone level can be expected over decades. New criteria for long-term implant success should be determined.

067 | Short Oral Communications

Bone healing after immediate implant placement in extraction sites. A randomized prospective clinical study

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Background: Several studies showed that marked hard tissue alterations occurred following tooth extractions (Schroop et al. 2003; Araújo & Lindhe 2005). It was demonstrated that immediate implant installation does not prevent the buccal bone loss, moreover, it was claimed that the collapse of the ridge is due to the resorption of bundle bone following tooth extraction (Botticelli et al. 2004; Araújo et al. 2005, 2006). The use of graft material in preserving dimension of the site and the buccal bone wall was well documented in two preclinical studies in the dogs model (Cardaropoli et al. 2005; Araújo et al. 2008), however, there is no a randomize clinical study regarding the usage of biomaterial and immediate implant installation and the effect on the healing of the buccal bone plate.

Aim: To evaluate whether the use of a biomaterial around immediate placed implants in extraction sockets may prevent the collapse of the socket envelope.

Methods: Forty patients were randomly selected for the study with a tooth comprised between premolar region that have to be extracted. No tooth was extracted because of advanced periodontal disease. Following local anesthesia and flap elevation an implant (ST Astra Tech, Sweden) will be placed immediate after tooth extraction. The dimension of the buccal bone wall was measured with a calibrated caliper at the level of the most coronal portion or the ridge. In the test group, Bio-Oss Collagen® and Bioguide® were used to grafted the site. In the control group no biomaterial was used. All the implants were installed at the level of the buccal bone plate and primary closure was achieved. The reentry procedure was performed 3 months following the implant installation and the same measurements were performed. Differences between test and control were analyzed using Student's *t*-test for paired observation. *P*-value < 0.05 was considered as significant.

Results: Bone alterations occurred in the treated sites. The percentage reduction of the buccal bone wall was 12.5% in the test group and 50% in the control group. The difference was statistical significant ($P < 0.05$).

Conclusions and clinical implications: The use of a biomaterials around immediate placed implant in extraction socket marked reduced the collapse of the buccal bone plate. The results of this investigation have a high clinical relevance regarding the treatment of implant immediate placed following tooth extraction.

068 | Short Oral Communications

Comparison of two bone substitutes for treatment of bony dehiscences

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Background: The unpreventable resorption of the alveolar crest after tooth extraction implies the use of a bone substitute to cover bone dehiscences after implant insertion.

Aim: In this *in vivo* study a synthetic bone substitute was compared with a bovine bone mineral in the treatment of this indication.

Methods: This split-mouth RCT compared the healing capacity of two bone substitutes: BioOss® (BO, Geistlich Biomaterials) and Straumann® BoneCeramic (SBC, Institut Straumann AG) to treat bony dehiscences along implants. Fourteen patients with a very narrow maxillary ridge received 4–6 implants (Standard Plus SLActive®, Straumann) to support an overdenture. Two comparable dehiscences of at least 4 mm in height within the same patient were first covered with a layer of autogenous bone, followed by a layer of one of the bone substitutes. Finally, a resorbable membrane (Bio-Gide®, Geistlich Biomaterials) sealed the augmented area. The primary parameter of the study was the change of the vertical dimension of the defect measured at implant placement (baseline) and after 6 months (when the abutment was connected). At this visit the vestibular flap was reflected to inspect the healing of both sites and the defect was measured with a periodontal probe. The changes in vertical defect height were compared between the test and control groups using the two-sample-*t*-test (two sided) at significance level $\alpha = 0.05$ and power of 80%. Clinical and radiological parameters were evaluated at both time points and after 1 year of loading. Bone remodelling was calculated based on intra-oral radiographs taken implant placement, abutment connection and 1 year of loading.

Results: Data of 13 patients were considered in the "per-protocol" analysis. The vertical size of the defect at surgery was 6.54 mm ($\pm$ 2.19 mm) in the SBC group and 6.54 mm ($\pm$ 1.45 mm) in the BO group. After 6 months the depth of the defect was reduced to 1.85 mm ($\pm$ 1.21 mm) at the SBC sites and 1.5 mm ($\pm$ 1.27 mm) at the BO-treated sites. The mean changes were not statistically significant between the two groups ($P = 0.672$). No implant failure was observed during the first year of loading.

Conclusions and clinical implications: Both bone substitute materials are equally effective in the treatment of dehiscences along implants.

069 | Short Oral Communications

Immediate loading of interforaminal implants using a chairside-fabricated bar

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Background: The SFI-Bar® (C + M, Biel, CH) is a round clip bar for immediate chairside completion and connection to the implants.

Aim: In a randomized clinical trial, the performance of the SFI-Bar® connected to two interforaminal implants was tested under immediate and delayed loading conditions.

Methods: After case number estimation, 30 subjects with functional complete dentures received two interforaminal SI-Cace implants (SIC-invent AG, Basel, CH). Paired patients were randomly allocated in two groups, either for immediate (test, $n = 15$) or delayed loading (control, $n = 15$). The SFI bar was completed chairside in both groups and the bar clips were polymerized into the existing denture directly in the mouth. The denture base remained without any metal framework. Patients were regularly monitored. Standardized radiographs were taken at six time-points: at implant surgery, at bar insertion (both in one day for test group) and at 1, 3, 6 and 12 months after bar insertion. At 3, 6 and 12 months after bar insertion, the implant removal resistance (> 20 N cm) was tested. Simultaneously plaque (PI), bleeding on probing (BoP) and probing and sounding depths were recorded. Crestal bone level changes were measured radiographically and any technical complication registered. All data were analyzed by non-parametric statistical methods. The hypothesis was that the performance of the immediately loaded implants was not inferior to the control group.

Results: Implant survival rate was 100%. All 60 implants were stable as tested by removal resistance and X-rays. Twelve months after bar insertion, mean bone loss was -0.37 mm (CI 95%: -0.59; -0.16) in the test group and -0.78 mm (CI 95%: -1.07; -0.49) in the control group. The average PI was 0.39 ± 0.31 (test) and 0.4 ± 0.36 (control), BoP 0.09 ± 0.15 (test) and 0.08 ± 0.11 (control), probing depth 2 ± 0.4 (test) and 2.1 ± 1 (control) and sounding 2.7 ± 0.4 (test) and 2.9 ± 1.4 (control). In each group one denture fractured after 3 months of loading. Eight dentures in each group had to be relined. The test group was not found to be inferior to the control group for any of the parameters tested ($P < 0.05$, power $> 80\%$).

Conclusions and clinical implications: The treatment outcome with the SFI bar connecting two interforaminal implants was excellent and comparable in both groups. The hypothesis of the study was accepted as immediate loading demonstrated equal or better results than delayed loading. According to the accepted implant success criteria (Albrektsson & Isidor 1994), both treatment protocols were 100% successful.

070 | Short Oral Communications

Porous titanium granules in the surgical treatment of peri-implant osseous defects – a randomized clinical trial

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Background: A growing number of publications support that the prevalence of peri-implantitis is high and the development of treatment strategies for peri-implant osseous defects is important. Recent animal experimental studies suggest that porous titanium granules (PTG, Tigran Technologies AB, Malmö, Sweden) have potential as an osteoconductive graft material.
Aim: The objective of this prospective randomized clinical trial was to investigate the regenerative potential of PTG when used as a bone graft substitute in the surgical treatment of peri-implant osseous defects.
Methods: Thirty-two patients with peri-implant osseous defects were included in the trial. Screening of in total 66 patients had been performed by a team of board certified periodontists and prosthodontists before inclusion. After causative peri-implantitis treatment, the patients were randomized into open flap debridement and surface decontamination with titanium curettes and 24% EDTA gel (control), or in addition insertion of PTG (test). The patients were prescribed Amoxicillin, 500 mg, three tablets a day and Metronidazole, 400 mg twice daily, 3 days before surgery and 7 days after surgery. Patients were recalled every 3 months. The implants were loaded after 6 months of submerged healing. Probing pocket depth (PPD), clinical attachment level (CAL), bleeding on probing (BoP), implant stability using resonance frequency analysis (RFA) and radiographic evaluation were performed at baseline and at 12 months. All statistical analyses were performed using Sigma Stat 3.0 (Aspire Software International, Ashburn, VA, USA) and using Student's *t*-test for parametric data and Mann-Whitney U-test for non-parametric data. The significance threshold (α) was set at a 0.05 level.
Results: The mean radiographic defect fill for the PTG-treated implants was 1.96 mm ($\pm$ 2.13) compared with 0.53 mm ($\pm$ 1.32) for the control implants, which was a significant difference ($P < 0.001$). Significantly fewer defects with progression in attachment loss were also seen in the case group ($P < 0.05$). Furthermore the PTG-treated implants had a mean increase in RFA of 1.77 ISQ compared with 0.39 for the control group. The difference in RFA values was not statistically significant but the power was below 80%. No significant differences were seen in CAL, PPD or BoP between groups.
Conclusions and clinical implications: This study demonstrated that grafting with PTG led to significantly better defect resolution and significantly fewer implants with progression of attachment loss as seen on radiographs, but there were no significant differences in clinical parameters and implant stability between groups.

071 | Short Oral Communications

Maxillary sinus augmentation following removal of maxillary sinus pseudocyst after a shortened healing period

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Background: Dome-shaped radio-opacities on the floor of the maxillary sinus are commonly interpreted as a sinus cyst on radiographs during dental implant planning. They might present an obstacle in sinus grafting, leading to bone graft failure, or implant loss later. The therapeutic approaches to the removal of such cystic lesions and the following sinus augmentation are still discussed controversial.
Aim: The purpose of this study is to present a modified technique that can be used for predictable removal of maxillary sinus cyst and sinus augmentation after a shortened healing period in patients with maxillary sinus pseudocysts.
Methods: A total of 11 patients with a mean age of 43.7 years with a radiographic dome-shaped opacity in the posterior maxilla sinus were included in this study. A lateral sinus window (Ø 5 mm) was prepared and the removal of the cyst was performed with grasping forceps. Three months after removal of the cyst, a conventional sinus augmentation with xenogenic material was undertaken. Dental implants were placed 6 months later. The panoramic radiography and coronal/axial computerized tomography (CT) was performed to diagnose sinus lesion preoperative and for follow-up.
Results: A total of 11 pseudocysts were removed from the sinuses of 11 patients under local anesthesia. Histologic evaluation showed antral pseudocysts in all specimens. A soft tissue scar was evident after 3 months of healing at the time of sinus augmentation. No sinus membrane perforation was seen or experienced during the sinus augmentation. A total of 17 implants were placed and restored prosthetically. No clinical complications were observed. The patients were followed up for a mean of 29.2 months (ranged 17–43 months) after prosthetic loading, during which no implants were lost or a recurrence of the antral pseudocyst was observed.
Conclusions and clinical implications: The described modified surgical technique allows the minimal invasive removal of the antral pseudocyst and histologic verification of the diagnosis without compromising the naso-antral entrance as well as the

anatomy of the sinus for future sinus augmentations. It could be performed under local anesthesia without endoscopic equipment while shortening the treatment period.

072 | Short Oral Communications

Three-year follow-up of immediately placed implants in sockets exhibiting periapical pathology

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Background: Today's literature provides information on different factors influencing the success of implants placed immediately after tooth extraction. One factor, which has been discussed controversially, is the presence or absence of periapical pathologies. Several studies advise against the immediate placement of implants in the presence of periapical pathologies. In contrast to these findings, more recent animal studies have shown that implants placed in artificially induced periapical lesions osseointegrate as well as implants placed in healthy sites. Data in humans are only available for a 1-year follow-up period and showed no disadvantages for implants immediately placed into sites with a periapical pathology. Hence, studies with longer follow-up periods are needed to determine the safety of this procedure.
Aim: The aim of the present study was to compare the clinical and radiological outcome of immediately placed implants in sockets with or without periapical pathology 3 years after implant placement.
Methods: Twenty-nine patients with immediate implant placement were clinically and radiologically followed 3 years after implant placement (test-group: 16 patients without periapical pathology, control-group: 13 patients with periapical pathologies). Clinical (FMBS, FMPS, CAL, width of keratinized mucosa buccaly of the implant) and radiological parameters (IS-BIC) were assessed. Both 95% confidence intervals, as well as results of statistical tests (one-sample, two-sample, paired *t*-test) were provided.
Results: The implant survival rate was 100% for all 29 implants after 3 years. The clinical and radiological parameters showed no statistically significant difference between the test- and the control-group at 3 years (two-sample *t*-test). The vertical distance from the implant shoulder to the first bone-to-implant contact (IS-BIC) was between 1.54 ± 0.88 mm (mesial, test) and 1.69 ± 0.92 mm (distal, test). Between the 1- and 3-year visit the IS-BIC increased in both groups significantly on the one side of the implant: 0.3 ± 0.37 mm (mesial, test) and 0.33 ± 0.43 mm (distal, control) (one-sample *t*-test). None of the 13 examined radiographs of implants immediately placed in sockets with periapical pathologies revealed retrograde peri-implantitis after 3 years.
Conclusions and clinical implications: It is concluded that after careful debridement of the extraction socket, immediate placement of implants into sites with periapical pathologies can be a successful treatment modality for at least 3 years with no disadvantages in clinical and radiological parameters to immediately placed implants into healthy sockets.

073 | Short Oral Communications

Effect of platform switching on peri-implant bone around short implants: an RCT

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Background: Stress analysis studies revealed that short implants (< 10 mm in length) develop a peak compressive stress in a relatively small area positioned around the first implant thread. These stresses may result in bone microfracture and resorption, while, particularly when short implants are applied, the aim is to preserve peri-implant bone. A solution to reduce these effects and thus to allow for a better preservation of peri-implant bone might be the use of prosthetic abutments with a smaller diameter than the implant (platform switching). Platform switching is thought to limit biologic width reformation, because the inevitable microgap at the level of the implant–abutment connection and its microbial colonization is shifted to a more medial upwards position.
Aim: In a randomized-controlled trial, it was assessed whether peri-implant bone loss around 8.5 mm implants supplied with either a platform-switched abutment connection (full Osseotite® Certain® Prevail™, Biomet 3i, Palm Beach Gardens, FL) or a conventional (same diameter) implant–abutment connection (full Osseotite® XP® Certain®, Biomet 3i, Palm Beach Gardens, FL) differed. Implant location, quality of the alveolar bone at the implant location and mucosal thickness before implant placement (biotype) were considered as possible confounders.
Methods: Forty-two partially dentate, healthy and non-smoking patients (31 female, 11 male) with a mean age of 51 years

(range 25–70 years) received a total of 67 implants with a length of 8.5 mm. The conventional and platform-switching concepts were randomly assigned. The independent sample *t*-test was used to assess the difference in peri-implant bone loss between the two abutment connection concepts. Pearson's correlation coefficients tests were used to assess whether the observed results were dependent on the confounders location, bone type, biotype and bone loss.

Results: Peri-implant bone loss around single platform-switched implants was significantly less ($P = 0.038$) compared with implants with conventional abutment connections (-0.24 ± 0.34 mm and -0.69 ± 0.51 mm, respectively) and remains stable from 1 month to 1 year in function. The confounder quality of the alveolar bone played a significant role ($P = 0.033$) in the bone loss around conventional implants–abutment, showing more peri-implant bone loss in more spongious bone. This was not the case with platform-switched implants. The location of the implant or mucosal thickness (biotype) was of no importance.

Conclusions and clinical implications: The effect of platform switching is of major importance on peri-implant bone preserve around short implants. The variables location, bone type or biotype are of no importance.

074 | Short Oral Communications

Bone marrow concentrate and bovine bone mineral for sinuslift. A controlled, randomized, single-blinded trial

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Background: Bone marrow aspirate contains important components needed for tissue regeneration, among them mesenchymal stem cells. The present study was designed to measure whether bone marrow aspirate concentrate (BMAC) in combination with bovine bone mineral (BBM) has a similar bone regeneration potential as a mixture of autogenous bone (AB) and BBM. To assess this, their early bone formation at 3–4 months was evaluated by histologies. The sinus floor elevation was chosen as the clinical indication, as it provides a secluded space in which bone can regenerate undisturbed from external factors.

Aim: To evaluate the potential of substituting AB by BMAC. Both AB and BMAC were tested in combination with a BBM, for their ability of new bone formation (NBF) after sinus lift procedures in a multi-centric, randomized, controlled, clinical and histological non-inferiority trial.

Methods: Forty-five severely atrophied maxillary sinus from 26 patients were evaluated in a partial cross-over design. As test arm, 34 sinus of 25 patients were augmented with BBM and BMAC containing mesenchymal stem cells. Eleven control sinus from 11 patients were augmented with a mixture of 70% BBM and 30% AB. Biopsies were obtained after 3–4 months healing time at time of implant placement and histomorphometrically analyzed for NBF.

Results: NBF was $14.3 \pm 1.8\%$ for the control and non-significantly lower at $12.6 \pm 1.7\%$ for the test (90%-CI-interval $-4.6 \ldots 1.2$). Values for BBM of $31.3 \pm 2.7\%$ were significantly higher for the test compared with control of $19.3 \pm 2.5\%$ ($P < 0.0001$). Marrow space was lower by 3.3% in the test compared with control (57.6%; $P = 0.137$).

Conclusions and clinical implications: NBF is equivalent in sinus, augmented with BMAC and BBM or a mixture of AB and BBM. This technique could be an alternative to using autografts to stimulate bone formation.

075 | Short Oral Communications

The implant-supported maxillary overdenture; a prospective randomized-controlled trial on four vs. six implants

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Background: An overdenture supported by endosseous implants gives the opportunity to improve retention and stability.

In case of insufficient bone a maxillary sinus floor elevation procedure is carried out and after a 3-months healing period the implants are inserted in the posterior areas of the maxilla.

There are a number of prospective studies on overdentures retained by implants in the posterior area of the maxilla. A clinical trial, in which a different number of implants are compared, has not been published yet.

Aim: The aim of the study is to compare four or six implants in the posterior area of the maxilla to support an overdenture during a 1-year follow-up period.

Methods: Fifty fully edentulous patients, 25 in each group, with problems with retention and stability of the upper denture were selected for the study. All patients had insufficient bone to place the implants directly in the posterior region. In all causes a sinus augmentation, with bone from the crista iliaca, had to be performed and after a 3-months healing period the implants were inserted.

After randomization patients were assigned to:

Group 1: Four implants (Straumann® Standard SLA® implant) of at least 10 mm length inserted in the posterior area (two implants on each side) of the maxilla,

Group 2: Six implants (Straumann® Standard SLA® implant) of at least 10 mm length inserted in the posterior area (three implants on each side) of the maxilla.

In each patient also four implants were placed in the interforaminal region of the mandible.

After 3 months of osseointegration, a bar-supported overdenture was constructed.

In this clinical trial the following items are evaluated: Implant survival, overdenture survival, peri-implant bone changes and patient satisfaction.

Results: After a period of 1 year, implant survival and overdenture survival was 100% in both groups. The mean marginal bone resorption was within the acceptable range of 1.5 mm in both groups. Patient satisfaction was measured with a general satisfaction score (from 1 to 10). General satisfaction improved from score 4 (pre-treatment) to score 9 (1 year) in both groups.

Conclusions and clinical implications: In this study, no significant differences could be detected between the two groups in implant survival, overdenture survival and peri-implant bone height changes. There was a significant increase in patient satisfaction within the two groups, 1 year after treatment.

For reason of cost-effectiveness, four bar-connected implants to support a maxillary overdenture is the method of choice.

076 | Short Oral Communications

Risk factors for loss of immediately placed implants in molar regions: a randomized-controlled trial

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Background: There are few studies on immediate replacement of molars with dental implants, and controlled studies on risk factors for early loss of the implant are scarce. Placing implants in molar extraction sockets results in large peri-implant non-spontaneously healing defects, which need to be addressed.

Aim: The aim was to identify risk factors for loss of immediately placed molar implants associated with three regenerative techniques.

Methods: Ninety-two patients (44 women and 48 men; mean age 50 years [range 23–77], 35 smokers and 57 non-smokers) in need of an implant replacing a molar were included. After extraction and placement of the implant (Brånemark System Wide Platform) (45 in the upper jaw and 47 in the lower jaw) large peri-implant defects remained. Each patient was randomly allocated to one of the three regenerative treatments: Autologous bone chips, Ossix membrane (Biomet 3i, Palm Beach Gardens, FL, USA) or a combination of these. Four months after implant placement a surgical re-entry was performed, and the implant was controlled for remaining peri-implant defect. The implant was explanted if it had a dehiscence on >2 of four sites (mesial, buccal, distal, oral) and if it had visible threads ≥ 50% of the total implant length on one of the four sites. Otherwise a healing abutment was connected with or without a concomitant GBR-procedure in case of smaller remaining peri-implant defects. Pre-operatively, per-operatively, 1 week and 3 weeks post-operatively and at the surgical re-entry clinical data were collected.

A multiple logistic regression model was applied with implant loss as the dependent variable and gender, age, treatment, smoking, infection and dehiscence as the independent factors to identify risk factors for loss of the implant.

Results: In total, 15 implants were lost. No statistically significant differences regarding loss were observed between the three treatments. The following risk factors were identified: Smoking (>10 cigarettes per day) (OR = 9.78, CI = 1.56–61.38), buccal bone dehiscence (OR = 10.98, CI = 1.71–70.38) and infection (OR 29.31, CI = 3.78–227.32). Post-operative soft tissue dehiscence or smoking less than 10 cigarettes per day was not significantly associated with the risk of losing the implant at the surgical re-entry. None of the other variables had a significant impact on implant loss.

Conclusions and clinical implications: Placing an implant immediately after extraction of a molar should be limited to carefully selected patients. A molar with a buccal bone dehiscence in a heavily smoking patient should not be replaced immediately while in light smokers there seemed to be no increased risk compared with non-smokers.

076bis | Short Oral Communications

Gingival Biotype Assessment in the Esthetic Zone: Visual Versus Direct Measurement

Presenter: Morimoto T

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Background: It has been suggested that a direct correlation exists between the gingival biotype and the susceptibility to gingival recession following surgical and/or restorative procedures. However, there has not been an objective classification to determine the gingival tissue thickness of different biotypes.

Aim: The aim of this study was to evaluate the reliability of visually assessing the facial gingival biotype of maxillary anterior teeth with and without the use of periodontal probe in comparison with direct measurements.

Methods: Forty-eight patients (20 male, 28 female) with mean age of 51.8 years (range 18 to 86 years) with a single failing maxillary anterior tooth participated in this study. Three methods were used to evaluate the thickness of the gingival biotype of the failing tooth. The examiners were calibrated prior to the commencement of the study. Prior to extraction, the gingival biotype of the failing tooth was identified as thick or thin by visual assessment and assessment with periodontal probe. After the tooth extraction, direct measurement of the gingival thickness using a tension-free caliper was performed to the nearest 0.1 mm. The gingival biotype was considered thin if the measurement was $\leq$ 1.0 mm, and thick if it measured > 1.0 mm. The assessment methods were compared using McNemar's Test at the significance level of $\alpha = 0.05$.

Results: The mean gingival thickness obtained from direct measurement was 1.06 $\pm$ 0.27 mm, with equal distribution (50%) of the sites with gingival thickness of $\leq$ 1 mm and > 1 mm. McNemar's Test showed a statistically significant difference in the way gingival biotype was identified when comparing visual assessment with assessment with periodontal probe ($P = 0.0117$) and direct measurement ($P = 0.0001$). However, there was no statistically significant difference when assessment with periodontal probe was compared with direct measurement ($P = 0.146$).

Conclusions and clinical implications: Assessment with a periodontal probe is an adequately reliable and objective method in evaluating gingival biotype whereas visual assessment of the gingival biotype by itself is not sufficiently reliable when compared to direct measurement.

077 | Short Oral Communications

Eleven-year follow-up of zirconia implant–abutments in anterior and premolar regions

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Background: To evaluate the long-term performance of customized zirconia abutments supporting all-ceramic implant crowns in anterior and premolar regions.

Aim: To evaluate the long-term performance of customized zirconia abutments supporting all-ceramic implant crowns in anterior and premolar regions.

Methods: Twenty-seven patients were included in this prospective clinical study (16 women, mean age 42 years [range 26–65 years], 11 men, mean age 46 years [range 27–75 years]) with a total of 54 implants (Brånemark, MK II, regular platform, NobelBiocare, Sweden). The implants replaced 25 missing incisors, 11 canines and 10 premolars in the maxillae and three canines and five premolars in the mandibles. Pre-fabricated abutment ingots made out of densely sintered yttrium-stabilized zirconia were used. The ingots were customized by means of copy-milling according to the desired shape given by the try-in wax-ups of the abutments. The finalized zirconia abutments were screwed onto the implants using gold screws with a defined torque of 32 N cm. All-ceramic crowns (Empress I, Ivoclar Vivadent, Liechtenstein) were fabricated and adhesively cemented onto the abutments (Panavia 21 TC, Kuraray, Japan). The implant abutments and crowns were clinically and radiographically examined after 1, 4 and 11 years of clinical function. The technical outcome was evaluated by analyzing whether or not the following complications had occurred: abutment/crown fractures, abutment/crown screw loosening, chipping of the veneering ceramic. The biological outcome was judged by assessing pocket probing depths (PPD), plaque control record (PCR), bleeding on probing (BOP) and the papilla index (PI) (Jemt 1997) at implants (test) and neighboring natural teeth (control). The data were descriptively analyzed.

Results: Sixteen patients (nine women, seven men) with 31 zirconia abutments (15 maxillary incisors, 9 canines, 4 premolars and 3 mandibular premolars) were examined at a mean follow-up time of 136 ($\pm$ 11.1) months. Eleven patients (seven women, four men) with 23 implants could not be tracked for the 11-year recall. Up to the 4-year follow-up, two abutment screw loosening and minimal chippings at three crowns occurred. No further technical failures or complications were found at the examined abutments and crowns. Hence, the survival rate for both the observed abutments and crowns was 100%. Furthermore, the biological integration was excellent. No biological complications occurred. The following mean values for the biological parameters were found at test and control sites: mean $PPD_{test} = 3.4 \pm 1.1$ mm, mean $PPD_{control} = 2.2 \pm 1.2$ mm, mean $PCR_{test} = 0.2 \pm 0.3$, mean $PCR_{control} = 0.2 \pm 0.3$, mean $BOP_{test} = 0.3 \pm 0.3$, mean $BOP_{control} = 0.1 \pm 0.2$ and mean $PI_{test} = 1.9 \pm 0.9$, mean $PI_{control} = 2.4 \pm 0.8$.

Conclusions and clinical implications: Customized zirconia implant–abutments exhibited excellent long-term technical and biological outcomes in anterior and premolar regions.

078 | Short Oral Communications

Zirconia implant osseointegration. A histomorphometrical study in mini pig

Presenter: Gahlert M
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Background: Zirconia as implant material has become an alternative to titanium because of its biocompatibility and its tooth like colour. In a previous study, we could demonstrate that there is no statistical significant difference between zirconia implants with a rough surface and Ti-SLA implants considering direct bone implant contact and peri-implant bone density.

Aim: The purpose of the present study was to investigate these attributes for implants with a new geometrical design using an operative procedure different to that of our previous study.

Methods: Cylindrical zirconia implants 4.1 mm in diameter and 10 mm in length were acid etched to modify the surface topography. Standard Ti-SLA implants of the exact shape served as controls.

After extraction of the anterior teeth and after a healing period of at least 6 months, 18 adult miniature pigs received a total of 36 implants in the maxillae using a randomized scheme.

The animals were euthanized after 4, 8 and 12 weeks and implants with the surrounding tissue were removed, embedded in MMA and stained with Giemsa-Eosin. The stained sections were digitized and histomorphometrically analysed with regard to peri-implant bone density and bone to implant contact ratio.

Results: Sixteen zirconia and 18 titanium implants could be retrieved. Two zirconia implants were excluded due to the death of one animal during the operation.

Both types of implants showed direct osseous integration. Zirconia implants revealed mean peri-implant bone density values of 60.4% at 4 weeks, 65.4% at 8 weeks and 63.3% at 12 weeks after implantation, whereas titanium implants demonstrated mean values of 61.1%, 63.6% and 68.2% at corresponding time points. Concerning bone to implant contact ratio the mean values for zirconia ranged between 67.1% and 70% and for titanium between 64.7% and 83.7%.

The best results could be observed when an implant was positioned with its entire length in osseous host tissue. Reduction of osseointegration was noticed when the implants were positioned to some extend into the sinus maxillaris or close to non-osseous structures.

The histomorphometrical evaluation revealed no statistical significant difference between both types of implants.

Conclusions and clinical implications: The histomorphometrical results could not demonstrate a statistical difference and the histological investigation showed direct osseous integration for both materials. Taken together, the data suggest that zirconia implants have a comparable capacity for osseous integration as the titanium implants from the control group.

079 | Short Oral Communications

A presentation of a national web-based quality assurance system for oral implants

Presenter: Slotte C
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Background: Dental implant treatment in Sweden has grown and expanded strongly since its introduction. Hundreds of thousands of patients have received implants. New systems are continually introduced, and more and more dentists are able to offer implant care. But greater treatment volume means more complications. Only a fraction of the implants that are currently being placed are being systematically monitored. So we lack knowledge of actual current and future functioning of all implants. To maintain high patient security and good quality in implant treatment, a system that allows continual registration and follow-up of all implant care being performed nationally is vital.

Aim: The project's aim was to create a user-friendly quality assurance system that encompassed all available implants on the market and allowed evaluation on various levels: operator, clinic, county council, and national.

Methods: In 2006, contacts were taken with representatives from Straumann, Scandinavia and the authors institution to discuss development of a quality assurance system for implant treatment that would primarily be used in specialist dental care. A joint project between the authors and Straumann was initiated to create variables for reporting and follow-up. A web-based quality assurance system – Straumann evaluation system (SEVS) – was developed in 2007 and introduced in the autumn of that year to specialist dental care centers in Sweden.

Results: Most county council specialist centers in Sweden have successively subscribed to the system. To this date, more than 3500 patients, 52.2% women and 47.8% men have been registered. The main reasons for tooth loss were caries (35%) and periodontitis (24%). Smoking patients constituted 11.8% of the population. The dominating indications for implant treatment were single-tooth replacements and fixed partial dentures in the maxilla (together 50%). Single-stage surgery was reported in 63.8% of a total of 5700 placed implants. The reported bone quality was 4.2% (type I), 45.3% (type II), 33.9% (type III), 3.8% (type IV), while in 12.8% of the sites it was not assessed. Immediate placement was reported in 3.2% of the sites. Bone augmentation was performed on 11.7% of the implants. To this date 789 implant-retained constructions has been done. Immediate loading was performed in 5.7%, early loading in 31.7% and delayed loading in 62.6% of the constructions. To this date, 102 implants has reached follow-up. Of these, success was reported in 85.3%, survival in 8.8%, and failures in 5.9%.

Conclusions and clinical implications: Within 2 years this quality system has been adopted and implemented by most county council specialists in Sweden. The registration procedure has been found feasible and not time consuming. In the coming years follow-up registrations will increase, enabling evaluation of treatments and implant products on a large clinical scale.

080 | Short Oral Communications

Stability of the grafted area in sinus floor elevation procedures using the layer technique: a 6 years radiographic follow-up

Presenter: Keller P
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Background: Sinus floor elevation was developed to increase vertical height in the posterior maxilla. The present study reported long-term results for a modified grafting technique in sinus lifting procedure.

Aim: The purpose of this study was to evaluate the radiographic stability of the grafted sinus floor in a long-term follow-up.

Methods: In the year 2004, 214 sinus floor elevations were performed on 129 patients using a modified technique. Autogenous bone particles harvested from intra-oral sites and slowly resorbable biomaterial (Algipore®) were grafted in layer form: the basal part of the sinus floor was grafted with pure autogenous bone while the cranial part was grafted with pure biomaterial. In case of simultaneous implant placement, the totally surface of the implants were covered by autogenous bone particles. A titanium membrane (Bone shield®) was used to cover the sinus window. In case of a two-stages procedure, the implant insertion was performed 3–4 months post-operative. The implants were loaded after a healing time of 4 months. Panoramic radiographs were performed after each surgical stage, after the prosthetic restoration and then twice a year for 6 years. These radiographs were used to measure the height between the implant shoulder and the top of the graft in two different positions. The two most posterior implants (M1, M2) were considered. The vertical heights were registered to evaluate the loss of graft.

Results: One hundred and forty-three sinus floor elevations were performed in one stage and 71 surgeries in two stages approach. Membrane perforations during surgery occurred in 18, 2% and were sutured with 6/0 resorbable material and sealed with fibrin glue. A total of 615 implants (Xive®) were placed in the grafted area. No severe post-operative complication occurred. All implant were osseointagrated and still functioning after a period of 6 years. A small decrease of vertical height was observed between the grafting surgery and the second-stage surgery (average of 1.8 mm). After this time, there were no changes of the gained bone height. Radiological evaluation after 6 years showed maintenance of vertical height gained after surgery.

Conclusions and clinical implications: The layer grafting technique showed radiographic stability of the vertical height over the 6 years period. This technique allowed the early placement of implants in the grafted area and also their early loading after a time of 4 months. The survival rate obtained with this procedure is similar to that expected for implants placed in non-grafted areas.

081 | Short Oral Communications

A 3-year life-table analysis of dental zirconia implants with prosthetic evaluation

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Background: Ceramic implants in dentistry are not new. Since the late 1960s several ceramic implant systems have been used and withdrawn from the market because they did not meet expectations. Zirconia was introduced into dentistry in the 1990s. However, the clinical use of zirconia implants lacks scientific evidence.

Aim: This study reports the prosthetic outcome and a 3-year survival analysis on dental zirconia implants placed in a private practice under common implantological conditions.

Methods: In 79 patients, 170 implants (Z-systems) were inserted in any region of the upper and lower jaw. Treatment covered all indications from single-tooth gaps to fully edentulous jaws. The implants were investigated by means of clinical tools in reference to the success criteria catalogue defined by Jahn and d'Hoedt. Moreover, the patients were asked to fill in a questionnaire (items on general medical and dental health). The 3-year cumulative survival rate was calculated by the Kaplan–Meier method.

Results: The study followed up a total of 121 dental zirconia implants out of 170 consecutively inserted implants in 57 of 79 patients. The average time *in situ* of the implants was 36.75 months. 30 implants were lost due to lack of osseointegration ($n = 17$) or fracture (diameter-reduced implants size 3.3, $n = 12$; diameter size 4.1, $n = 1$). Nineteen implants are *in situ* but dropped out of the clinical assessment because the patients had moved. Prosthetic information was available for $n = 119$ implants ($n = 89$ single crowns, $n = 25$ bridges and $n = 7$ removable hybride dentures). Prosthetic failure (loosening or porcelain fracture) was rare. The 3-year cumulative survival rate based on 170 implants was about 80%, regarding all different types of implant loss. After prosthetic loading, implant loss decreases to about 10% after 2 years. Eliminating implants lost due to fracture the survival rate after prosthetic loading was properly estimated as being 98% after 15 months.

Conclusions and clinical implications: Within the limits of this study dental zirconia implants, especially with a diameter of 4.1 or more have become an alternative to titanium because of its biocompatibility and its tooth like colour. Nevertheless, the non-selected use of diameter reduced zirconia implants is not recommended and reasons of implant fractures have to be examined.

082 | Short Oral Communications

New bone formation following sinus membrane elevation without bone grafting: histological findings in humans

Presenter: Ahn J-J

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Background: In recent years, several studies have indicated that maxillary sinus membrane might possess osteoinductive potential, and suggested that a sinus membrane elevation procedure without insertion of any graft material would be a substitutable technique for bone graft augmentation of the maxillary sinus floor.

Aim: The purpose of this study was to observe the human sinus floor histologically at 6 months following the membrane elevation and evaluate whether the sinus membrane elevation alone can lead to enough new bone formation on the maxillary sinus floor for implant placement.

Methods: Among implant treatment-planned patients, those who had radiographically 4–5 mm bone height in the maxillary sinus floor were selected as candidates for sinus membrane elevation. Lateral sinus wall was exposed through a buccal mucoperiosteal incision. Having made a sinus bone window, the sinus membrane was elevated, and the space underneath the membrane was filled with absorbable collagen sponges (Colla-plug®). In the presence of blood in the space, the collagen sponges were left to soak up the local blood; in the deficiency of blood, the sponges were saturated with venous blood drawn from the brachial vein. The mucoperiosteal flap was repositioned and closed with interrupted silk sutures. Then the sinus was left for 6 month healing. Core specimens of the maxillary sinus floor were obtained using a trephine bur at 6 months after the sinus membrane elevation in patients treated from January 2006 to June 2009. The trephined sites were utilized for implant placements. The biopsies were histologically analyzed to identify the presence and amount of new bone tissue.

Results: A total of 13 specimens from eight patients were included for this study. Microscopically 11 specimens exhibited no recognizable new bone tissue. Only two specimens exhibited a small amount of woven bone on the surface of sinus floor bone.

Conclusions and clinical implications: Within the limits of this study of eight patients, little or no new bone formation was observed on the maxillary sinus floor at 6 months following sinus membrane elevation and support with blood-soaked collagen sponges.

The present study shows the sole effect of sinus membrane elevation on the sinus floor bone. The osteoblastic activity in the periosteum of the human sinus membrane seems to be too weak to develop new bone.

083	Short Oral Communications

Interfacial gene expression and stability of oxidized and machined titanium implants

Presenter: Omar O

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Background: In previous studies, combination of experimental model and gene expression analysis showed that from 3 h to 6 days of implantation, significant differences in expression of genes denoting for cellular recruitment, inflammation, bone formation and bone resorption were seen at the interfaces of screw-shaped oxidized and machined titanium implants. It was concluded that the modulation of gene expression in favor of osteogenic differentiation and down regulation of the pro-inflammatory responses might explain the improved osseointegration of the oxidized implant surfaces. However, as a major condition, the developed bone-implant interface needs to be mechanically stable in order to fulfill the requirements of osseointegration.

Aim: The aim of the current study was to combine *in vivo* interfacial gene expression model with torque analysis in order to determine how molecular and cellular events taking place at the different titanium implants are related to the biomechanical properties of the interface.

Methods: Anodically oxidized and machined titanium miniscrews were inserted in tibiae of six rats. Each rat received two oxidized implants in one tibia and two machined implants in the opposite tibia. After 28 days, the implants were removed using torque-measuring equipment. The torque was registered and the implants completely removed and analyzed with quantitative polymerase chain reaction ($n = 12$). Wilcoxon signed rank test was used to analyze the statistical differences of biomechanical and gene expression results between the two implant types. In addition, similar oxidized and machined titanium miniscrews were characterized topographically, chemically and ultrastructurally using profilometry, Auger electron microscopy and cross-sectioning electron microscopy, respectively. For chemical and topographical analyses, three implants from each type were analyzed. The measurements were made on flanks, tops, and valleys of two nonadjacent threads giving a total of 18 measurements for each implant type. Topographical comparisons were performed using one-way ANOVA followed by Bonferroni's test.

Results: The biomechanical evaluation demonstrated 190% increase in torque values for the oxidized implants as compared with the machined ones. At the same time (28 days), oxidized implants showed significantly higher expression of Runt-related transcription factor 1, osteocalcin, and tartrate resistant acid phosphatase. On the other hand, higher expression of tumor necrosis factor-α and interleukin-1β was detected on the machined surfaces. Surface characterization procedures revealed major differences in the physico-chemical properties of the implant surfaces.

Conclusions and clinical implications: In conclusion, the favorable cellular and molecular events at the oxidized implants were in parallel with significantly stronger bone anchorage during osseointegration.

084 | Short Oral Communications

Synthetic resorbable barriers vs. anorganic bovine bone for sinus lift

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Background: The presence of large pneumatised maxillary sinuses prevents the placement of implants. To overcome this problem various sinus lifting techniques have been proposed.
Aim: To compare two different techniques for maintaining the space beneath a maxillary lining lifted using a lateral window approach: rigid synthetic resorbable barriers (Inion) vs. granular anorganic bovine bone (Bio-Oss).
Methods: Ten partially edentulous patients having bilaterally 1–5 mm of residual bone height and at least 5 mm bone width below the maxillary sinuses, as measured on CT scans, were randomised to receive two different two-stage sinus lift procedures using the lateral window approach. In one side, the sinus lining was raised by placing a resorbable rigid Inion barrier without any bone substitute whereas the contra-lateral side was packed with granular Bio-Oss. After 6 months, two to three implants were inserted at each side and submerged for 4 months. Implants were loaded with provisional prostheses, replaced after 4 months, by definitive screw-retained prostheses. Outcome measures were time necessary to complete the augmentation procedure, bone gain, histomorphometry, any complication, implant and prosthetic failures, and clinician and patient preference assessed by a blinded outcome assessor. All patients were followed up to 1 year after loading.
Results: No patient dropped out. There was no difference in time to complete the augmentation procedure (19.8 min for Inion vs. 20.5 for Bio-Oss). After 6 months, both interventions gained significant bone (14.4 mm for Inion vs. 14.1 mm for Bio-Oss) with no significant differences between the procedures. Histologically, more new bone formed at Bio-Oss-treated sites (24.3% vs. 36.1%), the difference being statistically significant ($P = 0.002$). There were no differences in complications between groups, however, in one of the patients where a perforation occurred at the Inion site, the sinus was two-thirds filled with soft tissue and the site was successfully retreated with Bio-Oss. No implant failed. The clinician preferred Bio-Oss because it was simpler to handle. There were no statistically significant differences in patient preference: eight patients had no preference while two preferred the Bio-Oss treated side.
Conclusions and clinical implications: Although grafting is not needed to augment atrophic maxillary sinuses because it is sufficient to keep space with a rigid barrier, bone was histologically more mature and appeared to be clinically harder when using Bio-Oss. Moreover, it was simpler to fill sinuses with a bone substitute than to position a rigid barrier to maintain space.

085 | Short Oral Communications

One-year results of a multicenter study, comparing two implant alloys

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Background: A new titanium and zirconium alloy has been developed for small diameter implants which shows better mechanical properties than pure titanium (cpTi) and animal models show at least as favourable results as for cpTi.
Aim: The aim of the presented study is a direct comparison between implants with cpTi (control) and TiZr (test) in a human split-mouth model.
Methods: In a randomized, controlled, double-blind, split-mouth multicenter study patients with a fully edentulous mandible were randomized by eight university centers. Two 3.3 mm bone level implants (Straumann) out of two different alloys (cpTi [control] and TiZr [test]) were inserted in the interforaminal region of the mandible and restored after transgingival healing time of 6 weeks with a removable prosthesis by using locator abutments. The study was un-blinded after a study period of 12 months. The following 2-year follow ups will be un-blinded. Change in crestal bone level of 0.1 mm was considered as clinically acceptable. The primary endpoint was change in crestal bone between surgery and 12 months post-surgery. Secondary objectives were survival rate and tissue assessment (sulcus bleeding index, plaque index).
Results: Out of 91 randomized patients, a total of 88 patients completed the 12 months follow-up as intended. Seventy patients were included into the per protocol population. Paired *t*-test showed difference in bone loss after 12 months of -0.031 ± 0.5301 mm between cpTi (-0.344 ± 0.5367 mm) and TiZr (-0.314 ± 0.4528 mm [corresponding one-sided 97.5% confidence interval was $-¥, 0.0959$]). As the non-inferiority margin of 0.1 is not part of this confidence interval, the

non-inferiority of titanium zirconium against pure titanium was statistically proven. Three implants were lost during the study before abutment connection (one in the TiZr group, two in the cpTi group). All secondary efficacy parameters showed no statistical significant differences between treatments.

Conclusions and clinical implications: Results proved that the TiZr implant is as safe and stable as cpTi implant. At 12-months post-surgery, the new TiZr alloy showed comparable biological reactions as known from commercially pure titanium implants. Non-inferiority regarding functional bone remodeling was shown. Together with the improved mechanical properties it shows that is safe in the application of small diameter implants.

086	Short Oral Communications

PepGen P-15® Putty for the augmentation of the maxillary sinus floor

Presenter: Butz F

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Background: Sinus floor augmentation is a suitable and predictable procedure to compensate bone deficiency in the posterior maxilla before implant placement. However, the use of autogenous bone requires an extra donor site with morbidity risks, and current grafting protocols involve healing times for up to 9 months.

Aim: This prospective *in vivo* study aimed to investigate histologically the time-dependant efficacy of PepGen P-15® Putty (DENTSPLY Friadent, Mannheim, Germany) as a sinus grafting material.

Methods: Twenty-four edentulous patients received bilateral sinus augmentations with PepGen P-15® Putty, a combination of the bovine hydroxyapatite OsteoGraf/N300 and the synthetic peptide P-15® that mimics the cell-binding domain of Type-I collagen responsible for cell migration, differentiation, and proliferation plus sodium hyaluronat (=putty). The patients were randomly divided into four groups of six patients each corresponding to 2, 4, 6, and 9 months of healing. After these time intervals, bone biopsies were retrieved through the alveolar bone crest into the augmented sinus using trephine burs. In the same session, the patients received oral implants (ANKYLOS®, DENTSPLY Friadent). A total of 127 implants were placed. The biopsies were immediately immersed in buffered formalin, then scanned in a desktop MicroCT (μCT 40, Scanco Medical AG, Bassersdorf, Switzerland), and subsequently processed for histologic and histomorphometric evaluation (cutting-grinding technique; Exakt-Cutting-Grinding System®, Exakt Apparatebau, Norderstedt, Germany). A mixed model was used for statistical analysis (PROC MIXED, SAS 9.1.2; Institute of Medical Biometry and Medical Informatics and Center of Data Analysis and Modelling, Freiburg, Germany) to analyse the mineralized bone as a tissue fraction in the augmented sinus (area of interest) in percentage.

Results: Three-dimensional μCT images depicted the distinct structure of trabecular bone encompassing PepGen P-15® Putty remnants and histology revealed osteoblasts and osteoid with osteocytes in the vicinity of the PepGen P-15® Putty particles at all healing stages. Histomorphometric results indicated an increase of the newly formed bone fraction in the biopsies as follows: 21.3% (± 2.33) at 2 months; 21.9% (± 8.9) at 4 months; 28.5% (± 6.9) at 6 months; 29.8% (± 11.8) at 9 months. The differences were statistically not significant. All implants placed in the augmented sites integrated and were restored prosthetically.

Conclusions and clinical implications: It may be concluded from this study that PepGen P-15® Putty can successfully be used for maxillary sinus augmentation. Implant placement even 2 months after sinus augmentation with PepGen P-15® Putty seems to be possible.

This investigation was supported by a grant from DENTSPLY Friadent.

Posters: Topic – Implant Therapy Outcomes, Surgical Aspects (Abstracts 87–208)

087 | Topic – Implant Therapy Outcomes, Surgical Aspects

Bone augmentation versus 5-mm dental implants in posterior atrophic jaws

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Background: Often posterior jaws have insufficient bone height to place dental implants of adequate length. Dentists are faced with the dilemma of whether augmenting or using short implants.
Aim: To evaluate whether short (5 mm) implants could be a suitable alternative to augmentation for placing longer implants (10 mm).
Methods: Thirty patients with bilateral posterior edentulism were included: fifteen patients having 5–7 mm of residual crestal height above the mandibular canal, and 15 patients having 4–6 mm of residual height below the sinus and bone thickness of at least 8 mm measured on CT scans. Patients were randomised either to receive 1–3 submerged 5-mm long Rescue implants (MegaGen) or 10-mm long implants placed in augmented bone according to a split-mouth design. Mandibles were augmented with interpositional anorganic bovine bone blocks (Bio-Oss) and maxillae with granular Bio-Oss. Grafts were left to heal for 4 months before placing submerged implants. Four months after, provisional prostheses were delivered, replaced 4 months later, by definitive screw-retained prostheses. Outcome measures were prosthesis and implant failures, complications, time needed to recover mental nerve function and patient preference. All patients were followed up to 1-year after loading.
Results: No patients dropped out. In five mandibles of the augmented group, there was not enough height to place 10-mm long implants and shorter implants (7 and 8.5 mm) were used instead. In each group, one prosthesis could not be placed because an implant was found to be mobile at abutment connection: one 5 mm maxillary implant and one 8.5 mm mandibular implant in the augmented group. Five complications occurred: two in the augmented group (one maxillary sinus perforation and one mandibular wound dehiscence) vs. three maxillary sinus perforations. The difference was not statistically significant. No patient suffered from permanent disruption of alveolar inferior nerve function, however, significantly more patients had paraesthesia for up to 3 days in the augmented group. There was no statistically significant difference in patient preference.
Conclusions and clinical implications: With residual bone height of 5–7 mm over the mandibular canal, short 5 mm implants might be preferable to vertical augmentation because the treatment is faster, cheaper and associated with less morbidity. In the presence of 4–6 mm of bone height below the maxillary sinus, it is still unclear which procedure could be preferable. These preliminary results must be validated by a follow-up of at least 5 years.

088 | Topic – Implant Therapy Outcomes, Surgical Aspects

Bone temperature during implant site preparation by bone condensing technique

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Background:
Introduction: Bone condensing technique is an alternative to conventional one and is recommended for implant site preparation in jaw regions with poor bone density (class D_3 and D_4 by Lecholm and Zarb). Excessive frictional heat generated during implant site preparation in bone causes necrosis of surrounding osteogenic cells and osseointegration failure.
Aim: The aim of the present study was to investigate bone temperature changes during implant site preparation by bone condensing with different irrigation methods.
Materials and Methods: In experiment pig ribs with uniform thickness of corticalis of 2 mm were used in order to simulate class D_3 and D_4 of human jaw bone. Bone temperature was measured by three calibrated thermocouples T-type (Energyx, Serbia) vertically positioned around every future implant site, at distance of 0.5 mm from the final condenser periphery (ø3.5 mm Straumann®, Switzerland). Thermocouples were placed in their canals in bone: one in corticalis at the depth of 1 mm and two in cancellous bone at depths of 5 and 10 mm. Constant distances between thermocouples and bone condenser were secured by a drill guide template. After marking positions of thermocouples and condenser, the template was removed, the specimen was fixed with bottom half in water bath at $29 \pm 1^{\circ}C$ and thermocouples were placed in the canals. Then bone condensing and temperature recording started. According to the irrigation method specimens were divided into three groups: I-no irrigation, II-saline at room temperature, III-saline at $+5^{\circ}C$. Data were collected from 78 measurements, 26 for each group and analysed in SPSS ver. 17 software using Kolmogorov–Smirnov test and one-way ANOVA.
Results: Significant differences were recorded between the mean maximum temperature increase in groups I and III at the depth of 1 mm: $1.78 \pm 1.1^{\circ}C$ and $0.28 \pm 1^{\circ}C$, respectively, and at the depth of 5 mm: $1.68 \pm 1.25^{\circ}C$ and $0.31 \pm 1.4^{\circ}C$, respectively.

Mean maximum increases of temperature were not significantly different between three groups at the depth of 10 mm, $P = 0.278$. The mean maximum temperature was in corticalis in group I 31.0 ± 1.09°C.

Conclusions and clinical implications: All temperatures recorded during bone condensing were below the threshold level for thermal necrosis. Irrigation with saline at +5°C during bone condensing significantly reduces bone temperature.

089 | Topic – Implant Therapy Outcomes, Surgical Aspects

The effect of administration of amoxicillin after implant surgery on bacterial colonization

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Background: Whereas cost and adverse effects of antibiotics, necessity of its prescription in simple implant surgery in healthy individuals remained poorly documented and studies yielded contradictory results.

Aim: The purpose of this study was to evaluate the effect of amoxicillin on bacterial colonization adjacent to implant surgical site.

Methods: This randomized-controlled clinical trial was included 20 patients (10 patients in test group and 10 patients in control group). Patients in each group were given 500 mg amoxicillin or placebo every 8 h for 7 days postoperatively. Microbiologic samples were collected with paper points inserted to peri-implant sulcus 30 min after surgery and 7 days later, before suture removal. Then samples were transferred to microbiological laboratory to analyze the bacterial colonization and bacterial species (with regard to resistance to amoxicillin, metabolism, gram staining, and morphology). Exact wilcoxon signed rank and Mann–whiteny tests were used to access statistical significance.

Results: In test group, the number of sensitive facultative species decreased significantly ($P = 0.01$) and resistant anaerobic species increased significantly ($P = 0.005$) after 7 days. Decrease of the sensitive facultative species and increase of resistant anaerobic species were statistically greater in test group in comparison with control group ($P = 0.025$ and $P = 0.005$, respectively). Increase of sensitive anaerobic species was statistically higher in control group ($P = 0.011$). Decrease of facultative gram-positive cocci was statically higher ($P = 0.035$) in test group in comparison with control group.

Conclusions and clinical implications: According to results of the present study after simple implant surgeries in healthy individuals, administration of amoxicillin leaded to increase of resistant anaerobic species and decrease of sensitive facultative species. The implication of administration of amoxicillin after simple implant surgeries remained inconclusive.

090 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival rate for implants placed in the posterior maxilla with and without sinus augmentation: a comparative cohort study

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Background:

Objectives: The reduced bone height and the proximity of the maxillary sinus are the most common limitations for the placement of dental implants in the posterior maxilla. The reconstruction of the atrophic posterior maxilla can be performed with the sinus augmentation procedure. The aim of this cohort study was to compare the survival rate of implants placed in augmented sinus with implants placed in native bone in the posterior maxilla.

Aim: The aim of this cohort study was to compare the survival rate of implants placed in augmented sinus with implants placed in native bone in the posterior maxilla.

Material and Methods: This study was designed as a prospective cohort study including consecutively treated patients. The patients who required the sinus augmentation (test group) were treated according to the two-stage technique. Patients were scheduled for follow-up evaluation at 3, 6 and 12 months after implant insertion and then every 6 months up to 6 years.

Results: One hundred and five patients with 393 implants were enrolled in the study. Two hundred and one implants were inserted after preliminary sinus floor grafting in 41 patients. The control group contained 64 patients with 192 implants that were placed in pristine bone of posterior maxilla. The cumulative implant survival rate was 86.1% and 96.4%, respectively. The difference between the two groups was highly significant.

Conclusions and clinical implications: These findings showed that implants placed in augmented sinuses had a lower survival rate when compared with implants placed in pristine bone. All the implant failures in the augmented sinuses occurred before the prosthetic rehabilitation. Moreover, it should be considered that most of the failures were observed in few patients thus suggesting a cluster behaviour.

091 | Topic – Implant Therapy Outcomes, Surgical Aspects

4-mm implants supporting FPD in severely resorbed posterior mandible 36-months follow-up

Presenter: Öhrnell LO
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Background: Implant treatment in the severly resorbed posterior mandibel is sometimes difficult to obtain due to the obvious

risk for nerv damage. Various methods of vertical bone augmentation are also dificult to predict and lateralization of the inferior alveolar nerv is theqnicaly difficult without jeopardizing the nerv function. Short implants is used extra-oraly as permanent retention for ear and eye prosthesis with predictable long-term resaluts. The use of short implants intra-oraly may offer many patients with severly resorbed edentoulus posterior mandibel an implant solution without complicated surgery and risk of nerv damage.

Aim: The objective was to assess a new, short Straumann SLActive implant, 4 mm long and 4.1 mm diameter supporting a FPD in patients with severely resorbed crestal bone in the edentulous posterior mandible.

Methods: In this multicenter study 32 patients were included; 11 males, 21 females, mean age 64.1 year. The patients should have an edentulous ''free-end'' situation in the mandible, posterior to canine or first premolar position. Three or four implants were inserted under local anaesthesia using a single-stage surgical procedure. A FPD was placed 10–12 weeks after surgery using screw-retained connection. Implant assessment, patient satisfaction, soft tissue measurement and crestal bone level registration are to be evaluated at follow-ups till 5 years after loading.

Results: Short implants were inserted in 32 patients; three implants in 28 patients and four implants in four patients. 27 were still included and evaluated 36 months after surgery. (One was not eligible at surgery, two were excluded due to early implant failure, one patient insisted on removal of all implants due to diffuse symptoms, and one died due to age.) Two implants were lost due to peri-impant bone loss at 37 and 39 months after placement, respectively.

Assessment of implant success criteria was good. Soft tissue measurement was stable, and patient satisfaction assessment varied between good and excellent.

Conclusions and clinical implications: This study indicates that 4-mm implants can support a fixed partial denture in the severely resorbed posterior mandible in a simplified procedure and with good results.

092 | Topic – Implant Therapy Outcomes, Surgical Aspects

Osseointegration in absence of implant bone anchorage: a pilot study

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Background: To our knowledge no report has described implant primary stability obtained by external fixation as a mean to obtain osseointegration in craniofacial settings.

Aim: To evaluate if osseointegration is achievable where no primary bone-implant contact exists and stability is provided by an external device.

Methods: Six patients who agreed to participate and signed an informed consent form were reconstructed with Brånemark Mk III TiUnite® implants (Nobel Biocare AB, Göteborg, Sweden) to support five cross-arch and one partial maxillary fixed prostheses. Twenty-five out of 21 implants were placed with high primary stability (insertion torque 50 N cm); moreover, for each patient, one additional implant was ''provisionally'' placed with low primary stability (insertion torque 20 N cm). The objective of this implant was to serve as a placeholder for the test implant during the manufacture of a provisional fixed bridge. After 48 h, at the time of provisional prosthesis delivery, an implant in each patient was removed and replaced with a shorter and narrower Brånemark Mk III TiUnite® implant screwed directly on the provisional prosthesis. Thus, for this implant with no contact to resident bone, the primary stability was provided only by rigid fixation to the prosthesis instead of bone anchorage. The provisional prosthesis were temporarily removed following a 6-month healing interval and the test implants and adjacent implants evaluated. Clinical and radiological follow-up was performed at 3, 6 and 12 months after surgery.

Results: All implants showed clinical and radiological stability at 6-month control. After 1-year, all implants including implants that were supported only by the prostheses showed clinical and radiographic signs of osseointegration. Marginal bone level around test implants averaged -1.2 ± 0.2 mm after 12 months. The mean marginal bone change at the mesial and distal implants adjacent to the test implants after 1 year was -1.4 ± 0.7 and -1.2 ± 0.8, respectively. Clinical recordings including plaque index, bleeding on probing and probing depths obtained at recalls showed values within normal limits.

Conclusions and clinical implications: These findings suggest that implant osseointegration can be achieved by providing primary stability using an external device. Primary bone anchorage/contact does not appear critical to the osseointegration process.

093 | Topic – Implant Therapy Outcomes, Surgical Aspects

Comparison of flap and flapless procedures for implant stability: an experimental study

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Background: Flapless implant surgery has been shown to accelerate recovery and to increase the vascularity of the peri-implant mucosa after implant placement.

Aim: The aim of this study was to compare dental implant stabilization patterns between flap and flapless implant surgeries over the first 8 weeks following implant placement.

Methods: In six mongrel dogs, bilateral, edentulated, and flat alveolar ridges were created in the mandible. After 3 months of healing, two implants (StraumannÒSLAactive) were placed in

each side using either a flap or flapless procedure. The implant stability quotient (ISQ) that was obtained from Osstell Mentor was measured at the time of implantation, and weekly over the first 8 weeks following implant placement.

Results: Implants stabilized more quickly without flap elevation than with flap elevation. For flapless implants, an increase in stability occurred after 2 weeks without a period of decreasing stability. However, for flap implants, a shift in implant stability from decreasing stability to increasing stability occurred after 2 weeks.

Conclusions and clinical implications: Flapless implant surgery is advantageous in enhancing implant stability compared with flap implant surgery.

094 | Topic – Implant Therapy Outcomes, Surgical Aspects

Clinical effect of different implant designs on peri-implant tissues

Presenter: Gultekin A
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Background: Post-loading crestal bone loss around two-stage dental implants have long been recognized to be a common drawback of implant therapy. Different implant designs have been developed to reduce the stress level at the coronal region of the implant body in order to prevent the long-term peri-implant bone loss.

Aim: The aim of this study was to evaluate the bone level changes between a new implant design (Nobel Biocare, Nobel Active) and a standart tapered implant design (Nobel Biocare, Nobel Replace Tapered) with conventional loading concept.

Methods: A total of 93 implants (43 Nobel Active-Test, 50 Nobel Replace Tapered-Control) were placed in 25 patients. Patients adequate for dental implants without the need of bone augmentation procedures before or at the time of operations, selected for this study. Minimum two implants (test and control implants) were inserted in healed sites randomly in the same patient. All implants were placed in crestal level and healed in two-stage approach for 4 months and restored with fixed prosthodontics. Implant stability was determined using resonance frequence analysis (RFA) following the implant insertion and second-stage surgery. Buccal, lingual, mesial and distal marginal bone levels around implants were assessed by dental volumetric tomography. Tomographic scans were made at the time of implant insertion, at the second-stage surgery and 1 year after loading. For the follow-up of peri-implant tissue health, modified plaque index, gingival index and probing depth scores recorded at 1 and 12 months after loading.

Results: Survival rates were 97.7% for Nobel Active and 100% for Nobel Replace after 1 year loading. After submerged healing at 4 months measurement, no statistically differrences were found between test (0.15 ± 0.04 mm) and control groups (0.16 ± 0.05 mm) related with mean bone resorption all around implants ($P > 0.05$). After 1 year, the marginal bone level at the test implants (0.38 ± 0.06 mm) was identified significantly in a more coronal position than control implants (0.88 ± 0.13 mm) ($P < 0.01$). Less bone resorption occurred at lingual than mesial, distal and buccal bone for all test and control implants ($P < 0.01$). When compared with control groups, no significant differences were found related with RFA values for corresponding test groups after submerged healing ($P > 0.05$).

Conclusions and clinical implications: Within the limitations of this study, it can be suggested that implant designs built in platform switching concept with internal conical connections may play a significant role to inhibit the resorption of peri-implant hard tissues after loading.

095 | Topic – Implant Therapy Outcomes, Surgical Aspects

Evaluation of pinc esthetics of implant-supported single-tooth replacments

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Background: The clinical effectiveness of dental implants treatment is well documented. Achieving an optimal esthetic result when replacing a single missing tooth with an implant in the esthetic zone is a very demanding procedure.

Aim: To evaluate soft tissue condition around single-tooth implants in esthetic area between two different tissue grafting techniques using pinc esthetic score.

Methods: Retrospective study involved totally 80 patients treated with Straumann single-tooth implants in esthetic area from 1 to 3 years. The patients were divided in two groups – Group A of 30 patients with following the same protocol of all steps which included early implant placement and guided bone regeneration with soft tissue grafting at the same time using allograft dermis. Group B of 50 patients with different kind of diagnostic criteria, flap design, implant type, bone and soft tissue augmantation, implant opening procedure. Compresing pink esthetic score (PES; the highest possible score 10) was used for the objective esthetic outcome assesment. Statistical analysis was carried out using SPSS v.15 for Windows.

Results: The mean pink esthetic score index for Group A was 8.38 (SD = 1.544) and for Group B – 6.85 (SD = 1.932). The difference between these two groups was statistically significant ($P = 0.006$). The mean values of the mesial papilla in Group A was 1.63 (SD = 0.5) and 1.3 (SD = 0.726) in Group B ($P = 0.108$), of the distal papilla in Group A was 1.5 (SD = 0.816) and 1.15 (SD = 0.759) in Group B ($P = 0.127$), of root convexity/soft tissue color and texture in Group A was 1.81 (SD = 0.403) and 1.74 (SD = 0.444) in Group B ($P = 0.563$), of facial mucosa level in Group A was 1.75 (SD = 0.577) and 1.48 (SD = 0.658) in Group B ($P = 0.148$) were not significant. The results of facial mucosa curvature were statistically significant between the groups ($P = 0.005$), Group A – 1.69 (SD = 0.479) and Group B – 1.17 (SD = 0.643).

Conclusions and clinical implications: This study demonstrated that esthetics in anterior maxillary region is possible to predict. However, strict diagnostic criteria, surgical and prosthetic steps should be followed to reach better results. Prospective clinical trials are needed to compare the influence of different time of impant placement, flap design, bone/soft tissue augmentation and implant type on esthetic result and longevity.

096 | Topic – Implant Therapy Outcomes, Surgical Aspects

Three-dimensional analysis of gingival contours useful for implant positioning

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Background: Correct three-dimensional implant placement is essential for achieving optimal gingival contours. The gingival contours are usually characterized by the gingival zeniths (GZ) position and the gingival line (GL). However, the location of GZ in the three dimensions of space remains to be clearly defined.
Aim: The aim of the present study was to obtain quantitative information concerning the three-dimensional arrangement of the gingival contours in healthy young adults.
Methods: Maxillary stone casts from 93 healthy young adults whose ages ranged from 21 to 30 years were made. The coordinates of seven landmarks were recorded using a three-dimensional digitizer (MicroScribe G2, Immersion, San Jose, CA, USA): GZ of the six maxillary anterior teeth and the tip of the maxillary midline papilla. From the landmarks, two angles and one linear distance were computed:

GLA_f: angle between GL and the maxillary midline in the frontal plane,

GLA_t: angle between GL and the maxillary midline in the transverse plane,

LID: distance between GZ of lateral incisor and GL.

The data were analysed using two-way analysis of variance.
Results: The gingival contours of males and females were characterized as follows:

In the frontal plane, GL is positioned with an inclination of $82.5 \pm 4^\circ$ on the right side and $83.5 \pm 3.7^\circ$ on the left side (GLA_f).

In the transverse plane, GL is positioned with an inclination of $59.6 \pm 3.9^\circ$ on the right side and $58.5 \pm 3.8^\circ$ on the left side (GLA_t).

GZ of the lateral incisor is below GL: ($LID = 1.2 \pm 0.4$ mm).

The analysis of the data showed an asymmetry and no gender difference.
Conclusions and clinical implications: This investigation showed that the gingival zenith of the canine is apical to the gingival zenith of the incisors in the frontal plane ($GLA_f \approx 83^\circ$) and the gingival zenith of the canine is posterior to the gingival zenith of the incisors in the transverse plane ($GLA_t \approx 59^\circ$). The gingival zenith of the lateral incisor is below the gingival line (1.2 mm).

This three-dimensional analysis of gingival contours revealed quantitative parameters that can be clinically applied to reestablish the proper gingival architecture around dental implant and used as reference point during treatment planning and implant positioning.

097 | Topic – Implant Therapy Outcomes, Surgical Aspects

Esthetic outcome of single-tooth implants following immediate, early and delayed implant placement with and without bone augmentation

Presenter: Hof M
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Background: The rehabilitation of single-tooth gaps in the anterior of the maxilla with implant-supported crowns is a challenging therapy for the surgeon and the prosthodontist. As implant survival and success rates are in the upper range, the esthetic outcome has become the main focus of interest in the anterior of the maxilla.
Aim: The aim of this study was to evaluate peri-implant soft tissue esthetics around single-tooth implants after immediate, early and delayed implant placement with and without bone augmentation procedures with the pink esthetic score (PES) (Fürhauser et al. 2005).
Methods: One hundred and eleven patients with a total of 153 single-tooth implants in the anterior zone of the maxilla up to 8 years after implant placement were included in this retrospective study. Patient-related factors such as age and sex, pocket depths, nicotine use, implant position and site of measurement were recorded.

Immediate implant placement was performed in 21 patients, early implant placement in 21 patients and delayed implant placement in 10 patients. Fifty-nine patients required bone augmentation before implant placement in the esthetic zone.

Orthoradial intraoral images were taken of the soft tissue around single-tooth implants and the contralateral tooth as reference tooth to evaluate the PES.

Statistical analysis was performed with a mixed model with data given as least-square means and standard errors of the mean.
Results: The PES reveals a mean overall of 10.79 ($\pm$ 2.17 SD), varied from 4 to 14.

The PES of immediately placed implants after tooth extraction reached the highest esthetic outcome with a mean of 11.23 ($\pm$ 2.14 SD) comparing to early (9.55 $\pm$ 2.41 SD), delayed (10.47 $\pm$ 2.45 SD) and implant placement following bone augmentation procedures (11.16 $\pm$ 1.88 SD).

The difference between immediate and early implant placement was statistically significant ($P = 0.0117$), as well as the comparison

between implant placement after bone augmentation procedures and early implantation ($P = 0.002$).

Conclusions and clinical implications: The esthetic outcome of peri-implant soft tissue after immediate implant placement is comparable with the soft tissue outcome of single-tooth implants after bone augmentation procedures.

Reliable esthetic results can be achieved in the anterior maxilla for single-tooth implants with different treatment protocols. Even after long-term of implant placement stable and esthetic satisfying peri-implant soft tissue was achieved.

098 | Topic – Implant Therapy Outcomes, Surgical Aspects

Evaluation of the facial bone wall thickness in anterior maxillary teeth using digital volume tomography

Presenter: Braut V

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Background: Facial bone wall plays an important role as decision criteria for an appropriate treatment selection in patients with post-extraction implant placement.

Aim: The purpose of this radiographic study was to analyze the thickness of the facial bone wall in anterior maxillary teeth using digital volume tomography (DVT).

Methods: The present study included DVT scans (Accuitomo, Morita, Kyoto, Japan) from patients treated with dental implants at the Department of Oral Surgery and Stomatology, University of Bern, between January and December 2009. A total of 125 DVT scans met the inclusion criteria and were analyzed with the according image processing software (Idixel, Morita, Kyoto, Japan). The thickness of the facial bone wall in the respective scans was measured at two points: at the middle of the root (measuring point 1, MP1) and 4 mm apical to the CEJ (measuring point 2, MP2). All measurements were performed in the sagittal plane, perpendicular to the long axis of the root.

Results: The respective analysis provided a sample size of 528 teeth. No existing bone wall was found in 50 teeth at MP1 (9.47%) and in 128 teeth at MP2 (24.24%). Mean values of the facial bone wall thickness atMP1 were 0.66 mm for premolars, 0.61 mm for canines, 0.54 mm for lateral incisors and 0.59 mm for central incisors, while at MP2 they were 0.74, 0.55, 0.54 and 0.48 mm, respectively. The majority of the examined teeth showed facial bone wall thickness < 1 mm (77.57% at MP1, 59.28% at MP2), but the highest percentage was observed for canines at MP1 (72.34%) and for lateral incisors at MP2 (62.18%). Bone wall ≥ 1 mm was found in only 9.28% of examined teeth at MP1 and 10.80% at MP2.

Conclusions and clinical implications: According to the findings in the present study, the thickness of the facial bone wall at natural teeth in the anterior maxilla is seldom greater than 1 mm, roughly in 10% of the patients. The evaluation of the facial bone wall thickness is clinically important and affects the planning of implant surgery in post-extraction sites.

099 | Topic – Implant Therapy Outcomes, Surgical Aspects

Two-year clinical outcome of immediately and conventionally loaded dental implants

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Background: Studies on dental implantology have been focused on immediate and early loading procedures in recent years. However, limited clinical studies exist on osseointegration of immediately vs. conventionally loaded implants.

Aim: To investigate the clinical outcome of immediate and conventional loading in dental implants having two different surface features, clinically and radiographically.

Methods: A total of 106 implants were consecutively placed in 18 patients (8 male, 10 female; age range: 41–64 years, mean age: 51 ± 1.4) over a 2-year period. Each patient received a minimum two implants (Straumann, Switzerland) with different surface characteristics (SLA-sandblasted and acid etched [S] [$n = 51$] and SLActive [SL] [$n = 54$]) either with bone augmentation or not. The distribution and number of implants placed were maxilla (52), mandible (54), anterior (40), and posterior (66). All implants were inserted with a torque of maximum 56 N cm and primary stability was assessed by resonance frequency analysis (RFA (ISQ); Osstell Mentor, Sweden). Implants having over 65 ISQ were loaded immediately within 48 h after surgery with provisional splinted fixed dental prostheses while implants assigned lower than this value were conventionally loaded. RFA related with bone type (Types 2, 3 and 4) was made during implant insertion and before final prosthetic rehabilitation in immediate loading group and RFA measurements at surgery (To), and at weeks 2(T1), 4(T2), 6(T3), 8(T4) and 3rd month (T5) were made in conventional loading group. Final prosthetic rehabilitation after 3–6 months was performed in conventional loading group. Statistical anaylses were made (ANOVA, Bonferroni, *t*-test, SPSS 16.0, USA).

Results: One implant failed associated with occlusal trauma. Implant surface characteristics did not have a significant effect on mean RFA values (ISQ $\pm$ SD) for all groups ($P > 0.05$). In conventional loading group, differences in RFA between all time periods (To: 59.65 ± 12.8; T1: 61.65 ± 12.08; T2: 66.82 ± 9.5; T3: 71 ± 6.7; T4: 73 ± 5.7; T5: 75 ± 4.9) were significant

($P < 0.05$). For immediate loading group, differences in RFA between baseline (To: 72.76 ± 11.6) and 3rd month (T5: 79.13 ± 11.7) were significant ($P < 0.05$). In terms of bone quality, conventionally loaded implants with SL surface had significantly higher mean RFA values (72.37 ± 6.7) than immediately loaded SL surface mean RFA values (67 ± 7.4) ($P < 0.05$) for Type 2 bone. Type 4 bone revealed a higher success rate with conventionally loaded SL implants at 3rd month (78 ± 9.3) than baseline (41 ± 9.7).

Conclusions and clinical implications: Both immediate and conventional loadings were clinically successful at the end of loading periods. Hydrophilic implant surface characteristics added to the success of loading in cases with poor bone quality. Immediate functional loading may be used successfully, when the primary stability is high and initial loading is minimized.

100 | Topic – Implant Therapy Outcomes, Surgical Aspects

A two-stage mandibular ridge split technique with new bone expanders

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Background: Narrow edentulous alveolar mandibular ridges < 5 mm in anterior mandible and < 6 mm in posterior mandible require horizontal augmentation for the placement of screw-type dental implants. A two-stage mandibular ridge splitting using round conical-shaped expanders is presented. The clinical goal is to decrease the risk of malfracture during osteotomy and minimize the possibility of loosing crestal bone.

Aim: In mandible, greenstick fracture during widening with osteotomes or expanders has not been controllable to date because of cortical thickness and strength of the bone; the risk of malfracture in the middle of the buccal most thin region is high with very high the possibility of future bone reseeding. With this two-stage mandibular ridge split (TSMRS) technique, the location of the greenstick fracture is predetermined away from the micfacial crestal area, and the perfusion of the buccal segment remains attached and intact. The buccal cortical segment remains a pedicled graft after ridge splitting and thus no bone loss crestally is the practical benefit.

Methods: Fifteen patients with short span of one missing tooth and long span of all the back teeth of the mandibular ridge were included in this study. After corticotomy of a rectangular buccal segment with thin separating disc and 3 weeks healing period, the mandibular ridge was expanded with round expanders with conical shape and in some advanced cases split buccally, leaving the periosteum attached to the lateralized segment. Twenty-nine dental implants were placed.

Results: All buccal segments expanded with no complications and all the fractured at the basal cortitomy as planned, gaining on average 2.7 mm of horizontal bone width. The initial ridge width varied between 2.8 and 4.8 mm with an average of 3.2 mm. The final width of the ridge varied between 4.5 and 6.9 mm with an average of 5.7 mm. The mean follow-up after the start of prosthetic loading was 25.4 months. Inserted implants varied from 3.5 to 5 mm diameter and from 8 to 11.5 mm length. After 4 months, all implants were stable and new trabeculae bone developed in all the empty areas. Loading with fixed partial dentures or crowns was successful in all cases.

Conclusions and clinical implications: The preliminary results of this clinical investigation indicate that this technique appeared to be reliable and simple, with reduction of morbidity and times of dental rehabilitation as compared with other techniques such as autogenous bone grafts and guided bone regeneration. Survival and success rates of implants placed in the treated areas are consistent with those placed in pristine areas.

101 | Topic – Implant Therapy Outcomes, Surgical Aspects

Mucosa and bone thickness in virtual implant planning: clinical implications

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Background: Healthy, well-structured mucosa may clinically disguise atrophic jawbone in pre-implant diagnosis. The use of sophisticated implant planning software gives maximum information on the complex maxillary anatomy and the bone volume. Little data are available in literature on relative bone width and mucosa thickness of the edentulous maxilla.

Aim: To analyze bone width and mucosa thickness in relation to the complete ridge thickness in different areas of the edentulous maxilla.

Methods: Data of 30 females and 22 males ($N = 52$) with a mean age of 62 ± 9 years were analyzed using a CT-based implant planning software (NobelGuide™). The patients were edentulous for at least 1 year and asked for an implant-supported maxillary prosthesis. CT-scans were obtained and virtually analyzed in perpendicular sections of 12 maxillary positions (center of central and lateral incisors, canines, premolars and first molars). Absolute thickness of complete jaw, palatal mucosa, bone and buccal mucosa were measured at a crestal and basal level of the jaw located 3 and 8 mm vertically of the ridge top. Proportional bone width was calculated in relation to the complete ridge thickness (i.e. palatal mucosa + jaw bone + buccal mucosa). Statistical analysis included descriptive methods and group comparisons by means of non-parametric tests (ANOVA).

Results: The measurements were not significantly different between the left and right side. Mean bone width at the basal level differed significantly ($P < 0.001$) between the central incisors (6.2 ± 2.0 mm) and the first molars (9.0 ± 2.3 mm). The basal proportion of the jawbone was 49% at incisors and canines, 50–53% at premolars and 59% at first molars. Absolute

and relative bone width at the crestal level was generally lower than in the basal level ($P < 0.001$). Mean bone width at the central incisors (3.8 ± 1.5 mm, 38% of relative thickness) was significantly lower ($P < 0.001$) compared with 5.5 ± 2.1 mm at the first molars (44% relative thickness).

Conclusions and clinical implications: The data show that average bone width is insufficient for the placement of implants with standard diameter (around 4 mm) in many areas. Absolute and relative bone width is increasing in the posterior jawbone, whereas the thickness of palatal and buccal mucosa was considerably stable. The osseous volume of a large ridge might be overestimated, as the relative bone width was generally lower than 50%. Clinicians can use the results of the virtual bone and mucosa measurements to have a better first estimation of the osseous proportion depending on the maxillary area.

102 | Topic – Implant Therapy Outcomes, Surgical Aspects

Osteoporosis and clinical features of peri-implantitis

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Background: Peri-implantitis is an inflammatory disease, which causes progressive bone loss and eventual loss of the dental implant. Risk factors for peri-implantitis involve smoking, diabetes, and insufficient oral hygiene. Systemic bone loss in postmenopausal osteoporosis is associated with alveolar bone loss. However, there is no general agreement if osteoporosis can be considered a risk factor for peri-implantitis.

Aim: The aim of this study was to find out whether peri-implant destruction is influenced by systemic bone loss.

Methods: We performed a cross-sectional study among 118 women who received 544 dental implants with a mean age of 65 ± 9 years at the Department of Oral Surgery (Medical University Vienna). The patients were assigned to one of three groups according to their declarations: those with osteoporosis (29 women; 24.5%), those with osteopenia (10 women; 8.5%), and the healthy controls (79 women; 67.0%). The primary outcome was the occurrence of peri-implantitis; the secondary outcomes were the occurrence of radiographic bone loss, probing depth >6 mm, and peri-mucositis. Potential confounders such as age, recipient site, implant surface, smoking, plaque, calculus, periodontal disease, and thyroid disease were also recorded.

Results: Peri-implantitis was observed in 5.9% of women with osteoporosis, in 0.9% with osteopenia, and in 13.6% of the healthy controls. Similar findings were observed with secondary outcome parameters, e.g., radiographic bone loss (5.1%; 1.7%; 13.6%), probing depth >6 mm (6%; 0.9%; 20.7%), and peri-mucositis (12%; 3.4%; 27.4%), respectively. The statistic evaluation based on a logistic regression showed no association between systemic bone loss and peri-implantitis. Age, recipient site, and implant surface were associated with the occurrence of peri-implantitis. Yet, even after statistical control for potential confounding factors in a multivariate analysis, no significant association between systemic bone loss and peri-implantitis was found.

Conclusions and clinical implications: Given the limitations of a retrospective study, our findings suggest that postmenopausal osteoporosis is not a risk factor for oral peri-implantitis.

103 | Topic – Implant Therapy Outcomes, Surgical Aspects

Factors associated with dental implant failure: follow-up of 2336 implants

Presenter: Anner Y
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Background: An implant-supported restoration offers a predictable treatment for tooth replacement. Nevertheless, failures that mandate immediate implant removal do occur.

Aim: The aim of this study was to evaluate the factors influencing long-term dental implant survival in a periodontal practice.

Methods: This was a retrospective evaluation of all implant performed in a periodontal practice between 1996 and 2008. The study cohort consisted of all patients who arrived to the periodontal practice for dental implant placement. There were 63.1% females and 36.9% males with a mean age of 53.59 (SD = 10.93). Data were recorded from patients file and implant failures were divided into early and late failures. Statistical analysis was used to asses which were the factors associated with implant failure.

Results: A total of 2336 implants were placed in 736 patients during the data collection period. Smoking was reported by 16.3% of the patients while diabetes mellitus by 10.9%. Moderate to advanced chronic periodontitis (controlled) was found in 64.7% of the study cohort while aggressive periodontitis was diagnosed in 3.3%. HA-coated implants consisted of 47.8% of the implants. Survival rate was 95.5% over a mean follow-up period of 4.52 years (SD = 2.78). Early implant failures were observed in 1.9% while late failures were reported in 2.2% of the implantations. Overall implant failures were found to be associated with jaw (OR = 1.74 for failures the mandible; $P = 0.01$), and implant coating (OR = 1.86 for failure of HA coating = 0.003). Implant length was also a factor in implant failure risk ($P = 0.03$). A higher risk for implant failure was also detected for smoking ($P = 0.081$) and a history of periodontal disease ($P = 0.003$).

Conclusions and clinical implications: Dental implants show highly predictable survival rates. Failures, however, do occur and were found to be related to jaw, implant length and coating, smoking and history of periodontal disease. Failures were rather equally distributed between early and late ones.

One-stage vs. two-stage implant placement protocols. a randomized clinical trial

Presenter: Tallarico M

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Background: Different placement and loading implant protocols have evolved in response to an increased demand for quicker treatments and less complicated surgery. Optimal primary implant stability seems to be one of the main requirements for a successful immediate/early loading procedure. Comparable results have been published using either two- or one-stage protocols, in terms of osseointegration, peri-implant bone resorption, and implant success rates, although the number of patients included in the trials was too small to draw definitive conclusions.

Aim: To evaluate osseointegration, assessed by resonance frequency analysis (RFA), in a one-stage group (study group, SG) every 2 weeks during a healing period of 3 months; furthermore, to evaluate and compare the stability measurements of a one-stage group and a two-stage group (control group, CG).

Methods: Twenty-nine patients received 60 dental implants (Nobel Biocare, AB, Göteborg, Sweden) with an anodized surface (32 Brånemark System® MKIII Groovy and 28 NobelSpeedy™ Groovy). All patients were monitored from implant placement until prosthetic loading. Implant stability was assessed by means of Osstell® mentor (Osstell, AB, Göteborg, Sweden) at the time of implant placement and every 2 weeks up to 3 months in the SG, and at the time of implant placement, at second-stage surgery, and every 2 weeks up to a total of 4 months, in the CG. Mean follow-up was 10.8 months (range: 4–14 months).

Results: Implant stability quotient (ISQ) values increased in both groups in the 2 weeks after implant placement, slightly decreased between the 4th and the 6th week (maxilla/mandible), increased in the 6th and the 8th week (maxilla/mandible), and finally tended to stabilize between the 8th and 12th week in both groups. In the maxilla, ISQ mean values at implant placement was 73.17 in the SG and 74.32 in the CG. In the mandible, the mean ISQ was 80.79 in the SG and 77.87 in the CG. In the maxilla, after an 8-week healing period, the mean ISQ was 75.5 in the SG and 77.95 in the CG. In the mandible, the mean values were 82.21 in the SG and 80.13 in the CG.

Conclusions and clinical implications: The submerged technique is not a prerequisite for osseointegration. One-stage technique is a viable alternative to two-stage technique. The utilized implants seem to be suitable for an early loading time in both the maxilla and the mandible.

Volume gain and stability of peri-implant tissue following bone and soft tissue augmentation

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Background: Although bone and soft tissue augmentations are frequent procedures associated with implant treatment, there is limited knowledge about the long-term behavior of the augmented tissues and the resulting esthetic changes.

Aim: The aim of the present study was to evaluate the dimensional changes of peri-implant tissues obtained by implant placement, bone and soft tissue augmentation, prosthetic reconstruction and 1 year of function using a new, non-invasive method for volumetric measurements.

Methods: In 16 patients, the missing central or lateral maxillary incisor was reconstructed with an implant-supported single crown. Impressions were taken before (t1), after implant placement with GBR using DBBM and a PTFE membrane (t2), after soft tissue augmentation (t3), immediately after crown placement (t4) and 1 year later (t5). The cast models were optically scanned and digitally superimposed allowing qualitative and quantitative analysis of alterations of the labial peri-implant tissue contour. In addition, the crown length and papilla height were measured at crown placement (t4) and after 1 year (t5).

Results: Fifteen patients were available for recall after 1 year. During therapy, a mean gain in distance in labial direction of 1.27 $\pm$ 0.67 mm was observed after the surgical procedures. One year after crown insertion, a mean loss of 0.04 $\pm$ 0.31 mm in labial direction was recorded. During the same period, the crown length increased by a mean of 0.22 $\pm$ 0.57 mm and the papilla height by 0.07 $\pm$ 0.61 mm. The degree and pattern of tissue change following crown insertion was highly variable between individuals, irrespective of the amount and quality of previously augmented tissues.

Conclusions and clinical implications: The clinical procedures were effective in augmenting peri-implant tissue volume. The augmented tissue volume remained stable to a high degree within 1 year after crown insertion. Large inter-individual variations regarding the tissue alterations were observed.

106 | Topic – Implant Therapy Outcomes, Surgical Aspects

The nasopalatine canal as related to implant dentistry: an analysis of 100 consecutive patients using limited cone beam computed tomography

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Background: Because of the close anatomical relationship of the nasopalatine canal and the roots of the central maxillary incisors, a careful radiological analysis is necessary when planning to insert a dental implant in that region. Nevertheless, data about anatomical variations, dimensions and typical morphology of the nasopalatine canal are scarce in the literature.
Aim: To analyze the dimensions and anatomic characteristics of the nasopalatine canal and the corresponding buccal bone plate of the alveolar process in patients referred for prospective implant planning using limited cone beam computed tomography (CBCT) imaging.
Methods: Partially edentulous patients scheduled for CBCT imaging for further radiographic evaluation of a prospective implant recipient site in the anterior maxilla (first premolar on the right to first premolar on the left) were consecutively enrolled in this study. For all CBCT images, a limited field of view (FOV) of 4×4 cm, 6×6 cm or 8×8 cm was selected. Reformatted sagittal and coronal slices were analyzed regarding dimensions and anatomic characteristics of the nasopalatine canal as well as the dimensions of the buccal bone wall. Factors influencing these parameters were evaluated using univariate and multivariate linear regression models.
Results: The study population comprised 44 men and 56 women with a mean age of 43.09 years ($\pm$ 19.88). Gender of the included patients had a statistically significant influence on the dimensions of the buccal bone plate, the mean values being generally higher for male subjects. The age of the patients had a significant influence only on the length of the nasopalatine canal with the mean values generally decreasing with increasing age. In the multivariate linear regression model, the status of the central maxillary incisors (both present, one missing, both missing) and the time period elapsed because loss of the central incisors (< 1 year vs. > 1 year) were independently associated with buccal bone wall measurements, adjusted for age and sex.
Conclusions and clinical implications: The present study demonstrates that the status of the central incisors and the time span because tooth loss both significantly influenced the coronal width of the buccal bone wall, with decreasing values for patients with missing central incisors and a time span since tooth loss over 1 year. The limited CBCT scans with FOVs varying between 4×4 and 8×8 cm are a valid diagnostic alternative for cross-sectional imaging.

107 | Topic – Implant Therapy Outcomes, Surgical Aspects

The influence of the place depth of Ankylos® implants on the marginal bone remodeling in the posterior mandible

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Background: Platform switching was believed to be an effective design to preserve the marginal bone of implant. However, vertical bone loss was still observed in some cases, and the Ankylos® implant was recommended to be placed below the level of the alveolar crest during operation, few clinical researches were presented.
Aim: The purpose of this research was to evaluate the influence of the place depth of Ankylos® implants on the marginal bone remodeling.
Methods: Two hundred and twenty-two mesial and distal sites of 111 Ankylos® implants in the posterior mandible of 46 patients were divided into two groups: Group A for the sites whose place depth was below the level of the marginal bone (LMB) during operation and Group B for the ones placed at or above the LMB. The heights of marginal bone on the immediate postoperative (i.e., place depth) and the over-3-year follow-up panoramic radiograph of each site were measured as the baseline and ending point, respectively, by an electronic slide gauge. The length of implant on each radiograph was also measured for elimination of the imaging magnification. The place depths of two groups were analyzed by the software of SPSS 16.0 for Windows.
Results: Totally 161 sites of Group A and 61 sites of Group B were measured in 111 implants. One hundred and nine sites (67.7%) of Group A and 12 sites (19.7%) of Group B had their LMBs stabilized at or above the implant platform, and the other sites of two groups had their marginal bone absorbed below the implant–abutment interface as the literatures reported previously. The difference between two groups was highly significant ($P < 0.001$).
Conclusions and clinical implications: Based on a radiographic observation of Ankylos® implants in the posterior mandible over 3 years, place depth had some effect on the marginal bone remodeling: placing the implant below, as compared with at or above the alveolar crest level, might provide enough space for the biologic width formation thus would have more chance to keep the level of the marginal bone stabilized at or above the implant platform.

108 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival probability of implants using NobelGuide™ for navigated placement

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Background: A substantial reason for the development of modern treatment concepts and systems is the request of the patient

for dental prostheses which aesthetically and functionally correspond to natural dentures. One of these modern concepts is represented by the computer-guided and template-based implantation system. It assures a high rate of success with minimal-invasive and safe surgical intervention.

Aim: It was the objective of this retrospectively executed pilot study to evaluate the computer-guided, template-based navigation system NobelGuide™ (Nobel Biocare, Sweden, Gothenburg) on the basis of implant failure.

Methods: Eighty-one people have been examined retrospectively. Overall 377 implants have been placed between 2004 and 2008. Two hundred and eighty have been placed in the maxilla and 97 in the mandible by using implant types of Nobel Replace Tapered Groovy and Mk III Groovy.

Results: The implants have been inserted by applying the NobelGuide™ System. Within the observation period, 25 implants were lost for a total of 10%. According to Kaplan–Meier, the survival probability was 97% (95% CI, 94, 9%–98, 7%) after 6 months and 93% (95% CI, 90, 3%–96, 2%) after 12 months. After 24, respectively, 36 months the survival probability was 90% (95% CI, 86, 6%–94, 2%). The Cox proportional hazard model yielded an estimated relative risk of 0.101 for the influencing factor of maxilla/mandible (95% CI: 0, 01–1.003). This indicates that the risk of loss in the mandible decreases to 10.1% compared with the maxilla. Furthermore the estimated relative risk for the influencing factor of age was 0.929 (95% CI: 0.878–0.983), which shows that for every additional year of the patient the risk of failure decreases. These risk ratios are significant ($P = 0.051$, $P = 0.011$).

Conclusions and clinical implications: The results of this study show that the NobelGuide™ system is – in relation to the success rate – an equivalent method to conventional implantation and to other systems, respectively.

109 | Topic – Implant Therapy Outcomes, Surgical Aspects

Use of the Straumann bone-level implant in the aesthetic zone: preliminary outcomes of an 18 months prospective study

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Background: To date, little information regarding the clinical performance of the Straumann bone-level implant is available in the literature.

Aim: This article reports preliminary results of a prospective study to evaluate the clinical performance and patient satisfaction of the Straumann bone-level implant in the anterior maxilla.

Methods: For this study, 60 consecutive patients (mean age 36.5 years, range 18–70) with a single missing tooth in the maxillary aesthetic zone were included. Each patient received an implant (Straumann bone-level implant). After a 3-month load-free integration period, second-stage surgery was performed and the implants were restored with a laboratory made provisional crown. Three months later the provisionals were replaced with definitive full ceramic crowns. Pre-operatively, 2 weeks, 7 months and 18 months after implant placement, clinical data were collected and standardized X-rays and photographs were taken. Patient satisfaction was evaluated using a self-administered questionnaire.

Results: During follow-up, no implant failed to integrate, resulting in an implant survival rate of 100% ($n = 60$, follow-up 10–18 months). After 18 months, a mean marginal bone resorption of 0.16 ± 0.26 mm was found ($n = 43$). Patients rated their overall satisfaction with a mean score of 9.2 on a VAS-scale ranging from 0 to 10.

Conclusions and clinical implications: From the preliminary data of this study, it was concluded that the Straumann bone-level implant is a reliable treatment system with low marginal bone loss and high patient satisfaction.

110 | Topic – Implant Therapy Outcomes, Surgical Aspects

A retrospective study on short 3i® machined and Osseotite® implants

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Background: The use of short implants ($\leq$ 8.5 mm) was associated with lower survival rates, and machined-surface short implants seemed to fare worse than those with textured surfaces, but recent clinical studies indicate that short implants survive as well as longer implants and can support most prosthetic restorations.

Aim: We report on the placement of short (7 and 8.5 mm long) 3i® machined surface and Osseotite® implants.

Methods: This retrospective clinical study involved 52 patients consecutively treated with 139 short 3i® implants supporting 63 prostheses (61 fixed and 2 removable); 73 implants were 7 mm long, and 66 were 8.5 mm long (in all, 90 implants were 3.75 and 49 were 4 mm in diameter).

Results: The mean time from stage-one surgery to latest follow-up was 8.66 years (range 4.5–16.33 years). Five implants were in the maxilla (four of them in the posterior part), 134 in the mandible (130 of them in the posterior part). The implant survival rates were as follows: 98% (for both 7 and 8.5 mm implants, and cumulatively), 99% (machined surface), 98% (Osseotite surface), 98.5% (7 mm long, machined), 100% (maxilla) and 98.5% (mandible). The marginal bone loss (MBL) was 1.45 mm (SD = 0.52) and was similar for all categories.

The mean anatomical crown/implant ratio was 1.47, and the clinical ratio was 2.08 (at follow-up). There were no statistically significant correlations between MBL and surface, length, diameter or type of implant (Wilcoxon–Mann–Whitney test), while a statistically significant correlation emerged between MBL and the anatomical crown/implant ratio (Kruskal–Wallis test, $P < 0.0001$).

Conclusions and clinical implications: The cumulative survival rates of implants 7 and 8.5 mm long with machined or textured surfaces indicate that such short 3i® machined and Osseotite® implants are a viable option.

111 | Topic – Implant Therapy Outcomes, Surgical Aspects

Inferior alveolar nerve damage after implant placement and prognosis according to canal damage, removal and reinsertion time

Presenter: Kim SW
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Background: The inferior nerve damage after implant installation is quite rare but once it is happened, the discomfort is disastrous. To predict the prognosis after nerve injury is important, however, a little is known about the prognostic factors in implant associated numbness.

Aim: The purpose of this study was to analyze the degree of numbness and inferior nerve damage after implant misplacement. The correlation between recovery and removal time and alveolar canal damage were evaluated.

Methods: From 2000 to 2009, 24 patients (M : F = 9 : 15) were referred from local clinic for evaluation of inferior nerve damage after implant installation. Dental CT scans were taken in all patients and degrees of damage in inferior alveolar canal were examined. Degree of alveolar canal damage was classified into three group (Group 1: no damage, Group 2: superior cortex damage, Group 3: total canal damage). Physical examination such as two-point discrimination, the area of numbness and visual analogue scale for recovery were reported every 3 months. The removal time of affected implants and reinsertion time interval were investigated and the correlation between functional recovery and removal time was examined. All patients were instructed to take gabapentin 300 mg twice a day for 2–6 months. Patients were classified into three group; complete recovery, partial recovery and no change and recovery.

Results: Implants had been already removed at the time of referral in 19 patients (79.1%) within 7 days after operation and short implant has been installed immediate after removal of implant in 14 patients (58.3%). Five patients were referred after immediate removal and no further treatment (20.8%). Another five patients were referred with affected implants *in situ* (20.8%). Five misplaced implants were removed at the first day of referral; however, the removal time was between 6 and 1.5 years (average 8.5 months). Two patients showed complete destruction of cortical bone; those nerve function was not recovered at all through the observation periods. Twenty patients showed superior cortex damage at CT scan. Two patients having affected implants showed close lateral contact of implant with canal. Only two patients (8.3%) showed complete recovery of nerve function with early removal and no further treatment. Partial recovery was observed in 15 patients (62.5%). Seven patients reported no change after the implant misplacement.

Conclusions and clinical implications: Early removal of implant that cause the alveolar nerve damage and degree of alveolar canal damage is correlated with functional recovery. However, only 8% of complete nerve recovery was observed in 24 patients. To prevent the nerve damage is most important using CT scan and guided surgery.

112 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediately provisionalized post-extractive implants in a population with risk factors

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Background: Few studies reporting on the effect of systemic conditions on post-extraction implant survival have been published. Therefore, evidence for systemic factors as risk for implant survival is still lacking.

Aim: The aim of this multicentric prospective study is in assessing the survival rate and the role of risk factors after immediate restoration of single post-extractive implants.

Methods: Entry criteria included the extraction of a single tooth excluding molar teeth and untreated periodontitis. Cases with putative risk factors were not excluded. The implants were inserted immediately after tooth extraction without elevation of surgical flaps. Cone-shaped implants with nano-surface (Nano-Tite Certain Tapered Implants Biomet 3i Inc, Palm Beach, FL, USA) were selected to increase primary stability and wound healing speed. Provisionalization was carried out within 48 h after surgery. Final restoration was scheduled in 3 months after implant placement.

Results: Data on 240 implants in 240 patients (aged 17–84) were gathered at 16 centres by February 2010. Risk factors were identified in 178 cases (74.17%) with putative risk factors including the following: habitual smoker, bruxism and other parafunctions, diabetes, suppuration, treated periodontitis, ''U''-shaped bone dehiscences, previous assumption of biphosphonates, anticoagulants, calcium antagonists, antibiotics and/or steroids in the preoperative week, inability to assume preoperative amoxicillin. Early minor complications were recorded in 24 cases in the first post-operative week. Implants were lost before final prosthesis in 24 of the 240 cases (failure rate 10%). The failure rate in the group without risk factors was < 4%. The definitive prosthesis was delivered to 171 patients: the remaining surviving implants still support a temporary crown. Late minor complications were recorded in 18 cases. Neither recession nor failures were observed after the definitive prosthesis

(follow-up 4–27 months). Patients' satisfaction for the definitive restoration rated 9.5 on the average (range 7–10), in a scale 0–10, most cases rating 10. Failures and complications appeared to be associated with thin periodontium and lack of antibiotic prophylaxis.

Conclusions and clinical implications: Immediate provisionalization with non-functional loading is a safe option for post-extractive implants in the short run even in cases with risk factors.

113 | Topic – Implant Therapy Outcomes, Surgical Aspects

Evaluation of anodized- vs. machined-surfaced implants 110 months in function

Presenter: Arnhart C
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Background: The edentulous mandible rehabilitated by four interforaminal screw-type implants is frequently used for implant outcome evaluation. Patients treated with machined–surfaced (MS) implants related to bar-supported overdentures show excellent long-term results with reference to peri-implant bone loss, pocket probing depth and bleeding on probing.

Aim: The purpose of this retrospective study was to compare peri-implant bone loss and clinical conditions around MS and anodized-surfaced (AS) implants in the edentulous mandible after mean functional loading for 110 months.

Methods: The local ethics committee of the Medical University Vienna approved the retrospective, clinical study design (EK 410/2009). Overall 114 patients, each treated with four interforaminal screw-type implants in the mandible, with a total number of 456 implants placed between 2000 and 2002 were included. Fifty patients were available for follow-up (43.86%). Rotational panoramic radiographs were used for evaluating marginal bone loss. Additionally marginal plaque index (mPI), bleeding on probing (BOP) and pocket probing depth (PPD) were evaluated. Analysis of covariance for repeated measurements was used for statistical analysis. Between group differences were expressed as least square means $\pm$ standard error.

Results: Preliminary data: There was no significance regarding peri-implant bone loss around AS implants (2.23 ± 0.29 mm) vs. MS implants (2.27 ± 0.32 mm). Overall, mesial implants show more peri-implant bone loss than distal implants (2.41 ± 0.26 mm vs. 2.09 ± 0.26 mm, $P = 0.011$). There was no difference regarding BOP, PPD and mPI between MS and AS implants.

Conclusions and clinical implications: Overall, preliminary data demonstrate nearly the same small amount of peri-implant bone loss for MS and AS implants. We cannot confirm a correlation between surface roughness and clinical signs of inflammation or peri-implant bone loss. The preliminary data verify the excellent outcome of lower jaw rehabilitation by four interforaminal implants and bar-supported overdentures for AS implants functionally loaded for 110 months.

114 | Topic – Implant Therapy Outcomes, Surgical Aspects

Radiological bone density and primary implant stability. Clinical study based on cone-beam CT, micro-CT and RFA

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Background: Primary implant stability (PIS) plays a major role in the success of implant osseointegration. Meredith et al. described a non-invasive method by means of which bone formation around the implant could be measured by the implant stability quotient (ISQ) with the resonance frequency analysis (RFA). Cone-beam CT (CBCT) offers some advantages in comparison to conventional CT: (1) higher spatial resolution, (2) less time consuming, (3) minor radiation dosage and (4) lower cost. Otherwise, micro-CT is a non-invasive technique that allows the acquisition of 2D and 3D images from bone biopsies with a high resolution (< 1.6 μm) and to calculate structural parameters such as bone volume (BV), total volume (TV), density of bone (BV/TV), degree of anisotropy (DA), structural model index (SMI) and others.

Aim: To demonstrate that radiological bone density (RBD) measured by CBCT in the implant site can be a predictor for histomorphometric bone density (HBD) measured by micro-CT and also a predictor for PIS measured by RFA.

Methods: Forty-five endosseous dental implants (3.75×13 mm) were inserted in 35 partially or totally edentulous healthy patients. The working process was (1) acquisition of CBCT images with i-CAT® Model 17–19 (Imaging Sciences International LLC, Hatfield, PA, USA) from the jaw bones of the patients; (2) pre-operative planning of the implant insertion by an specific software using CBCT images, and measurement of mean RBD along the axis of the implant (NTC units); (3) fabrication of a stereolitographic surgical guide to translate the exact position of the implant in the surgery; (4) obtaining a cylindrical bone biopsy with a Φ2.5 mm trephine through the exact hole of the analyzed implant; (5) placement of the implant and measurement of ISQ value by the Ostell™ Mentor; (6) acquisition of structural values by micro-TC (BV/TV) of the biopsy specimen; (7) statistical analysis (SPSS 15.0 software): Pearson's correlation.

Results: A significant positive correlation between RBD by CBCT (NTC units) and HBD by micro-TC (BV/TV) was observed. Also, a positive correlation between RBD and RFA measured by Ostell™ Mentor (ISQ) was noted.

Conclusions and clinical implications: By means of the CBCT, clinicians are able to determine the maxillary and mandibular areas with the highest radiological bone density, corresponding with areas with the highest bone volume proportion and

associated high ISQ values. It may help clinicians to predict primary stability before implant insertion, which is associated with higher implant survival rates.

115 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival and risks of immediate placed anterior implants

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Background: When an anterior tooth requires extraction, patients want as soon as possible a replacement. Immediate placement and/or immediate loading can be helpful. However, this can give rise for implant failure a.o. due to premature loading.

Aim: The aim was to evaluate the clinical outcome of implants, placed immediately and/or loaded immediate for anterior tooth replacement.

Methods: The life tables (Kaplan–Meijer) of 774 Camlog® implants were analyzed, distributed over four groups: Groups I and II had 141 immediately placed implants in fresh anterior alveolar extraction sites. These were compared with 633 implants, delayed placed, in normal healed (or partially healed) bony sites (Groups III and IV). Parameters as smoking habits, bone quality, whether or not immediate placed and/or loaded were recorded during implant surgery. During annual recalls, parameters were collected as implant presence, implant mobility, quality of the peri-implant tissues (1 = healthy, 2 = bleeding on angular probing 3 = inflammation, pockets till 7 mm, radiological bone loss between 3 and 5 mm). Implants removed before loading or implants showing deeper pockets (>7 mm), more peri-implant bone loss, apical infections or mobility were considered as failures.

Results: The cumulative survival rate (CSR) was calculated using these criteria. An average CSR of 96.7% was found over >5 years). Group I, 91 implants, placed immediately after extraction and immediate functionally loaded (immediate function), showed a CSR of 97.8%. Group II, 50 implants, also immediately placed, but delayed loaded, showed a CSR of 96.0%. Group III, 18 implants, placed in normal (fully healed) bony sites were direct loaded and had a 100% survival. Group IV, 615 implants, placed in healed or partially healed bony sites, delayed loaded, showed a CSR of 96.6%. Smoking habits had a significant effect on premature implant failure, with a nearly four times more implant loss, irrespective of the type of loading or placement. Besides smoking, problematic bone situations, remaining endodontic material or root fragments (ankylotic teeth) were also associated with early failures and poor postoperative healing. About half of the failures occurred late (48%) and were associated with endodontic infections from neighboring teeth (1.1%) or inadequate removal of (subgingival) crown cement (0.5%).

Conclusions and clinical implications: Immediate placement was not found to be a risk factor and also immediate loading was not, if the implant had sufficient initial stability (>30 N cm). Risk factors as smoking, endodontic materials, endodontic infections from neighboring teeth and cement excess were important risk factors. It is recommended to be reserved placing immediate anterior implants in smoking patients and placing implants beside questionable natural teeth.

116 | Topic – Implant Therapy Outcomes, Surgical Aspects

Effect of attached mucosa width on marginal bone resorption around platform-switched implants

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Background: The need for keratinized tissue around dental implants is a controversial topic for implant dentistry. Some researchers have reported that attached mucosa around implants are beneficial for making plaque control more effective, facilitating impression taking by the restorative dentist and preventing further recession. Controversially some of researches have showed that there is no relation between marginal bone loss and keratinized tissue width.

Aim: The aim of this study is to evaluate the effect of attached gingiva width on marginal bone resorption around platform switched implants.

Methods: Eighteen patients (14 female and 4 male) were enrolled to study. The patients' age range were between 23 and 65 years (mean age: 44.1 years). Forty-four dental implants (Astra Tech, Mölndal, Sweeden) were placed for rehabilitation of partial edentulism. Osteotomy was performed according to the manufacturer's written surgical protocol. All of the implants were left non-submerged healing. The ratios of implants placed to upper and lower jaw 51.2% and 48, 8%, respectively. In 44 dental implants, the numbers of implants with attached gingiva under 5 mm was 27 (62.8%) and above 5 mm was 16 (37.2%). The biotype of gingiva was thick in 32.6% of implants and was classified as thin in 67.4% of implants. All implants were left to heal for 2 months in the mandible and 4 months in the maxilla. All patients were screened with periapical radiography that was taken with parallel technique at the surgery day and 12 mounts after stage of loading. Marginal bone loss in mesial and distal site of dental implants were evaluated with (Schick Technologies CDR, NY, USA).

Results: Mann–Whitney U test was used for statistical analysis. There were no statistical difference between attached gingiva width, gingival biotype and marginal bone loss ($P > 0.05$).

Conclusions and clinical implications: Within the limitation of this pilot study, there is no correlation between marginal bone loss and attached gingiva width in platform-switched implants.

117 | Topic – Implant Therapy Outcomes, Surgical Aspects

Analysis of implant failure due to a high risk factor of peri-implantitis

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Background: In last 15 years of practice and scientific research in implantology, the philosophy of implant treatment has been changed, considering the fact of hard and soft tissue management, and manufacturing of new implants and prosthetic components materials.

(Implant – Bone) + (Abutment – S. Tissue) + (Presergical Planing) = Result.

Aim: Analyzing types and specifications of different implant systems in our clinical practice, and considering our experience in new regeneration methods and materials – we have faced the fact, that there are three groups of factors that decreas the implant failure due to a high risk factor of peri-implantitis. The analysis and structurization of these factors were the aim of our study.

Methods: We recruited 100 (male and female) patients, aged 21–65, with or without hard and soft tissue augmentation, patiants with single-tooth restoration were excludede. Smokers and non-smokers, radiologic and clinical exams, depth probing, OPG and RVG measurement by OssTell® in last 5 years. Male smokers and non-smokers were divided 25–25, and female smokers and non-smokers were divided 15–35. All had examination two times a year. Successful (non-smokers only) patients recieved only hygiene and specifical treatment, survivor non-smokers recieved several methods of treatment like HELBO-laser application, flap-surgery and augmentation procedures with different materials (bio-oss + bio-gide, titanium granules, etc. survivor (B) smokers – recieved only flap-surgery and HALBO-laser application with hygiene recomendations without augmentation failure – group – three patients recieved new implants after extraction, four patients dropped from experimental study.

Results: Non-smokers patients had successful (group) result in 58 cases, and two more became in the survivor (group) result in the last year, and required different procedures to obtain the successful group – (as HELBO-laser application, flap-surgery, augmentation procedures and soft tissue managment). Male and female smokers had clinical signs of mucositis or peri-implantitis in approximately 80% of cases, and were grouped as a delayed failure cases, required only flap-surgery and high motivation in hygiene (personal and professional). Three patients required implant replacement, or a new prosthetic constructions, and four patients dropped from experimental program.

Conclusions and clinical implications: Peri-implantitis in different clinical situations is one of the most common problems in a long-term period. Understanding the risk factors and the practical asspects of handling different cases could be useful for clinitions; our clinical experience shows that results may vary not only from one patient to another, but even from different operation sites of one patient.

118 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediate dental implants in infected sockets. Microbiological aspects, marginal bone level and implant stability

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Background: Immediate dental implants placement in previous infected sockets remains to be a controversial topic in implant dentistry.

Aim: To evaluate the outcomes of immediate dental implants placement in infected sockets regarding marginal bone level and implant stability and to evaluate a cleaning procedure in order to eliminate the microorganism present in these situations.

Methods: Thirty patients with teeth with chronic infections requiring extraction were selected and received 30 dental implants. All cases were single-root teeth in the maxilla. The microbiological aspects and the cleaning procedure were evaluated taking a sequence of samples for cultures as follows: (1) sample from the crevicular fluid, (2) sample from the socket after tooth extraction, (3) sample after debridement using manual curettes and (4) sample after applying citric acid 2% for 1 min. After that, implants were placed and baseline periotest stability values and X-ray marginal bone level were addressed. At 4 months, before starting the prosthetic part, new periotest values and marginal bone level were recorded.

Results: The most common microorganism found was Streptococcus groups C, H (S. sanguis) and K (S. salivarius), Staphylococcus aureus, Bacteroides forsythus and Fusobacterium nucleatum. Candida albicans was also found in some samples. Most effective antimicrobials were ciprofloxacin, amoxicillin plus clavulanic acid and metronidazole. Fluconazole was the more effective antifungal medication. Manual debridement was not able to produce an adequate cleaning of the socket. However, this cleaning was improved after applying citric acid 2% as it was shown in the cultures. There were not failures during the evaluation period. Mean periotest values were -3.16 (0.74) at baseline and -3.73 (0.64) at 4 months ($P = < 0.001$ signed rank test). Marginal bone level was considered 0 at baseline, in order to evaluate the changes later. Mean marginal bone level at 4 months was -0.20 mm ($\pm$ 0.10) ($P = < 0.001$ paired t-test).

Conclusions and clinical implications: Within the limitations of the present study, immediate implant placement in infected sockets could be considered a predictable procedure. Regarding this, we need to point out that manual debridement alone was not enough to perform an adequate cleaning, thus additional procedures should be used. In this study, citric acid 2% showed interesting results regarding microbiological control. Finally, as a recommendation, in these cases a sample for culture and antibiogram should be taken in order to select the most appropriate and effective systemic medication to be used.

Early loading at 3 and 6 weeks of titanium implants with conventional and chemically modified sandblasted and acid-etched surfaces

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Background: One of the main reasons for the wide success of implant therapy observed in daily clinical practice has been caused by the simplification of implant therapy, especially for standard cases, mainly due to shortened healing periods using implants with micro-rough surfaces. Clinical trials using implants with sandblasted and acid-etched (SLA) surfaces showed that healing periods were significantly shorter than conventional healing periods of 3–6 months, which had been the standard in clinical practice for almost three decades.

Aim: The present study compares two cohorts with dental implants loaded after 3 and 6 weeks after placement. The tested hypothesis was that both early loading concepts would achieve a success rate as well as clinical and radiographic peri-implant parameters similar to each other.

Methods: A total of 56 implants with a chemically modified sand-blasted and acid-etched surface (modified SLA) were inserted in the posterior mandibles of 40 partially edentulous patients, and underwent undisturbed healing for 3 weeks. Clinical measurements regarding soft tissue parameters and radiographs were obtained at different time points up to 36 months after implant placement. The soft tissue and radiographic parameters for the modified SLA implants after 3 years in function were compared with a control group of implants with a conventional, non-modified SLA surface using an early loading protocol after 6 weeks and comprising 87 implants inserted in the posterior mandible.

Results: During the early healing phase, one implant in the conventional SLA group failed to integrate. None of the modified SLA implants was lost. However, two implants were considered ''spinners'' at day 21, and left unloaded for an extended period. Therefore, 96.4% of the inserted implants were loaded according to the protocol tested. All 56 modified SLA implants including the ''spinners'' showed favorable clinical and radiographic findings at the 3-year follow-up examination. Dental implants with a modified SLA surface demonstrated statistically significant differences for probing depths (PD) and clinical attachment level (AL) values compared with the SLA group, with the modified SLA surface implants having overall lower PD and AL scores.

Conclusions and clinical implications: This prospective study comparing two early loading protocols demonstrated that titanium implants with a regular and modified SLA surface can both achieve and maintain successful tissue integration over a period of 3 years.

Immediate loading with a new concept of maxillary sinus elevation: S-reamer® osteotome technique

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Background: The malleting osteotome technique for maxillary sinus graft still comes with the magnitude of forces and the amount of heat. Once in a while, this malleting osteotome technique arises several post-operative complications such as discomfort and inner auditory organ damage. Also the possibility of damage on the sinus membrane with excessive fracture of sinus floor still remains. This report introduced a new maxillary sinus floor elevation technique in which only the inferior cortical wall underneath the sinus would be perforated without tearing of maxillary sinus membrane by drilling instead of malleting using a rotary instrument, called S-reamer® (Neobiotec Co., Korea).

Aim: The objective of this presentation is to show our scientific and clinical experience related to implant supported fixed restorations for the partially and fully edentulous jaws including a situation after sinus graft with S-reamer osteotome technique, and to assess the survival outcome of immediate loading protocols according to their treatment sequence and selected prosthodontic design.

Methods: S-reamer used in this report was designed to remove the bone beneath maxillary sinus floor without tearing any maxillary sinus membrane. One hundred and four implants for 32 patients were placed with help of S-reamer in order to increase vertical bone dimension on the posterior maxillae, and had immediate restorations after implant surgery with this sinus elevation procedure at Kyung Hee University East-West Neo Medical Dental Hospital (Seoul, Korea) since 2006. The bone chip is collected in the head of the reamer that has the letter ''S'' shape, making the head surface smooth to prevent the tearing of the membrane. The image of S-reamer was captured from the recorded video clip when it was drilling on the sinus wall of a pig in a simulation test. It revealed that moving drill did not tear the sinus membrane even though it was pushing over the border of inner sinus wall.

Results: The initial remained bone thickness between sinus floor and alveolar crest varied from 5 to 10 mm. As a result, 8–10 mm length of implants were installed according to site preparation including internal sinus augmentation. The post-operative CT image demonstrated that about 2–3.5 mm grafted material was detected on the apex of implant fixture. There were no perforation of membrane or no post-operative complications reported.

Conclusions and clinical implications: The newly designed ''S-reamer osteotome technique'' can be used as a predictable

alternative treatment modality as compared with malleting osteotome technique as well as external lateral window approach. This technique would be a minimal invasive sinus floor elevation procedure and an effective way to achieve immediate loading due to the sinus inferior cortical fixation on the posterior maxilla.

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Evaluation of the bone repair using polylactic and polyglycolic acid copolymer around of implants. Histometric analysis

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Background: The repair around of implants osseointegrated implants and bone grafts in unfavorable situations depends on the establishment of an appropriate contact between bone tissue and implant through the primary stability.

Aim: The aim of this study was to evaluate the association of the polylactic and polyglycolic acid copolymer around of dental implants installed with or without primary stability, through the histometric analysis of the bone/implant interface.

Methods: Ten male rabbits received 40 implants of titanium of 2.6/6.0 mm with surface treated by acid attack and jet of sand, being two in each tibia. The animals were divided in to four groups: group controls locked (I) in that the implant was installed with primary stability, associate to the clot; group controls without stability (II) in that the implant was installed without stability and associate to the clot; group polymeric locked (III) in that the implant was installed associate to polylactic and polyglycolic acid copolymer with primary stability and polymeric group without satability (IV) in that the implant was installed associate to polylactic and polyglycolic acid copolymer, without primary stability. The euthanasia of the animals was accomplished to the 40 and 90 postoperative days. The pieces were included in resin, split up, consumed and stained with alizarina red and blue of Stevenel. The histometric analysis of the lineal extension of contact was accomplished between the bone tissue and the surface of the implant in the edge module and in the first thread and of the area of neoformation bone tissue in the first thread, bilaterally.

Results: There was neoformation bone in all of the groups and periods. To the 40 days, neoformation bone tissue was larger in the group III when compared with the group IV ($P < 0.001$). The neoformation bone in the first thread was difference statistically significant in the group I of what in the group III ($P < 0.001$) and in the group I when compared with group II ($P < 0.001$) to the 40 days. The neoformation bone tissue in the edge module to the 40 and 90 days was larger in the group IV of what in the group II ($P < 0.001$).

Conclusions and clinical implications: Can be concluded that the copolymer presented biocompatibility and allowed bone neoformation in contact with the implant. The presence of the copolimer provoked a delay in the bone neoformation in the groups with primary stability, but it aided in the maintenance of the primary positioning in the groups without stability. Besides, it happened the osseointegration process in both groups, even in the absence of primary stability of the implants.

122 | Topic – Implant Therapy Outcomes, Surgical Aspects

Treatment concept for oral rehabilitation of children with syndromal oligodontia

Presenter: Heuberer S
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Background: The aetiology of congenitally missing teeth is mainly caused by gene mutation, in serious cases it is associated with a syndrome-like ectodermal dysplasia or may even be idiopathic.

Because of insufficient bone level and the lack of teeth the retention of partial removable denture is problematic. Therefore dental implants are discussed to enable prosthodontic rehabilitation.

Aim: The ambition of this study was to showcase a treatment concept for oral rehabilitation of children with syndromal oligodontia for the partial or total edentulous mandible and maxilla. The difficulty in the treatment is related to the skeletal growth, the small number of developed teeth, the underdeveloped bone volume and the young age.

Methods: Between 1992 and 2009, 420 patients with hypodontia (minimum of three congenital permanent teeth missing, wisdom teeth excluded) were registered at the Bernhard Gottlieb University of Dentistry, Vienna. An individual interdisciplinary treatment plan involving orthodontists, oral surgeons and prosthodontists was elaborated according to the number and localisation of missing teeth. The interdisciplinary team decided to perform an implant therapy in seven patients with subtotal edentulism although the mean age was 9 years. The average number of permanent teeth missing was 21 (± 3). The maxilla was treated with two so-called onplants (OnPlant®, Nobel Biocare, Götteborg, Sweden) inserted in the anterior part of the hard palate whereas two or four rootform implants (NobelReplace®, Nobel Biocare, Götteborg, Sweden) were placed in the mandible. The removable prosthodontic devices were supported by the onplants, respectively, the rootform implants. The time when first consultation took place ranged from 5–10 years of age.

Results: In total eight onplants in the hard palate of four patients and eight dental implants in the interforaminal region of three patients were placed. None of the rootform implants and only one onplant was lost. The mean observation period of the onplants was 5 (± 1) years and of the dental implants in the mandible 3 (± 2) years.

Conclusions and clinical implications: The treatment of children suffering of syndromal oligodontia is very complex and limited

by the ongoing skeletal growth and the narrow bone volume. Therefore, an interdisciplinary teamwork and patient's compliance are the keyfactors for a satisfying outcome. The present study demonstrates the success of a treatment concept that offers these patients with a minimum of surgical burden and disturbance of skeletal growth a sufficient oral rehabilitation and recovery of the stomatognathic system even during early adolescence.

123 | Topic – Implant Therapy Outcomes, Surgical Aspects

Evaluation of OsseoSpeed™ 3.0 S implants – 1 year clinical follow-up

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Background: In cases with limited space between adjacent teeth and roots, particularly in the anterior region, there is a clinical need for using narrow implants. This study was initiated to evaluate 5-years implant survival for Astra Tech OsseoSpeed™ 3.0 S implant when replacing a single tooth in the anterior region.
Aim: This study was designed to evaluate the clinical performance of Astra Tech OsseoSpeed™ 3.0 S implants using one-stage procedure and early loading in the anterior region. Sixty-nine patients with 97 implants were recruited at six different study centres in Europe (Spain, Sweden, the United Kingdom, Denmark, Italy and Germany).
Methods: This is a prospective, single-arm, multi-centre study. Patients missing a lateral incisor or mandibular central incisor were eligible to the study. In cases were both contra laterals were missing, installation of two study implants was allowed. The implants used in the study were of 3.0 mm diameter and 11, 13 or 15 mm lengths. One-stage surgery was utilized for all patients, and healing abutments were used during the 6–10 weeks healing period before crown cementation.

Main inclusion criteria were edentulism in the study area for at least 2 months and presence of natural roots adjacent to the study implant. Main exclusion criteria were smoking more than 10 cigarettes daily and a health status that not allowing implant placement.

Primary variable in the study is implant survival 5 years after implant placement. Secondary variables are overall implant survival, implant success, implant stability, marginal bone level alterations, soft tissue status, gingival zenith score and safety.
Results: Totally 69 patients with 97 implants were included. Sixty-six patients with 94 implants have had study implants installed for more than 12 months. The study population represents a wide variety of patients with respect to age (mean 32 years, ranging from 17 to 72 years), gender (52% male and 48% female) and smoking history (16% smokers, 13% previous smokers, 71% non-smokers).

Mean buccal probing pocket depth at crown placement was 1.6 mm, after 6 months 1.4 mm and after 12 months 1.4 mm.

Complications are limited to four lost implants during the healing period, before loading (95.9% survival) and no additional implants have been lost after placement of the crown (100% survival after loading).
Conclusions and clinical implications: Twelve months follow-up data from this clinical study indicate that treatment with OsseoSpeed™ 3.0 S implants is a safe and predictable treatment option in the anterior region when physical space is limited.

124 | Topic – Implant Therapy Outcomes, Surgical Aspects

All-on-four with flapless computer-guided implant surgery

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Background: There is a need for clinical evidence of computer-guided flapless implant surgery when combined with the all-on-four and all-on-six treatment.
Aim: To report the clinical results of an implant placement protocol using four or six implants supporting inmediately loaded fixed prostheses following 3D software-based planning and flapless guided surgery.
Methods: Thirty patients (24 women and 6 men), mean age of 52.9 ± 10.45 (range 35–84 years) were treated with 195 immediately loaded implants (97 NobelSpeedy Groovy and 98 Brånemark MKIII Groovy) (Nobel Biocare, Göthenburg, Sweden) supporting 25 maxilla and 17 mandible fixed full-arch acrylic prostheses and followed up to 3 years. Outcome measures were failures of the prosthesis and of the implants, an approximate radiographic evaluation, and any other complication. The Procera Software v1.6 and v2.0 was used to plan the implant positioning and get the surgical template to guide flapless implant placement. To perform immediate loading, implant had to be inserted with torque of at least 35 N cm. Provisional prostheses were made before surgery using software planning and were placed in the same session after implant placement; definitive restorations were delivered 6 months after surgery.
Results: The overall follow-up range was 12–36 months (mean 22.1). Four implants out of 195 failed during the osseointegration period: two in the maxilla, one straight and one tilted, and two in the mandible, both of them tilted; three of them were successfully replaced. Implant cumulative survival rate at 1 year was 98% (98.5% and 97% in the maxilla and mandible, respectively). No other implant failed so far. No final prosthesis failures occurred. At 1-year, radiological examination showed stable bone levels for all implants except two implants that had bone loss up to the second thread. In three cases, the surgical template fractured during surgery. In one patient, a new impression had to be taken to fit the provisional prosthesis onto the implants.
Conclusions and clinical implications: The results indicate that the ''all-on-four'' and ''all-on-six'' treatment protocol, combined

with computer-guided flapless implant surgery, could be a viable and predictable treatment.

125 | Topic – Implant Therapy Outcomes, Surgical Aspects

Success of calcium phosphate-coated dental implants. A systematically approached review of the literature

Presenter: Junker R
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Background: Because of their bone bonding capacity, calcium phosphate (CaP)-coated implants are supposed to result in superior bone-to-implant contact and increased mechanical strength at the bone–implant interface as compared with implants made of commercially pure titanium. Consequently, CaP-coated dental implants gained some popularity during the last two decades. However, short- and long-term predictability, as well as indications for their use remain controversial.
Aim: The objective of the present review was to assess the long-term success rate of calcium phosphate (CaP)-coated dental implants in clinical trials with at least 5 years of follow-up.
Methods: An electronic Pub-Med search complemented by manual searching was conducted to identify prospective and retrospective clinical trials dealing with reports about the success rate of CaP-coated dental implants with at least 5 years of follow-up.
Results: After 5 years, cumulative success rates ranged from 10% to 96% and for up to 12.5 years cumulative success rate ranged from 54% to 98%. Only one study indicated a long-term progressive loss of bone fixation around CaP-coated implants. In this study, the cumulative success rates after 5, 8, and 10 years in function were 89.9%, 79.1%, and 54%, respectively. All other analyzed studies could not prove progressive loss of bone fixation of CaP-coated implants.
Conclusions and clinical implications: Published long-term success rates on CaP-coated dental implants are very limited, and there is limited evidence of progressive loss of bone fixation around CaP-coated dental implants.

126 | Topic – Implant Therapy Outcomes, Surgical Aspects

Computer-assisted implant surgery in fibula free-flaps. Prospective clinical trial

Presenter: Meloni SM
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Background: Bone continuity defects following ablation for tumours, ballistic traumas or other reasons may generate a series of problems, such as facial contour disfigurement, large oronasal communications, impaired speech, chewing, swallowing and saliva retention. The osseous free-flap has become the gold standard for reconstructing these defects. Implant-supported prosthetic rehabilitation is enabled with this microvascular reconstructive option, although it still represents a major challenge.
Aim: The aim of this prospective pilot clinical trial is to evaluate the functional assets, the prosthetic improvement and the patient's satisfaction in terms of quality of life, offered by the CT guided implant surgery in patients who underwent fibula free-flap reconstruction after ablation for tumours or ballistic traumas.
Methods: Fifteen patients who underwent reconstruction with osseous free-flaps were selected. At the moment four consecutive patients of both sexes have been treated. Prosthetic restoration was performed according to a modified NobelGuide protocol (Procera Software; Nobel Biocare, Gothenburg, Sweden). Computer-assisted, flapless dental implant placement was based on accurate prosthetic and aesthetic analysis. Classical NobelGuide protocol had to be modified due the necessity to adapt the technique in these reconstructed patients. A total of 21 fixtures were installed (Replace Tapered Groovy Nobel Biocare), the implant length ranged between 8 and 16 mm and the implant diameter was either 3.5, 4.3 or 5 mm. All implant were immediately loaded or loaded after 6 months with a screw-retained prosthesis. Clinical and radiological follow-up was scheduled at 3, 6, 12 months after surgery.
Results: All four treated patients have reached 6 months follow-up (range 6–11 months). Only one implant was lost during the healing period. Every patient received a correct provisional prosthetic rehabilitation with high degree of satisfaction when it comes to masticatory function, social functioning and overall quality of life. Radiological rough estimation of bone level showed a stable marginal bone level. No other complication, biological or mechanical, was so far recorded.
Conclusions and clinical implications: As far as we know this is the first study applying computer-assisted implant surgery and immediate loading in osseous free flaps reconstructed patients: from these still very preliminary findings it seems this approach is valuable when it comes to function, aesthetic and patient's quality of life.

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The use of cone beam tomography to assess the evolution of buccal bone plate of immediately placed and restored dental implants

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Background: The immediate placement of implants after tooth extraction is a common clinical practice with a success rate similar to implants placed in healed sites 1–2. Nevertheless, the observation of gingival recessions in the buccal side reported by some authors 3–4 raised the problem of placing immediate implants in the esthetic areas. Gingival recessions follow the

vertical reduction of buccal bone plate and the possibility of preserving this structure seems to be the keystone for a reliable long-term result.

Aim: The purpose of the present case series is to present long-term results of dental implants placed immediately after extraction in esthetic areas, by means of a non-invasive method to study the evolution of the buccal bone plate after 5 years of loading.

Methods: Fifteen patients received an immediately loaded Xive implant placed in a fresh extraction site for the substitution of a upper central or lateral incisor. After 5 years, all the patients were recalled for a clinical and radiographic visit. Ten of them accepted to participate to the study. A Cone beam computed tomography (CBCT) was performed for each implant: vertical distance between implant–abutment junction and bone crest, and bone thickness at three points were measured.

Results: During the clinical visit neither recession nor pathological probing depth were found. A vertical mean resorption of $0.5 + 0.5$ mm at buccal and $0.2 + 0.3$ mm at palatal aspect was found. An average thickness of the buccal bone plate of $1.1 + 0.5$ mm was found at its most coronal point.

Conclusions and clinical implications: Within the limitations of the present case series, the results suggested that immediately restored implants placed in a fresh extraction site are a reliable option as for success and long-term soft and hard tissues stability even in esthetic areas.

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Immediate implant insertion following single-root teeth extraction

Presenter: Stoll V

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Background: Conventional insertion of screw-shaped implants is usually done following a variable time interval after tooth extraction and bone healing of the extraction alveolus. On the contrary, immediate insertion is done immediately after extraction.

Aim: The aim of the investigation was to assess whether immediate insertion leads to a success rate comparable with delayed (2 months) or late (4–6 months) insertion.

Methods: One hundred and twenty immediate implant insertions were performed within a prospective longitudinal clinical study. Single-root teeth were extracted atraumatically. Tested were screw-shaped implants: 108 two-piece titanium (84 Straumann and 24 Thommen Medical) and 12 one-piece zirconium oxide implants (Z-systems). The incongruence between the alveolus and implant was in each case spanned by using autologous bone from the drilled site. Follow-up was done 6 months and final assessment 1 year after definitive prosthetic loading. It included the assessment of stability as well as periimplantological and radiological parameters.

Results: All titanium screw-shaped implants have been *in situ* at the final 1 year assessment, whereas three (of 12) zirconium dioxide implants have failed before permanent prosthetic loading was attempted. The remaining nine ceramic implants have shown intact peri-implantological picture, whereas five (Straumann 3 and Thommen Medical 2, of 84 and 24, respectively) have shown pockets that needed revision, i.e., a clinically significant crestal bone loss, mainly labially/buccally.

Conclusions and clinical implications: Immediate insertion of titanium screw-shaped implants resulted in a success rate comparable with delayed or late insertion. The suboptimal results obtained with the small population of one-piece ceramic implants were, in two cases, due to insufficient protection during the healing phase. In the authors opinion this is not pertinent to the implant system.

The important advantage for the patient is the time gain of the faster prosthetic loading. The remodeling processes of the alveolar bone have to be taken into consideration already at implant insertion planning.

129 | Topic – Implant Therapy Outcomes, Surgical Aspects

Surgical techniques to improve implant stability in low-density bone

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Background: Low bone density often requires special surgical techniques to achieve primary stability at implant insertion, especially in maxillary sites, extraction sockets or cases of immediate loading.

Aim: The objective of this study was to compare the clinical results of different techniques without grafting.

Methods: Only patients with bone type IV were included in this study. Group A was treated with 25 special soft bone implants (Astra Tech TX implants, Mölndal, Sweden) in combination with the application of adapted drilling protocol. Group B patients were treated with regular cylindrical implants after implant beds had been prepared with conical osteotomes. Both techniques led to compaction of the implant surrounding bone, improving bone density and primary stability. Insertion torque was measured at implant placement. Abutments were delivered 8–12 weeks after implant placement.

Results: Both techniques improved implant stability in low-density bone and showed similar results with respect to implant survival rates. All implants could be loaded with prosthetic rehabilitations without any loss so far, however, the tapered implants proved better stability at implant placement.

Conclusions and clinical implications: Within the limits of this study, both techniques showed similar results with respect to creating a strong bond between implant surface and surrounding bone. The use of soft bone implants in combination with an adapted drilling protocol, however, is less complex than the

osteotome technique and reduces morbidity for patients. Concerning long-term reliability and implant survival, longer observation and validation periods will be required.

130 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival and success rate of consecutive 330 sinus lifting and simultaneously placed 690 implants

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Background: If <4 mm of residual bone is left in posterior maxilla, two-stage operation is recommended for implant installation. However, if primary stability could be obtained with tapered designed implant, one-stage surgery could be applied with reliable success rate.

Aim: The purpose of this prospective study was to evaluate the effect of residual bone height and other factors on survival and success rate of the implants simultaneously placed into grafted sinus using only xenogenic bone when optimal initial stability was gained by tapered designed implant.

Methods: A total of 330 sinus lifting through lateral approach and 690 simultaneous implants were installed by one experienced oral and maxillofacial surgeon. Rough-surfaced implant and xenogenic bone were used solely for bone graft. Second surgery was performed around 6 months after operation and temporary prosthesis was used to perform progressive loading for average 3 months. Implants were divided into two groups according to residual alveolar bone (Group 1: 1–4 mm and Group 2: 5–8 mm). Statistical differences of success rate between groups were analyzed with χ^2 test. Cox proportional hazard regression was used to identify risk factors such as age, sex, bone quality and smoking.

Results: The mean follow-up was 55.9 ± 14.5 months. Of the 690 implants, 376 implants (54.5%) were Group 1 and 314 implants (45.5%) were Group 2. The cumulative survival rate was 98.9% (683/690). Twenty implants including the removed were considered as failure and the cumulative success rate was 97.1% (670/690). There was no statistically significant difference in success rate between the two groups ($P = 0.577$). However, significant differences of success rates were found in smoker ($P < 0.001$) groups.

Conclusions and clinical implications: Sinus lifting with simultaneous implant placement using only xenogenic bone graft could be used to treat atrophic maxilla in patients with minimal residual bone heights when initial stability can be obtained by using appropriately designed implants and careful surgical techniques.

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Sparing sufficiency strategy with 5 and 7 mm porous-surfaced dental implants

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Background: Sparing sufficiency strategy is the rule of choosing an implant treatment method for the easiest and shortest achievement of the patient care quality. The concept is applied at atrophic posterior jaws. One of expedient variants of application of the strategy is endopore dental implants.

Aim: Aim is the substantiation of sparing sufficiency strategy with 5 and 7 mm porous-surfaced implants.

Methods: There were 66 patients with partial edentulous atrophicposterior jaws. One hundred and forty-six short porous-surfaced implants were used: 35 of 5 mm long and 5.0 mm wide, with external hex and 111 of 7 mm long and 4.1 mm wide, with external and internal hex. Ninety-two implants (63.0%) were placed in maxilla and 54 in mandibula. Most of implants were located in the upper first molar – 37 (25.3%), the upper second molar – 29 (19.9%) and the lower first molar – 25 (17.1%). Teeth at implant sites had been extracted at least 3 months before implantation.

The bridgeworks, single and connected crowns were made with a support on implants. The supervision after loading lasted from 12 to 27 months, on the average 18.6 ± 4.7. A radiographic evaluation and periotest were performed.

Results: Only one implant was lost in the postoperative period. Survival rate after surgery was 99.3% and success rate was 98.5%. In 3 months, after implantation loss of bone level equaled 0.17 ± 0.19 mm, a minimum 0, a maximum of 0.7 mm. Implants stability was defined in the range from '' – 1'' to '' – 5'', on the average – 3.42 ± 1.06.

No implants were lost during total loading period. For all implants, the bone decrease in a year after loading was 0.27 ± 0.24 mm and stability was – 5.32 ± 1.57. For 5-mm long implants the bone decrease was 0.31 ± 0.28 mm and stability was – 5.29 ± 1.66. The same indexes for 7-mm long implants equaled 0.26 ± 0.23 mm and – 5.33 ± 1.55 accordingly. Differences were not statistically significant.

Conclusions and clinical implications: Short endopore dental implants placed in partially edentulous atrophic posterior upper and lower jaws have shown high clinical efficiency. There were low bone loss and high implant stability both after surgery, and after prosthetics with no dependence on implant length.

Sparing sufficiency strategy with 5 and 7 mm porous-surfaced implants has to be considered as an effective alternative to more difficult, long and expensive pre-implantation augment procedures.

132 | Topic – Implant Therapy Outcomes, Surgical Aspects

Resonance frequency analysis of dental implants after laser therapy

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Background: The importance of primary stability in implant placement for long-term success is well known in the literature. The resonance frequency analysis technique has extensively been used in experimental and clinical research for the last 10 years, for assessing primary stability. The benefits of low-level laser therapy in bone tissue are already consolidated in the literature, however, little is known about its benefits on improvement of stability of dental implants.

Aim: The aim of this random double blind clinical study was to investigate whether stability of titanium implants can be enhanced by low-level laser therapy during the osseointegration process when measured by means of resonance frequency analysis.

Methods: Thirty implants ($n = 30$) were placed in the posterior region of partially edentulous mandible of eight adult patients, after following several inclusion criteria and were distributed bilaterally in agreement with the prosthetic requirement. The implants on the experimental side were randomly submitted to low-level laser therapy (830 nm, 86 mW, 92.1 J/cm^2, 2.57 J, 3 s/point, at 20 points), and on the control side the laser irradiation was only simulated. The first irradiation was performed in the immediate postoperative period, and it was repeated every 48 h in the first 14 days. The initial implant stability quotient of the implants was measured by means of resonance frequency analyzer (Osstell®). New implant stability quotient measurements were made after 10 days, 3, 6, 9 and 12 weeks. ANOVA for repeated measurements and Bonferroni test were used to assess statistically significant differences.

Results: The initial implant stability quotient values ranged from 65 to 84, with a mean of 76. The irradiated side showed significant drop in stability from the 10th day until the sixth week only ($P = 0.028$), and presenting a gradual increase from the sixth to the 12th week. In the control side, the mean implant stability quotient increased up to the third week, decreased in the sixth week, and then began to grow again. The highest stability values were observed in the 10th day in the irradiated group, and the lowest in the sixth week in both groups. No statistical differences were detected among the ISQ means in the two groups for each of the six times observation.

Conclusions and clinical implications: No evidence was found of any effect of low-level laser therapy on implants' stability when measured by resonance frequency analysis. Because high primary stability and good bone quality are of major relevancy for a rigid bone–implant interface, additional low-level laser therapy under these conditions may have little impact macroscopically. Further researches under different bone conditions are necessary for a better understanding of the occurrences at bone/implant interface.

133 | Topic – Implant Therapy Outcomes, Surgical Aspects

Flapless surgery using CT-based mucosa supported templates: 2–year results

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Background: Surgical templates produced from CT-scan data, using virtual 3D planning systems, are increasingly used in implant dentistry. In accordance with radioprotection recommendations, preoperative CT examinations should be reserved for fully edentulous jaws or for large edentulous spaces. Conventional imaging techniques before implant surgery allow high implant success rates in fully edentulous patients with a favorable residual bone crest, or after a bone graft; CT-scan-based surgical templates are not necessary in these cases.

Aim: The aim of this study is to evaluate if a surgical guide based on the CT-implant planning allows implant insertion in edentulous patients with limited bone volume.

Methods: From May 2006 to August 2007, 47 implants Replace Straight (Nobelbiocare®, Goteborg, Sweden) were inserted in the completely edentulous upper jaw of seven patients (five female and two male patients, mean age 47 years). The implants were inserted following the Nobelguide® procedure using a flapless technique and a mucosa supported CT-derived surgical template. In immediately loaded cases, the prosthesis was manufactured following the Nobelguide® process.

Results: After implant insertion, partial relief of the screw was palpated through the buccal mucosa in 9/47 (19%) implants indicating a perforation of the buccal cortical plate. Immediate loading of the implant-supported prosthesis delivered at the time of implant placement was performed in three patients (20/47 implants, 42.6% implants). There were 7/47 (14.9%) early failures during osseointegration: two (4.3%) implants were mobile and were removed immediately at the end of surgery and 5 (10.6%) during the first weeks, including four that had been immediately loaded. There was one (2.1%) implant failure after osseointegration. Thus during the follow-up period 8/47 (17%) implants were lost giving a 2-year survival rate of 83%.

Conclusions and clinical implications: This 2-year clinical evaluation shows the limits of flapless implant placement using CT-based mucosa-supported surgical templates in patients with limited bone volume. Although preoperative evaluation of implants sites in difficult anatomical situations seemed facilitated

by virtual implant planning, clinically evident surgical endosseous placement errors were observed in 19% of the implants, possibly due to CT data base imprecision and inaccurate positioning of the mucosa supported surgical guide. The implant failure rate with this technique was higher than is usually observed with standard implants in similar clinical situations. Larger long-term studies and an effort to increase the accuracy of this technique, which implies an additional radiation burden for the patient, are necessary before expanding its use.

134 | Topic – Implant Therapy Outcomes, Surgical Aspects

Correction of severe lateral open-bite using miniscrew anchorage and corticotomy

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Background: Open bite dental and skeletal pattern often represents one of the more difficult malocclusions to treat to a successful and stable result. Like most orthodontic problems, the cause of open bite is often multifactorial. There are several different approaches for open bite treatment. Skeletal anchorage systems such as miniscrews are now frequently used for correcting severe malocclusion.

Aim: The purpose of this study was to determine the effectiveness of combining corticotomy with the application of skeletal anchorage systems as a proposed method for correction of severe lateral open bite.

Methods: The patient was a 20-year and 5-months old caucasion girl having Angle Class I dental malocclusion and Class III skeletal relationship with the chief complaint of right lateral open bite. Her overjet was + 3 mm, and overbite was ranging from − 1 to − 8.5 mm. From the model analysis, the arch-length discrepancy was − 3.5 mm on the upper and − 4.2 mm on the lower arch. The cephalometric analysis indicated the features of a skeletal open-bite with hiperdivergent measurements. As a treatment protocol, fixed orthodontic appliances with Roth prescription of 0.018″ slots were placed in both arches. A levelling of maxillary and mandibular arches was performed excluding the open bite region. Also the patient was instructed to wear intermaxillary elastics between the teeth of both arches corresponging to open bite region. When it was concluded that this intervention did not cure the problem, subapical corticotomy was performed from the lower-right second molar to the lower-left canine under local anaesthesia. After the surgery, the patient was instructed to wear intermaxillary elastics were from the screw to the lower correspoding teeth group with the total force being 200 g for each groups of teeth (two groups making totally six teeth). When the overbite of 2 mm was achieved within 3 months period, short intermaxillary elastics for intercuspitation was used for 5 weeks.

Results: Our results revealed that by the use of combined treatment with corticotomy and skeletal anchorage provided safe and non-compliance treatment of lateral open bite in a short period. The utilization of corticotomy allows positively accelerated tooth movement thereby shortening active treatment time with lesser risk of root resoption and more stable results as well.

Conclusions and clinical implications: A combination of subapical corticotomy and orthodontic treatment supported with miniscrews may be an alternative method for skeletal lateral open bite correction in adult patients who would like to consider a rather rapid treatment option.

135 | Topic – Implant Therapy Outcomes, Surgical Aspects

The effects of two different types of collagen membranes on immediate implant placement in extraction socket during periradicular surgery

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Background: In previous studies, we evaluated the effects of non-resorbable membrane and non cross-linked collagen membrane on osseointegration of immediate implants with periradicular lesion. Results showed that non-resorbable membrane increased bone-to-implant contact (BIC) compared with cases where membranes were not applied. However, non cross-linked collagen membrane did not increase BIC. Cross-linked collagen membrane is known to decrease degradation rate and prolong barrier function more than non-cross-linked collagen membrane.

Aim: The aim of this study was to evaluate the effect of cross-linked collagen membrane on immediate placement of implant during periradicular surgery and compare it with that of non-cross-linked collagen membrane.

Methods: Lower third and fourth premolars of two beagle dogs were used. Periradicualr lesions were induced. Twelve weeks later, periradicular lesions were removed with buccal osteotomy, curettage and saline irrigation and teeth were extracted. Immediate implants were placed. Buccal-osteotomized defect was covered with non-cross-linked collagen membrane (BioGide; control group) ($n = 7$) and cross-linked collagen membrane (Ossixplus; experimental group) ($n = 7$). After 12 weeks of healing period, the dogs were sacrificed and undecalified specimens were prepared. BIC was measured at the apical third histomorphometrically. Data were analyzed by Mann–Whitney test.

Results: Implants were clinically not mobile and showed no signs of infection except the two that failed. There was no significant difference between two groups ($P = 0.123$). However, the control group showed higher BIC (48.46 ± 11.82%) than the experimental group (38.07 ± 10.12%).

Conclusions and clinical implications: The effects of the two kinds of collagen membranes used to enhance BIC in this study did not show any significant difference. The previous study revealed no significant difference in BIC between applying

non-cross-linked collagen membrane and not applying any membrane at all. This means that none of the two collagen membranes shows any beneficial effect on bony defect created during periradicular surgery.

136 | Topic – Implant Therapy Outcomes, Surgical Aspects

A 1-year prospective multicenter clinical and histological study on bone augmentation at Neoss implants using a porcine bone graft

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Background: The presence of small bone volumes beneath the maxillary sinus floor and localized bone defects may compromise the positioning of dental implants.
Aim: The objective of the present prospective multicenter study was to clinically and histologically evaluate the use of a porcine bone graft for augmentation of localized defects in the alveolar crest and of the maxillary sinus floor.
Methods: Nineteen patients (12 female, 7 male, mean age 42.3 years) were included in the study and treated with a bone augmentation procedure using a porcine bone graft with or without barrier membranes (OsteoBiol, Tecnos Srl, Turin, Italy) before ($n = 24$) or in conjunction ($n = 8$) with the placement of dental implants ($n = 34$) (Neoss Ltd., Harrogate, UK). Nine patients were treated due to the presence of localized defects; five patients had self-containing defects and four augmentations were made beyond the skeletal envelope. Ten patients were subjected to maxillary floor augmentations; five with a replaceable bone window technique and five with a traditional lateral approach. The dimensions of the bone defects and the height of the residual bone below the maxillary sinus were registered before and after treatment. Bone biopsies were taken for histology. Implant stability was registered with Osstell measurements (Osstell AB, Gothenburg, Sweden) at placement and abutment connection. All implants were clinically and radiographically followed for at least 1 year in function.
Results: One sinus procedure failed which precluded placement of implants. The lateral bone augmentation procedure resulted in a horizontal gain of $2.5 + 1.6$ mm. All self-containing defects healed. For maxillary cases, the vertical bone height gain was $11.1 + 1.3$ and $9.4 + 3.8$ mm for the two procedures, respectively. One implant placed in conjunction with a sinus augmentation procedure was lost during the study, giving overall CSR of 97.1% after 1 year of function. The initial mean stability was $71.9 + 7.7$ ISQ that significantly increased to $75.3 + 6.8$ ISQ at abutment connection. Histology showed and admixture of bone and porcine bone particles. New bone was formed on the surface of the particles, which also showed signs of resorption and replacement with new bone.
Conclusions and clinical implications: The use of porcine bone graft results in predictable augmentation of defects in the alveolar crest and of the maxillary sinus floor to enable implant placement and integration.

137 | Topic – Implant Therapy Outcomes, Surgical Aspects

Bone of nasal floor gave us opportunity for primary stability in anterior maxilla at immediate implantation

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Background: Primary stability is fact for successful osteointegration. Achievement of this could be a problem at immediate implantation in anterior maxilla. Bone of nasal floor is denser than residual bone of alveolar ridge of anterior maxilla. This fact can be used for achieving better primary stability.
Aim: The aim of study was to show the secure use of nasal floor for primary stability and also that with these procedure longer implants could be used.
Methods: In 34 patients, 37 implants, Ankylos® (Dentsply/Friadent, Mannheim, Germany) were immediately inserted subcrestaly and beyond apical region of sockets; incisor central/lateral 24/11, canine 2. Reasons for extraction were root fracture (17), root resorption after luxation injury (4), failure of treatment of cronical periapical periodontitis (14) and periodontitis gravis (8). In 24 sockets at least one clinical sign of inflammation was present: fistula with pus (9) and evident mucosal swelling (15). For better primary stability compact bone of nasal floor were used at 22 implants; 5 into (INF), 17 trough nasal floor (TNF) up to 3 mm without any sights of tearing nasal membrane. Twenty-nine implants were healed transgingival; 10 with sulcus formers, 19 with single temporary crowns and eight were covered with resorbable membrane and mucoperiostal flap. For elevation of nasal floor in group TNF, the procedure was the same as sinus floor elevation with osteotomes. At other 15 sights implants were inserted below the cortical bone of nasal floor (BNF). Antibiotic was prescribed for 10 days. Clinical control with radiographs was at 1/6/12/24 week and then annual. Finally prosthetic were delivered after 24 weeks.
Results: All implants from INF and TNF were osteointegrated. One implant with temporary crown from group BNF failed due to patient incompliance of soft diet. Fistulas were closed in 2 weeks. At our period of follow-up (6–48 months) no sights of nasal–oral communication and no obstacle of nose airways were found. In TNF and INF group 14/7/1 implants of length 17/14/11 mm were used compare with BNF where the rate was 3/10/2.
Conclusions and clinical implications: Bone of nasal floor gave us opportunity to achieve primary stability with consider of

anatomy, exact pre-operative X-rays, precise surgery and progressive thread design of implants. With this procedure longer implants were inserted. This pilot study should be continued to prove these early results.

138 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediate function of astra implants in the esthetic zone – a clinical evaluation of bone and soft tissue stability

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Background: To overcome the disadvantages of staged implant surgery and treatment, immediate loading concepts as well as flapless surgery approaches have been introduced in the last years. Specifically, promising results in terms of high success rates and remarkable esthetic outcomes have been reported for implants placed in extraction sockets and immediately loaded via provisional crowns and prostheses. These techniques completely avoid a provisional removable denture and focus on preservation of the existing osseous and gingival tissues through immediate function or at least structural support.

Aim: The study examined the clinical performance of Astra Tech OsseoSpeed implants and its transgingival components in a one-stage procedure with immediate provisionalization in the esthetic zone.

Methods: Seventy-one Astra Tech OsseoSpeed implants were inserted in 37 patients. All patients received immediate prosthetic restorations. Primary outcome variables were implant success, marginal bone levels and pink esthetic score (PES).

Results: Mean primary stability at time of implant insertion was 24 N cm; seven further implants had to be excluded because of insufficient primary stability for immediate provisionalization (below 15 N cm). There were two implant losses. Overall cumulative success rate was 96.9%. Mean follow-up for surviving implants was 10.6 months (range 3–16 months), 44 implants have reached the 1-year follow-up. Marginal bone loss averaged about 0.6 mm from the time of implant insertion to the 1-year follow-up. Mean PES ratings improved from 10 preoperatively to 12.2. In 95% of the implant sites it was possible to keep the gingival esthetics stable or even to improve it from the preoperative examination to the 1-year follow-up.

Conclusions and clinical implications: Survival rates and esthetic results suggest proof of principle for immediate function with Astra OsseoSpeed implants. Although marginal bone levels show considerable adaptive changes within the first year, PES ratings remained stable or improved in the vast majority of patients.

139 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival rate of SPI implant system: a retrospective study

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Background: Over the last two decades, there has been a considerable increase in use of titanium implants to restoring fully/partially edentulous patients. Recently, edentulous individuals have become the main group of patients being considered for oral implant treatment, and several reports show favorable long-term outcomes with different oral implant systems. The SPI® implant system is characterized by sand-blasted and acid-etched surface, internal connection and self-tapping thread. Although there has been several studies about the survival rate of implant systems so far, the SPI implant has received relatively little attention. This paper provides an analysis of SPI® implant and its short-term survival rate.

Aim: The aim of this retrospective study is to evaluate the short-term survival rate of SPI® implant system.

Methods: One hundred and forty-nine patients received placement of 262 SPI® implant between July 2006 and November 2008 in Kyung Hee University dental hospital. They are surveyed for cumulative survival rate. In addition, associated factors, such as the patient characteristics, distribution of implants, treatment type were analyzed.

Results: 1. From patient characteristics, 88 patients (59.1%) were male and 61 patients (40.9%) were female. Distributions of the age reached the peak within the range of 50–59 years (41.6% of patients' number and 42.8% of implants' number). From distribution of the implants, total number of implants was similar on maxilla (51.5%) and mandible (48.5%). Thirty implants (11.5%) were placed on anterior region, 232 implants (88.5%) on posterior region.

2. The reason of tooth loss was periodontal problem (43.9%), dental caries (5.0%), tooth fracture (5.0%) and so on.

3. Two hundred and twenty-one implants (84.3%) were treated by single crown, 39 implants (14.9%) by bridge type.

4. None of implants failed. The cumulative survival rate was 100% of 262 implants in 149 patients.

Conclusions and clinical implications: SPI® implant system showed excellent survival rate in this short-term retrospective study and could be a predictable implant system.

On the relation between insertion torque and ISQ measurements of Neoss implants and bone density

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Background: Primary implant stability is considered as one important determinant of implant success. Insertion torque (IT) and ISQ measurements are frequently used to assess primary stability. However, the relation between the two techniques in different bone densities is not well understood.

Aim: The aim of the study was to evaluate the relation between IT, ISQ and bone density at the day of implant placement.

Methods: At total of 292 implants (Neoss, Harrogate, UK) were placed in 89 patients in both jaws and in all regions. Bone density and volume was assessed using the Lekholm and Zarb index. The final drill diameter and degree of countersinking was registered. Insertion torque was measured when inserting the implant with an Elcomed SA200C drilling unit (W&H, Bürmoos, Austria) at 20 rpm and 8 Hz to a maximum torque of 50 N cm. The data were imported and analysed in specially designed software (Impdat, Kea Software GmbH, Poecking, Germany). Implant stability was measured in ISQ units with a Mentor machine (Osstell AB, Gothenburg, Sweden). The torque/time curves were examined for mean IT and consumed energy over the total curve and for the coronal (E1), mid (E2) and apical (E3) thirds. The Spearman's σ test was used to find possible correlations.

Results: Insertion of the implants resulted in a continuous increase of IT over time. There was a correlation between ISQ and mean IT and between ISQ and consumed energy during implant insertion for the total curve and E1, E2 and E3 parts. In a similar fashion, there was a correlation between bone density and mean IT and consumed energy. In addition, there was a correlation between final drill diameter and mean IT and area for the E1 part of the curve, but not for the total curve and E2 and E3 parts.

Conclusions and clinical implications: Insertion of Neoss implants results in a continuous increase of IT, most likely reflecting the tapered design. There is a correlation between ISQ and IT, which in turn correlate with bone density. The data suggest that both techniques can be used to assess primary implant stability.

Immediately loaded implants in severely resorbed edentulous maxillae, 3-year results

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Background: Immediate loading of implants in the edentulous maxilla has previously been successfully performed and reported. Severe resorption of the maxillary alveolar crest presents a more demanding situation for the restorative team. The benefit for patients of this treatment modality is also of interest to further evaluate.

Aim: The aim of this study is to prospectively investigate the long-term results of immediately loaded dental implants, provisionally restored with fixed prostheses, in atrophic maxillae without previous augmentation.

Methods: Two centers enrolled a total of 51 patients with severely resorbed edentulous maxillae (Lekholm and Zarb quality 3 or 4 and quantity C, D or E), in which 306 implants were placed (OsseoSpeed™ Astra Tech). The six implants in each patient were restored with screw-retained fixed provisional prostheses within 24 h after implant placement.

Early soft tissue healing was assessed at 2 and 4 weeks after implant placement, and the implants were clinically evaluated regarding soft tissue status and stability after 12 weeks when provisional restorations were removed. Impressions were taken for definitive restorations installed 20–24 weeks after implant surgery.

Radiographs are taken to analyze marginal bone level changes throughout the study.

The patients will be followed annually for 5 years and a subject satisfaction survey, Oral Health Impact Profile (OHIP), will be repeatedly completed by the patients.

Results: As of today, 44 patients have been back to the 3-year follow-up visit, successfully wearing their permanent prostheses. Fourteen implants in seven patients have been reported lost. Sixty-two percent of the implants were placed in bone quantity C and quality 3 or 4 and 38% of the implants in quantity D, type 3 or 4. The mean marginal bone level change over the first year was –0.5 mm (SD = 0.8) for 250 implants. OHIP indicated a rising satisfaction level among patients restored immediately with maxillary fixed prostheses. Analyzed 3 year data for all patients will be presented.

Conclusions and clinical implications: Data from the first 3 years of this long-term study reveals good clinical outcome. A careful selection and planning by the restorative team enables successful treatment outcomes for patients presenting with severely resorbed edentulous maxillae.

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Factors influencing dental implant stability detected by resonance frequency analysis and Periotest

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Background: Primary stability is crucial for osseointegration of dental implants. Two noninvasive methods (resonance frequency analysis [RFA] and Periotest) are commonly used to evaluate and monitor the implant stability. However, which factors related to dental implant contributes to the implant stability values have not been well documented.

Aim: This study was aimed to determine the variables associated with primary implant stability and the stability after osseointegration using RFA value and Periotest value (PTV) and to compare two stability values.

Methods: This study included 290 implants, which were placed in 111 patients via two-stage submerged approach and were monitored using RFA and Periotest for the stability both at placement surgery and at abutment connection. We included the patient age, gender, systemic factor, bone density during implant placement surgery(by Lekholm and Zarb's classification), bone width, edentulous period, bone property (native/augmented), implant diameter, length, and implant surface area as independent variables, and PTV or RFA values as dependent variables. Multiple regression analysis and correlation analysis for PTV and RFA at implant placement (PTV1 and RFA1) and at abutment-connection (PTV2 and RFA2) were performed.

Results: For primary stability, PTV1 was significantly correlated with bone density ($P < 0.01$), implant length, edentulous period, gender (lower at male) as well as RFA1, whereas RFA1 was significantly correlated with implant diameter, length, bone density bone property, jaw (higher at lower jaw), edentulous period, gender (lower at male). In multiple regression analysis, PTV1 was predictable by bone density (adjusted $R^2 = 0.231$, $P < 0.001$) whereas RFA1 was predictable by bone density as well as implant diameter, edentulous period, and gender (higher for male) (adjusted $R^2 = 0.316$, $P < 0.001$). After osseointegration, PTV2 was significantly correlated with patient age, bone property, implant surface area as well as PTV1 and RFA2 ($P < 0.05$), whereas RFA2 was significantly correlated with implant diameter, length, and implant surface area ($P < 0.01$) as well as RFA1. In multiple regression analysis, PTV2 was predictable by implant diameter and patient age (adjusted $R^2 = 0.132$, $P = 0.034$), whereas RFA2 was predictable by implant diameter and RFA1 (adjusted $R^2 = 0.246$, $P < 0.001$).

Conclusions and clinical implications: The bone density at implant placement and the implant diameter after osseointegration seem to influence both RFA and PTV at each period. Additionally implant diameter, gender, and edentulous period at implant placement and the primary stability itself after osseointegration seem to contribute to RFA. The present results could explain that RFA value be more predictable by the variables included in this study that PTV.

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Clinical outcome of endosseous implants in cancer patients with grafted and irradiated jaw

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Background: The surgical-radiotherapic treatment of malignancies in the head and neck region seems to obtain better results in respect to non-surgical protocols, although it can lead to significant facial deformity and impaired oral function. Advanced reconstructive techniques allowing autogenous soft and bone tissue graft improve the functional and aesthetic outcome of ablative surgery, even though the masticatory function has to be restored. Dental rehabilitation in these patients may be difficult because of lower bone quality both in grafted and irradiated jaws, critical factors for the success of osseointegration. Irradiation therapy causes early and late alterations and deeply affects bone cells and vascularization; moreover, tissue damage seems to be dose-dependent and influenced by the delivery protocol.

Aim: The aim of this study was to evaluate the clinical outcome of implants in cancer patients with a grafted and irradiated jaw.

Methods: The study included 39 implants placed in 11 patients with an average age of 62 years (42–72 years). Thirty-five out of 39 implants were inserted in grafted bone while 20 were also placed after radiotherapy. One patient (four implants) was treated with radiotherapy only. Thirty-two implants out of the a.m. 39 implants were placed in mandible and seven in maxilla. The range of radiotherapy dosage was 50–70 Gy (average 63 Gy).

Results: Three implants failed and required to be replaced. One of them went lost as the patient did not undergo radiotherapy, but it had been located in grafted mandible with fibula free flap. The two remnant failed implants had to be replaced in the same patient in an irradiated mandible. The total loss rate was of 7.8% out of 39 implants. Such result is slightly higher than rate of implant failure for non-irradiated and non-grafted jaws reported by literature.

Conclusions and clinical implications: Implantology offers tremendous chances of life improvement for patients needing oral rehabilitation. On the basis of such results, we can conclude that irradiation therapy and surgical treatment with autogenous bone reconstruction should not be considered as absolute contraindications for implant therapy.

Clinical and radiographic evaluation of one-piece implants

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Background: The mainstream of periodontal therapy in the 21th century is simple, convenient, and minimum invasive. Early treatment modality for dental implant recommended two-stage surgery and making incision on alveolar mucosa which increase treatment time and discomfort. Recent studies indicated that the success rate of one-stage implant surgery is similar to that of two-stage one. One-piece implant design was also invented.

Aim: The present study was to retrospectively evaluate the clinical performance of one-piece implants (NobelDirect, Nobel Biocare AB, Gothenburg, Sweden).

Methods: Clinical data were obtained from dental clinics at Tzuchi Hospital, Taipei. Data were obtained for all consecutively placed one-piece implants from 2005 to 2009. One hundred and eighty patients received 451 one-piece implants supporting both multiple and single-tooth reconstruction. 32.8% were placed in maxilla and 67.2% were placed in mandible.

Results: 8.4% were immediately placed in extraction sites. Surgical techniques for implant installation included flapless surgery (57%) or modified flap technique (43%). 13.1% of the implants were subject to early restoration. Three implants were lost, rendering a clinical survival rate of >99% up to 4 years of loading. No implants were lost for those placed with flapless technique. Implants were lost due to heavy early loading, infection, or no initial stability. 3.8% of all implant sites had marginal bone loss >1 mm. 2.6% of the immediate implants, 1.7% of the early-loaded implants, and 0.8% of implants placed with flapless technique had marginal bone loss >1 mm. Risk factors for marginal bone loss were uncontrolled diabetes, bruxism, early loading, periodontitis, or endodontic infection, inadequate keratinized mucosa, retained cement, unhealed and grafted sites, and subgingival margin.

Conclusions and clinical implications: The data from the present clinical trial showed one-piece implants may be used successful and predictable in many clinical situations and deserved further evaluation.

Preoperative 3D bone density measurement as predictor of oral implants primary stability

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Background: Primary stability of oral implants is crucial to achieve osseointegration.

Aim: The impact of bone density around implants measured with a guided surgery software on their primary stability measured by resonance frequency analysis was evaluated.

Methods: The study included 10 totally edentulous patients who were treated by full-fixed bridges with the Nobel Guide® concept. Virtual surgeries were performed installing 55 Replace® implants in the jaw bones of the patients (five mandibles) with the 3D surgical planning software which was used to obtained 12 bone density values as hounsfield units (HU) at the surrounding bone of each implant at the coronal, middle and apical threads, repeating this procedure at the mesial, distal, vestibular and palatal/lingual sides of all implants. Average values of the mesial-distal (M-D) and vestibulo-palatal/lingual (V-PL) measurements were obtained. After guided surgery, implant stability quotients (ISQ) were recorded through a resonance frequency analyzer (Osstell®) both in the M-D and V-PL directions. HU and ISQ values were then statistically analyzed for possible correlations.

Results: All implants were installed as virtually planned. Statistically significant differences were obtained when comparing ISQ values of the upper (69) and lower jaw implants (77) and M-D vs. V-PL values in both jaws. The upper jaw implants obtained higher ISQ values in the M-D direction measurements (70) whereas the ones in the lower jaw were higher in the V-PL direction measurements (80). Differences in bone density were statistically significant between the upper jaw (653) and lower jaw (1032) HU values and when comparing V-PL (731) vs. the M-D (813) ones. Accordingly with the ISQ results, in the upper jaw HU values were higher in the M-D sides (672 vs. 625) of the implants while in the lower jaw they were higher in the V-PL sides (1124 vs. 931). There was a statistically significant correlation between ISQ and HU values in both jaws and all directions.

Osstell (ISQ) and Bone Density (HU) values

	All 55 implants		Maxila (30 implants)		Mandible (25 implants)	
	Osstell (ISQ)	Bone Density (HU)	Osstell (ISQ)	Bone Density (HU)	Osstell (ISQ)	Bone Density (HU)
Average	72.8	772	68.8	653.5	76.9	1032.3
Vestibulo-palatal/lingual	71.8	730.8	66.2	625.5	80.4	1123.5
Mesial-distal	72.6	812.9	70.4	671.7	74.2	931

Conclusions and clinical implications: A 3D-guided surgery software can help to predict the primary stability of oral implants

preoperatively. To obtain a higher ISQ value at insertion, it seems that in the upper jaw the M-D quality of bone is more important than the V-PL one, contrary to the lower jaw where the later can assure a better ISQ value.

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Single implant treatment in healing vs. healed sites of the anterior maxilla: an esthetic evaluation

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Background: Implant therapy is considered highly predictable and successful for the oral rehabilitation of fully and partially edentulous patients. The classical criteria by Albrektsson et al. (1986) are widely accepted and used as a method to assess success. In spite of multiple modifications, the focus of these criteria remained osseointegration and therefore, these may not apply to evaluate esthetics. However, the latter is more and more becoming the key for success in daily practice. The commonly used Nobelreplace® (Nobel Biocare, Göteborg, Sweden) implant system with its TiUnite® surface may not even show any documentation in this field.

Aim: The aim was to compare and document in detail the esthetic outcome of single-implant treatment in healing sites (early implant placement) with fully healed sites (conventional implant placement) of the anterior maxilla.

Methods: A cross-sectional study in patients who had been treated by two periodontists and two prosthodontists in 2006 and 2007 were conducted. Surgical treatment involved standard flap elevation without releasing incisions and restorative procedures included cemented crowns in all patients. Only straightforward single-implant treatments using Nobelreplace tapered TiUnite® implants (Nobel Biocare, Göteborg, Sweden) in healing sites (6–8 weeks following tooth extraction) and fully healed sites ($\geq$ 6 months following tooth extraction) were considered with both neighbouring teeth present and without the need for hard and/or soft tissue grafting. The esthetic outcome was objectively rated using the pink esthetic score (PES) and white esthetic scrore (WES) by a blinded clinician who had not been involved in the treatment. Patients rated esthetics by means of visual analogue scales.

Results: 21/22 early and 25/27 conventional implant treatments were available for esthetic evaluation after on average 2.5 years of function. There were no significant differences for any of the criteria between the treatment concepts. Overall, papillae were most easy to satisfy, whereas alveolar process and tooth colour most difficult. Twenty-six percent of the cases were esthetic failures (PES < 8 and/or WES < 6) and only 13% showed an (almost) perfect outcome (PES $\geq$ 12 and WES $\geq$ 9). There was no significant correlation between objective and subjective ratings.

Conclusions and clinical implications: Early and conventional single-implant treatment yielded comparable esthetic outcome. Despite a high clinical experience level of the care providers and the selection of relatively easy cases, one out of four single-implant treatments were esthetic failures and only a minority showed perfection.

147 | Topic – Implant Therapy Outcomes, Surgical Aspects

The use of fresh frozen homologous bone grafts in ridge atrophies: preliminary results of a randomized-controlled study

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Background: Creating adequate bone volumes for implant placement is a major clinical challenge. Although autologous bone grafting is still considered the gold standard, it may lead to undesired side effetcs, such as increase in morbidity because of the need of a donor site.

Aim: The goal of the present study is to assess the clinical, histological and radiographic findings of homologous vs. autologous bone block grafts in cases of transversal ridge atrophy (class IV, Cawood and Howell). The success of the following implant rehabilitation will also be evaluated.

Methods: Fourteen patients were randomized into two groups and underwent a surgical bone augmenting procedure: in the test (T) group, a fresh frozen tissue block from the tibial emiplate was grafted, fixed with screws and covered with a resorbable collagen membrane (Osseoguard, Biomet 3i, IN, USA); in the control (C) group, a block graft was harvested from an intraoral site and placed in the recipient site to increase bone volume following the same surgical protocol as group T. Homologous bone blocks were obtained from Banca cellulare e del tessuto muscolo/scheletrico (Istituti Ortopedici Rizzoli, Bologna, Italy)''. After 6 months (T6), implants were put in place and bone biopsies collected. CT scans were performed at the time of enrollment (CT-pre), after bone augmentation (CT-To) and some days before implant surgery (CT-T6). Volume (VOL) variation, minimum (MIND), maximum (MAXD) and mean (MEAND) bone graft densities were calculated for CT-To and CT-T6. Six months after placement, implants were exposed and healing screws positioned. Prosthetic rehabilitation was carried out at complete soft tissue healing.

Results: Thirty-one implants were placed. No complications were reported. All implants reached primary stability. One implant from T-group failed to integrate and was removed 2 weeks after surgical exposure. Thus far, eight implants have been used to support all-ceramic abutments and crowns. In T-group, VOL-T6 as measured in CT-T6 was 38.3% of VOL-To measured in CT-To; in C-group, VOL-T6 was 53.0% of VOL-To. Mean Density at T-6 (MEAND-T6) increased, respectively, of

41.8% for T-group and −2% for C-group in comparison to MEAND-To values.

Conclusions and clinical implications: The preliminary radiographical and clinical results of this ongoing trial show that the volume reduction of homologous bone blocks is higher than autologous bone and still widely unpredictable.

148 | Topic – Implant Therapy Outcomes, Surgical Aspects

All-on-Four™ tecnique in the lower jaw. A prospective study on bone level changes up to 60 months

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Background: Recent clinical studies reported encouraging survival rates with immediate fixed restorations supported by four implants only, of which the two posterior tilted. No difference in clinical and radiographic outcomes was reported between tilted and axial implants. Tilting of the implants can be associated with surgical and prosthetic advantages, such as the reduction of the distal cantilever extension. Clinical reports evidenced that prostheses with a cantilever shorter than 15 mm are associated with a better survival rate.

Aim: The aim of this prospective study was to evaluate peri-implant marginal bone level changes around tilted and axial implants supporting full-arch fixed immediate rehabilitations in lower jaw up to 60 months of loading.

Methods: Thirty-three patients (17 women and 15 men) were included in the study. Each patient received a full-arch fixed bridge supported by two axial implants and two distal tilted implants (All-on-Four, Nobel Biocare AB, Göteborg, Sweden). Loading was applied within 48 h of surgery. Patients were scheduled for follow-up. Periapical radiographs were taken using a paralleling technique and an individual X-ray holder at the time of prosthesis delivery and at each follow-up visit. Each radiograph was scanned and converted in TIFF format and the marginal bone level was assessed with an image analysis software by two independent blinded evaluator. The linear distance between implant neck and the most coronal bone-to-implant contact at the mesial and distal aspect was measured for each implant and all data were analysed with the Student's *t*-test.

Results: A total of 132 implants in the mandible with 4 mm diameter was placed. The mean follow-up duration was 52.8 months (range 30–66 months). No implant was lost to date, so the cumulative implant survival rate was 100%. No prosthetic failure occurred. There was no statistically significant difference in marginal bone loss between mesial and distal part of axial and tilted implant, except for axial implants after 24 months of loading ($P < 0.01$) (Table 1).

Table 1. Bone loss for axial and tilted implants in the mandible

Months	Number of patients	Axial	Tilted	*P*-value
		Mean ± SD	Mean ± SD	
6	33	0.52 ± 0.22	0.47 ± 0.22	56
12	33	0.57 ± 0.42	0.48 ± 0.23	24
18	33	0.67 ± 0.35	0.64 ± 0.37	74
24	33	0.96 ± 0.52	0.7 ± 0.38	0.03*
36	29	1.15 ± 0.61	0.81 ± 0.53	0.03*
48	24	0.92 ± 0.55	0.81 ± 0.4	60
60	12	0.51 ± 0.17	0.39 ± 0.18	29

*significantly different.

Conclusions and clinical implications: This study suggested that the use of tilted implants in the immediate loading procedures is safe and is not associated to a higher marginal bone loss as compared with axially placed implants. Further studies with a larger number of implants and a longer follow-up are needed to confirm the present results.

149 | Topic – Implant Therapy Outcomes, Surgical Aspects

Validation of a template-guided treatment accuracy (NobelGuide®) comparing two versions of a novel validation software tool

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Background: Template-guided treatment concepts for restorative-driven implant surgery are used to enable the transfer of complex prosthetic planning into the clinical situation. The possible deviations between the virtually planned implant positions and the implant positions post-surgery need to be evaluated and quantified, especially when flapless surgery is applied. For the verification of the accuracy of the template-guided implantology several studies have been published so far.

Aim: The purpose of this study was the evaluation of the overall deviation measured with a novel validation software and the comparison of two different levels of development (V1.0/V2.0) of this validation software tool.

Methods: After computer-aided planning (Procera® Software, Nobel Biocare, Sweden) 261 implants were placed in 65 partially or fully edentulous patients with the NobelGuide® treatment concept (NobelBiocare, Sweden). On the basis of the merged preoperative and post-operative DVT-scans (fusion) the deviations between the virtually planned and the actually placed implants were automatically measured by both versions (V1.0/V2.0) of this novel validation software tool.

Results: All patients underwent an uneventful one-stage implant surgery. The average deviation measured with the first version of the validation software was 1.26 ± 0.6 mm on implant shoulder and 1.47 ± 0.6 mm on implant apex. Additionally

the average depth deviation along the *z*-axis was 0.05 ± 0.9 mm. The mean angular deviation between the proposed and the actual direction was 3.3° ± 1.8° with a maximum deviation of 10.5°. The latest version of the validation software showed average deviations on implant shoulder of 1.19 ± 0.5 mm, on implant apex of 1.45 ± 0.6 mm. The average depth deviation was 0.12 ± 0.9 mm with an average angular deviation of 3.1° ± 1.6°.

Conclusions and clinical implications: The template-guided treatment concept NobelGuide® generated similar deviations compared with other clinical studies. The latest version of the validation software showed no statistically significant differences of the measured deviations. A detailed analysis of a possible intrinsic validation error needs to be evaluated thoroughly by further technically different validation processes.

150 | Topic – Implant Therapy Outcomes, Surgical Aspects

Split-crest technique with ultra-sonic bone surgery for ridge expansion

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Background: Split-crest surgery is a minimally invasive technique that lessens the risk of damage to surrounding soft tissues and important structures.

Aim: The aim of the present study was to evaluate the effectiveness of Split-crest bone augmentation technique for implant placement (BTI implants, Biotechnology Institute BTI, Vitoria, Spain).

Methods: A retrospective cohort study design was used. Fourteen patients with narrow ridges underwent between November 2007 and October 2008 a split-crest procedure using ultrasound device (BTI Ultrasonic) with the aim of placing 36 implants. Patients were recalled between June 2009 and January 2010 for a final evaluation. This visit included a complete evaluation of each implant status and surrounding soft tissues (success, plaque and bleeding index, probing depth) and a computed tomography scanner (CT-scanner) in order to evaluate bone expansion achieved with split technique. The minimum observation time for implants–patients was 11 months from implant placement. Implant survival was analysed using a life-table analysis (Actuarial method). The achieved bone expansion was measured comparing basal and final CT-scanner. Full descriptive analysis was carried out considering demographic, clinical, surgery-depending and prosthetic factors.

Results: The mean age of the 14 patients was 55 years (SD = 13.5) (range 19–72) at implant installation time. All patients were female. Seven of them were classified with a previous periodontal disease (50%). Seventy-five percent of the implants were placed in the maxilla (27) and 25% in the mandible (9). The mean follow-up time from implant insertion was 16.3 months (SD = 2.3, range 11–20) and from loading was 10.65 (SD = 2.2, range 6–14). The probing depth measured at four points showed a mean of 2.63 mm (SD = 0.7) (11–20 months post-implant insertion). Mean initial crestal bone width was 4.43 mm, and mean crestal bone expansion achieved was 2.83 mm (SD = 1.56) at final evaluation, showing a mean final crestal bone width of 7.26 mm (SD = 1.65). The overall survival rate was 100% for the implant and patient-based analysis, respectively. None of the implants failed during the observation period.

Conclusions and clinical implications: The results of this study show that split-crest technique is an effective and safe technique for ridge expansion used with careful treatment planning and strict clinical protocol. This less-invasive technique is especially indicated for very narrow ridges and may allow the insertion of implants in previously inaccessible locations. Split technique could be easier and associated with less complications than other conventional techniques used for bone ridge expansion.

151 | Topic – Implant Therapy Outcomes, Surgical Aspects

Extra-short BTI implants in maxilla and mandible. A retrospective study

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Background: When short or extra-short implants are used, it is possible to avoid bone grafting techniques to implant placement.

Aim: The aim of the present study was to evaluate the safety and survival rates of 5.5 and 6.5 mm extra-short BTI implants (Biotechnology Institute BTI, Vitoria, Spain).

Methods: A retrospective cohort study design was used. Forty-four patients were included who received 65 extra-short BTI implants in the posterior areas of upper and lower maxilla from May 2007 to March 2009 in Vitoria, Spain. The minimum observation time for all the included patients and implants from the insertion date was 10 months. All implants were already loaded at the time of final observation. Implant survival was analysed using a life-table analysis (Actuarial method). Marginal bone loss was measured mesially and distally. A full descriptive analysis was carried out considering demographic factors, clinical factors, surgery-depending factors and prosthetic variables.

Results: The mean age of the 44 included patients was 55.6 (SD = 9.6) years (range 29–75 years) at implant installation time. Thirty-one patients were female (70.5%). Seven patients were classified as smokers (15.9%). Eight 5.5 mm (diameters: 4.5, 5 and 5.0 mm) and 57 6.5 mm (diameters: 3.75, 4, 4.5, 5 and 5.5 mm) extra-short BTI implants were installed. 35.4% of the implants were placed in the maxilla and 64.6% in the mandible. Twenty-one extra-short implants (32.3%) were installed following special techniques (mainly vertical growth, $n = 19$). The mean follow-up time for the implants was 20 months (SD = 7.9, range 10–32). The mean follow-up period since loading time was 12.9 (SD = 6.9, range 3–31). Mean marginal bone loss at 12–24 months was 0.77 mm (SD = 0.9, median 0.58) in mesial, and 0.63 mm (SD = 0.7, median 0.56) in distal. The overall survival rate was

98.5% and 97.7% for the implant and patient-based analysis, respectively. Only one of the implants (6.5 mm in length) failed during the observation period.

Conclusions and clinical implications: The results of this preliminary study support that 5.5 and 6.5 mm extra-short BTI implants are safe and predictable when used with careful treatment planning and a strict clinical protocol. These implants are especially indicated for highly reabsorbed maxillae and will be always splinted.

152 | Topic – Implant Therapy Outcomes, Surgical Aspects

A new implant for the retention of nasal prostheses after total rhinectomy

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Background: Extra-oral implants have been used for many years to anchor silicon nasal prostheses. Surgical access for implant placement can be difficult, and the particular position of the fixture head may be unfavourable for the prosthodontist.

Many patients requiring surgery of this kind also happen to be edentulous.

Aim: Our objective was to use computer-aided design (CAD) computer-assisted manufacturing (CAM) technology to design a specially engineered ''bifunctional'' implant, to be installed via an intra-oral approach, to simultaneously anchor nasal and oral prostheses, for an edentulous patient who has undergone a total rhinectomy.

Methods: The bifunctional fixture was designed in CAD software, and milled from commercially pure titanium using CAM technology. The nasal part of the fixture was designed to fit through the prepared site and protrude into the piriform aperture. A Hex attachment was orientated perpendicular to the axis of the fixture on this extension.

The intra-oral head of the fixture was provided with a standard Branemark ''Hex'' configuration.

Surgical planning software (Nobleguide Gothenberg, Sweden) was used to plan surgery and design a drill guide so that the implants could be precisely positioned in relation to a dental prosthesis and the piriform aperture. Implants were placed using the guide and associated instrumentation.

So as to compensate for the natural inclination of the premaxilla, angled abutments were used to retain a gold substructure and the prosthesis.

Results: In then two cases treated so far, the implant greatly facilitated surgical and prosthetic management, improving access for prosthodontic treatment and offering the added potential to use the implants to stabilize an oral prosthesis.

Conclusions and clinical implications: CAD CAM technology has the potential to produce bespoke implantable components at low cost.

The bifunctional fixture appears to offer some advantages in terms of the surgical and prosthetic management of patients requiring rhinectomy.

153 | Topic – Implant Therapy Outcomes, Surgical Aspects

A 4- to 5-year retrospective clinical and radiographic study of Neoss implants placed with or without GBR procedures

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Background: In the modern implant clinic, the implant specialist will on a daily basis meet demands to efficiently deal with different clinical problems. These may include augmentation of bone and soft tissues, which has been lost due to trauma or infection, placement of implants in soft bone densities and in narrow spaces. Thus, an implant system that performs well in the different clinical situations is needed for a successful outcome. New dental implant systems are continuously introduced to the market. It is important that clinicians report their experiences with these implants when used in different situations.

Aim: The aim of the study was to retrospectively evaluate the survival rate of Neoss implants when used with or without GBR procedures after up to 5 years of follow-up. The purpose was also to examine the marginal bone conditions.

Methods: The study group comprised of 50 consecutive patients previously treated with 183 Neoss implants (Bimodal surface, Neoss Ltd., Harrogate, UK) in 53 sites due to single, partial or total tooth loss. Implants were placed in healed bone in 23 sites, while a GBR procedure was used in 30 sites in conjunction with implant placement. A healing period of 3–6 months was utilized in 45 sites and in eight sites a crown/bridge was fitted within a few days for immediate/early function. The number of failures, withdrawn and drop-out implants was analysed in a life table. All available intraoral radiographs from baseline and annual check-ups were analysed with regard to marginal bone level and bone loss.

Results: A CSR of 98.2% was found for the non-GBR group and 93.5% for the GBR group with an overall CSR of 95.0% after up to 5 years of loading. In spite of the failures, all patients bout one received and maintained their prostheses. Based on all available radiographs, the bone level was situated $1.3 + 0.8$ mm ($n = 159$) below the top of the collar at baseline and $1.7 + 0.8$ mm ($n = 60$) after 5 years of follow-up. Based on paired baseline and 1-year ($n = 70$) and 5-year radiographs ($n = 59$), the bone loss was found to be $0.4 + 0.9$ and $0.4 + 0.9$ mm, respectively. There were no statistically significant differences between GBR and non-GBR sites with regard to survival and bone loss.

Conclusions and clinical implications: It is concluded that the Neoss implant system shows good clinical and radiographic results after up to 5 years in function when used in normal sites and in areas subjected to a GBR procedure. Short and narrow

implants seem to be more prone to failure when placed in conjunction with a GBR procedure, than longer and wider implants.

154 | Topic – Implant Therapy Outcomes, Surgical Aspects

The Straumann bone level implant in the esthetic zone: a private practice experience

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Background: In recent years, the concept of platform switching design has gained interest because it is believed to show minimal crestal bone and enhance esthetic results. Straumann® bone level implants (BLI) benefit from the Bone Control Design® based on the platform switching concept.
Aim: The aim of this study was to review and assess the outcome of implant treatments in the esthetic zone with BLI and to document there survival rates for up to 25 months after placement in a private practice setting.
Methods: A retrospective review and an outcomes assessment of BLI placed in the esthetic zone between January 2008 and July 2009 in a private practice were conducted. Implants were assessed by chart review and clinical review. Data were collected relative to patient age, gender, implant diameter, implant length and anatomic location of implants. Clinical review consisted of mobility testing, soft tissue evaluation, prosthetic evaluation and radiographic evaluation.
Results: Thirty-six patients were treated with a total of 48 BLI. Two different endosteal diameters were used: 17 implants of 3.3 mm diameter and 31 implants of 4.1 mm diameter. Implants of three different lengths were inserted: one implant of 14 mm, 30 implants of 12 mm and 17 implants of 10 mm. The implants position covered the following anatomic locations: maxillary central incisors (21 implants), maxillary lateral incisors (10 implants), maxillary canines (four implants), maxillary premolars (five implants) and mandibular incisors (eight implants). The follow-up period ranges from 7 to 25 months and all implants have at least 3 months of loading/function. Within the limits of this timeframe the survival rate is 100%.
Conclusions and clinical implications: A retrospective review of 48 BLI placed in the esthetic zone between January 2008 and July 2009 confirmed the reliability and predictability of this implant.

155 | Topic – Implant Therapy Outcomes, Surgical Aspects

Maxillary sinus augmentation by the crestal core elevation technique

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Background: Rapid crestal bone resorption following maxillary tooth loss is further accentuated in the posterior region due to pneumatization and enlargement of the maxillary sinuses. A treatment that enables preservation and augmentation of the available vertical bone at the time of maxillary tooth extractions may offer numerous therapeutic benefits.
Aim: To retrospectively evaluate the outcome of 45 sinus lift procedures in 45 patients using the crestal core elevation (CCE) technique performed concomitantly with extractions of the upper molars over an 11 years period of time.
Methods: After extractions of upper molars, core preparation was made by a calibrated 6 mm trephine bur to about 1 mm estimated distance from the sinus membrane. The trephined interradicular bone and the underlying sinus membrane were imploded into the sinus. The surgical crater and residual extraction socket were filled with either anorganic bovine bone mineral (DBBM) or with freezed-dried bone allograft (FDBA) material and was protected with a bioabsorbable collagen membrane. Flaps were coronally positioned and sutured utilizing interrupted mattress sutures so as to achieve passive primary closure. Implants were placed 4 months later. Success was recorded if an implant of at least 9 mm in length could be placed without perforating the floor of the sinus. At sites presenting with 7–9 mm bone height the bone added osteotome sinus floor elevation (BAOSFE) procedure was performed simultaneously with implant placement; these were recorded as partial success.
Results: Out of 45 procedures in 45 patients, eight sites in eight patients (17.8%) failed at the time of surgery. All implants placed in 37 patients were successful during 1–11 years follow-up period of time.
Conclusions and clinical implications: The advantages of the CCE procedure over the lateral window procedure is that it is less invasive, the corronally positioned bone plug remains attached to part of its original blood supply, and in this study all implants placed successfully integrated and restored, yielding 100% success rate of implants survival. The main limitations are core detachment or large tears of the sinus membrane during the malleting phase, resulting in this study a relatively high failure rate (17.8%).

156 | Topic – Implant Therapy Outcomes, Surgical Aspects

Influence of early cover screw exposure on the crestal bone loss around implants in identical subjects: 1-year follow-up study after loading

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Background: Spontaneous early exposure of implants during initial healing stage may be an additional complication, because partial exposure of the coverscrews is possible foci for plaque accumulation. It may result in peri-mucositisand possible crestalbone loss, if left untreated.

After functional loading, peri-implant bone loss may occur during the first year. For this reason, it is necessary to compare the bone level that is established around the exposed and non-exposed functionally loaded implants to understand the clinical significance.

Aim: The aim was to evaluate the clinical and radiographic changes of the marginal bone level between exposed and non-exposed implants in identical subjects after 1 year of functional loading.

Methods: Treatment procedure

Fourty Astra Tech implants were placed following the two-stage surgical protocol. After a healing period of 3 months in the mandible and 6 months in the maxilla, the second surgery was performed. Three to four weeks after the second-stage surgery, the suprastructure was inserted.

When cover screw exposure through the oral mucosa between the first and the second surgery was observed, uncovering surgery was performed immediately.

Radiographic examination

Nineteen patients who had both exposed and non-exposed implants were included in the radiographic examination, and the crestalbone loss in 40 implants (20 exposed implants, 20 non-exposed implants) was evaluated. The radiographs of exposed and non-exposed implants were evaluated for the marginal bone level at the mesialand distal surfaces and an average value was obtained. Bone loss was measured by comparing the radiographs taken at the first surgery to those taken immediately after prosthesis delivery, immediately after prosthesis delivery to 1 year after functional loading and the first surgery to 1 year after functional loading.

Statistical analysis

The crestalbone losses of exposed and non-exposed implants in identical subjects were compared with Wilcoxon signed ranks test.

Results: The mean crestalbone loss in exposed implants from fixture placement to prosthesis delivery was 0.41 ± 0.43 and 0.16 ± 0.22 mm in non-exposed implants. The difference in change of crestalbone loss was statistically significant between exposed and non-exposed implants ($P = 0.005$).

Conclusions and clinical implications: The early exposure of cover screw that result in the breakdown of mucosal seal around the implants seems to facilitate peri-implant crestalbone loss. But, if the exposure of cover screw is detected in early stage and proper treatment is done, re-integrated soft tissue and hard tissue is stabilized after functional loading.

157 | Topic – Implant Therapy Outcomes, Surgical Aspects

Peri-implant marginal bone loss based on the thread size of implant neck area: a 1-year prospective study after loading

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Background: The role of micro-threads in the neck portion has been researched in numerous studies. The advantages of micro-thread compared with a smooth neck is claimed to be superior bone-to-implant contact and marginal bone level maintenance.

However, there are few clinical studies comparing implant with a uniform thread size from the apex to the neck area and implant with micro-threads in the neck area.

Aim: The aim of this investigation was to compare the changes in marginal bone level of implants that have two different thread size on implant neck area and to analyze the effect of thread size on peri-implant marginal bone change.

Methods: Implants

The two groups of implants used in this study differ only in the thread size of the implant neck area. One (Group A) has a uniform macro-thread from the apex to the neck area, and the other (Group B) was provided with micro-threads on the coronal 3.0 mm of the fixture. The surface treatment method and implant–abutment connection type of both groups are identical.

Patient selection

Patients who required implant therapy were recruited between July 2007 and June 2008. In total, 10 patients (5 males and 5 females, 11 cases and 22 implants) participated in the study, with a mean age of 58.1 years and a range of 23–65 years.

Treatment procedure

All surgeries were performed using a two-stage method. Implants from each group were placed adjacent to each other in the partially edentulous area of each patient. The mesiodistal location of each implant was randomly determined. The prostheses were delivered 3 weeks after the second surgery. Patients were recalled every 6 months for oral hygiene evaluation, professional plaque control, and review of self-performed oral hygiene instruction.

Statistical analysis

Wilcoxon signed rank test was used to analyze the differences in peri-implant marginal bone loss between the two groups.

Results: The mean marginal bone losses (Group A, 0.218 ± 0.126 mm; Group B, 0.175 ± 0.156 mm) were not statistically significant between the two groups ($P = 0.553$).

Conclusions and clinical implications: Implant with micro-threads has slightly less marginal bone loss. However, there was no significant difference statistically. The results can be interpreted as the thread size at the implant neck area not being the determining factor in the amount of marginal bone loss,

because both groups of implants have a rough surface produced by RBM surface treatment. Also macro-threads can be viewed as having as much stress distribution as micro-threads. Long-term follow-up observations are needed for a clear conclusion.

158 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival rates and marginal bone loss at dental implants with short functional intraosseous length below 10 mm: a retrospective evaluation

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Background: Short implants are an interesting alternative to bone augmentation in atrophic jaws. Recent studies showed 1–3 years survival rates above 90% in maxilla and mandible if a good bone interface is given. Finite element models of implants showed a load induction in the first mm of bony embedding. While functional length of 8 mm is accepted, shorter implants and longer surveillance times are a current research issue.

Aim: The goal of this study is to show the survival rates of short implants (9 mm and shorter) compared with longer implants in the partly edentulous mandibular premolar and molar region with fixed prosthetics (crowns and bridges). Marginal vertical and 2D bone loss was evaluated additionally.

Methods: Five hundred and six dental implants with fixed prosthetics (crowns and bridges) in the premolar and molar region of the mandible were evaluated. Ninety implants were 9 mm or shorter. Patient data were evaluated to acquire implant survival rates, implant diameter, gender, and age. Orthopantomography was analysed with image J software. An algorithm for vertical and 2D marginal bone loss was established.

Results: Average surveillance time was 502 days. Survival rate of short implants was 95.5% (five implants lost) compared with 89.1% in the longer implants group. Sixty-five of the short implants were Astratech (two losses) and 22 were Camlog Screw Line Promote Plus (two losses). Other implants were three. Vertical marginal bone loss was not significantly different in short and regular length implant group with averaged 0.6 mm over the observation period. The 2D bone loss was averaged 0.7 mm^2 with no significant difference between the two groups.

Conclusions and clinical implications: Within the limits of this study, we conclude that short implants with a length of 9 mm or less have equal survival rates compared with longer implants over the observation period of 1–3 years.

159 | Topic – Implant Therapy Outcomes, Surgical Aspects

Survival rate of tapered vs. straight implants – 1-year follow-up

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Background: Biomet 3i change macrogeometry of their tapered implant due to decrease in implant survival rate.

Aim: Report retrospectively, the survival rate of the new NT Tapered implant (Biomet 3i) compared with the Straight implant (Biomet 3i).

Methods: A retrospective study of 150 consecutive implants 76 Tapered implants included in the study group, and 74 Straight implants in the control group.

Both had the same double acid-etch implant surface (Osseotite).

The study group included 50 implants in the maxilla.

Seventeen (dimensions in mm were 3.25 × 8.5 – (1), 4 × 8.5 – (3), 4 × 10 – (2), 5 × 8.5 – (1), 5 × 10 – (2), 4 × 11 – (4), 4 × 13 – (3), 4 × 15 – (1)) in the posterior area (directly under the maxillary sinus) and 33 (3.25 × 10 – (3), 3.25 × 13 – (4), 3.25 × 15 – (2), 4 × 11.5 – (2), 4 × 13 – (12), 4 × 15 – (10)) in the anterior area.

Twenty-six were in the mandible from which 18 (3.25/8.5 – (2), 4 × 8.5 – (3), 4 × 10 – (5), 5 × 10 – (1), 4 × 11.5 – (7)) were in the posterior area (distal from the mental foramen), and eight (4 × 10 – (2), 4 × 11 – (1), 4 × 13 – (4), 4 × 15 – (1)) in the interforaminal area.

The control group included 33 implants in the maxilla, 20 (4 × 13 – (9), 4 × 15 – (6), 3.75 × 13 – (5)) in the anterior area and 13 (4 × 8.5 – (3), 4 × 10 – (2), 5 × 10 – (2), 4 × 11 – (4), 3.75 × 13 – (2)) posterior.

Thirty-seven in the mandible, from these 20 (4 × 11 – (2), 3.75 × 13 – (12), 3.75 × 15 – (6)) in the anterior area, and 17 (4 × 8.5 – (4), 4 × 10 – (5), 5 × 10 – (1), 4 × 11 – (7)) posterior.

For the entire sample, insertion torque was between 35 and 50 N/cm. Primary stability achieved from native bone, all left submerged and stage two made 3-5 month after implant insertion.

Final restoration placed 4–7 month after implant installation and 1-year follow-up was made.

Results: The overall survival rate of the study group was 100% and the control group was 97.3%.

The average dimensions of the implants for the study group in the maxilla were 4.13 × 10.62 posterior and 3.31 × 13.36 anterior, while in the mandible was 3.97 × 10.16 posterior and 4 × 12.25 anterior.

For the control group the average in the maxilla was 3.9 × 13.6 anterior and 4.12 × 10.42 posterior. In the mandible was 4.0 × 10.05 posterior and 3.77 × 13.4 anterior.Two implant failed in the anterior region of the maxilla being the survival rate of this area, with straight implants, of 90%.

Conclusions and clinical implications: When sufficient native bone is present for primary stability, a two-stage implant approach is made with at least 3 month interval from installation and with 1 year follow-up after final restoration, the

survival rate of tapered implants with double acid etch has a tendency to be similar to the straight ones with the same surface, despite implant dimensions or site specifications. (Although in our statistic the anterior region of the maxilla showed a tendency for worse prognostic when using parallel wall implants.)

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Implant surgery using bone- and mucosa-supported stereolithographic guides: surgical and post-operative outcomes

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Background: Computer-assisted implant placement using stereolithographic surgical guides may provide significant benefits for the surgeon and the patient.

Aim: The aim of this study was to compare the surgical and post-operative outcomes of computer-aided implant surgery performed by bone- and mucosa-supported stereolithographic (SLA) guides against the standard technique.

Methods: Multiple- and single-type SLA guides from two commercial manufacturers were produced and a total 341 implants were placed to 52 patients using the standard technique (control group), bone- (BSG group) and mucosa-supported SLA guides (flapless group) in 21, 16 and 15 patients, respectively. Surgical duration (min), number of analgesics (tablets) as well as hemorrhage, difficulty in mouth opening (or trismus) and other incidences were recorded. Pain and swelling was assessed by visual analog scale (VAS). Parametric and non-parametric tests were used for statistical analysis ($P < 0.05$).

Results: Mean surgery duration (23.53 ± 5.48 min) and the number of analgesics consumed (four tablets) in the flapless group was lower than BSG (68.71 ± 11.4 min and 10 tablets) and control groups (60.94 ± 13.07 min and 11 tablets, $P < 0.01$). The change of pain-scores (VAS) and the number of analgesics consumed in time were statistically significant ($P < 0.01$ and $P < 0.05$, respectively) and the flapless group reported a lower pain score than the BSG ($P < 0.01$) and control groups ($P < 0.001$). The flapless group experienced less hemorrhage ($\chi^2 = 4.12$, $P = 0.041$ on the day of surgery) and fewer instances of trismus ($\chi^2 = 6.91$, $P = 0.031$ the day after surgery). The differences of early term failures were not statistically significant between the groups (Log rank test: $P = 0.782$).

Conclusions and clinical implications: The use of mucosa-supported single SLA guides for flapless implant placement may help reduce surgery duration, pain intensity, related analgesic consumption and most other complications typical in the post-implant surgery period. However, there are particular drawbacks in both guide types and further studies are required to confirm the prosthodontic conformity and long-term success of implants placed by computer-assisted techniques.

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Radiographic vertical bone loss evaluation following 1 year of functional loading

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Background: Marginal bone loss is evaluated by mean of radiography and directly associated with the long-term success of implant treatments. According to Albrektsson and colleagues' marginal bone level changes in the first year after implant insertion should be < 1–1.5 mm, and ongoing annual bone loss should be < 0.2 mm. Using Branemark System, Adell and colleagues reported a bone loss of 1.2 mm for the first year in their 15-year study. It seems that the initial marginal bone level change occurrs as an adaptation of the peri-implant bone to the occlusal load.

Aim: Vertical bone loss evaluations in the Nobel Biocare Replace Select Tapered™ implant system in human after 1 year loading time.

Methods: This retrospective cross-sectional study was done on 31 patients (14 males, 17 females, mean age of 60.39 years old) receiving 170 implants (mean 5.48 for each patient) of Groovy and Nongroovy design in Nobel Biocare Replace Select Tapered™ system. The marginal bone loss was measured at mesial and distal aspects of the implants on OPG X-ray findings after 1 year follow-up. The data regarding patient's gender, age, history of disease, smoking, bone type at implant location, loading time of prosthesis and implant, implant design, diameter and length were recorded by patients' records and interview. The data were subjected to multiple linear regression and Pearson's coefficient ratio regarding different factors.

Results: The mean (standard deviation) distal, mesial and overall bone loss was 0.688 mm (0.851), 0.665 mm (0.849) and 0.935 mm (0.905 mm) in the studied implants. No significant differences were found regarding implant location, bone quality at the implant region, implant design and bone graft reception. Also, no significant correlation was found between the occurred bone loss and implant diameter, length and number of used splints.

Conclusions and clinical implications: Because of the criteria mentioned for implant success in term of bone loss values after 1 year loading time, Noble Biocare Replace Select Tapered™ implant system is an accteptible treatment option for implant restorations in this regard.

RCT comparing minimally with moderately rough implants: microbial observations

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Background: Most current implants have a moderately rough surface (compared with older minimally rough ''turned'' implants) to facilitate osseointegration.
Aim: This split-mouth RCT examined whether this increased surface roughness influenced the subgingival plaque formation.
Methods: Ten fully edentulous and eight partial edentulous patients, all with a history of severe periodontitis, received four to six implants (mandible or maxilla). Per jaw, both minimally (turned) and moderately rough (TiUnite) implants (MKIII, Nobel Biocare) were alternated. Also the healing and final abutments had similar surface characteristics. At each visit (day 3, weeks 1 and 2, months 3 and year 1 after abutment connection) samples were taken from the subgingival implant flora (two pooled implant sites per surface). Microbiological analysis was done by microbial culturing, qPCR and checkerboard DNA–DNA hybridization. Bacterial counts were log-transformed and a linear mixed model with patient as random factor was fit to find differences between the minimally and moderately rough surfaces.
Results: Over the entire period, no statistically significant differences ($P > 0.05$) could be detected between the minimally and moderately rough surfaces for any of the applied microbial analysis techniques. In partial edentulous patients, the biofilm matured to a higher concentration of pathogens when compared with full edentulous patients. A significant difference was observed between the numbers of periodontopathogens when partial edentulous patients were compared with full edentulous patients.
Conclusions and clinical implications: The surface roughness of the investigated implants and abutments did not influence the microbial colonization during the first year after abutment connection. One should keep in mind that the presence of natural teeth in periodontitis susceptible patients may affect the long-term outcome of implants, independently from a minimally or moderately rough implant surface.

Effect of smoking habbits on accuracy of implant placement using mucosally supported stereolithographic surgical guides

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Background: Patients with a thick mucosal biotype have a more resilient mucosa leading to a higher degree of freedom when positioning a surgical guide. Therefore, variations in thickness of mucosal structures between smokers and nonsmokers could lead to a different outcome regarding accuracy of stereolithographic surgical procedures when using full mucosally supported guides.
Aim: To evaluate effects of smoking habbits on gingival thickness of patients treated with full mucosally supported stereolithographic surgical guides and consequently measure deviations between virtually planned and clinically placed implants.
Methods: Six OsseoSpeed^{TM} implants (Astra Tech AB), with a TiO2-blasted surface, were inserted into the maxilla for each patient. Post-op, a new CT scan was taken. Software (Mimics 9.0) was used to fuse images of the virtually planned and actually placed implants, and locations and axes were compared.

In order to evaluate thickness of the mucosal supporting tissues, 12 reference points were defined within each patient. Mucosal thickness was defined as the distance between the surface of the alveolar crest and the base of the scanning template and was measured by drawing a tangential line at an arbitrarly chosen distance of 15 mm for the buccal/platal cusp for molars and at 15 mm distance from the incisal line for canines and incisors.
Results: Thirteen patients were included. Out of 13 patients, six were current smokers (+10 cig/day). In the smoking subgroup, 36 implants were placed compared with 42 in the nonsmoking subgroup. Mean coronal deviation was 1.04 mm (range: 0.29–2.45 mm) in smokers compared with 0.80 mm in the nonsmokers (range: 0.29–1.67 mm). At apical point mean deviation was 1.26 mm (range: 0.39–3.01 mm) in smokers compared with 1.02 mm in the nonsmokers (range: 0.32–2.59 mm). Mean angular deviation was 2.64° (range: 0.41°–6.81°) in smokers compared with 2.57° in the nonsmokers (range: 0.16°–8.86°). Significant differences were found when comparing global coronal and apical deviation between smokers and nonsmokers ($P < 0.05$).

Twelve recordings per patient were used to define a mean patient value for mucosal thickness. In the smokers group, mean mucosal thickness was 3.19 mm (range: 2.39–4.01 mm) compared with 2.43 mm in the nonsmokers (range: 1.44–3.03 mm). A statistically significant difference was found between smokers and nonsmokers on patient level.
Conclusions and clinical implications: Statiscally significant differences were found when comparing accuracy of dental implant placement in smokers to nonsmokers.

Smokers have significant thicker supporting mucosal tissues compared with nonsmokers who may explain inaccuracy due to less surgical guide stability.

Simultaneous sinus membrane elevation and dental implant placement without autogenous bone graft: a 6-month follow-up study

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Background: Earlier studies have shown that the simultaneous sinus mucosal lining elevation and installation of dental implants without graft materials could be a predictable procedure.
Aim: Therefore, the aim of this prospective, controlled and randomized clinical study was to evaluate whether sinus membrane elevation and simultaneous placement of dental implants without autogenous bone graft can create sufficient bone support to allow implant success after 6 months post-surgically.
Methods: Sinus membrane elevation and simultaneous placement of dental implants were performed bilaterally in 15 patients in a split-mouth design. The sinuses were assigned in two groups: test group, with simultaneous sinus mucosal lining elevation and installation of dental implants withoutgraft materials, and control group, with simultaneous sinus mucosal lining elevation and installation of dental implants with intraoral autogenous bone graft. After 6 months of healing, abutments were connected. For each implant, length of implant protruded into the sinus, resonance frequency analysis (RFA) and bone gain were recorded at baseline and 6 months follow-up.
Results: Clinical complications were not observed, except for two post-operative fistulas/suppuration in both groups. Only one implant of test group was lost, reaching a success rate of 96.4% and 100% for test and control groups, respectively. After healing, radiographic new peri-implant bone was observed in both groups ranging between $8.3 + 2.6$ and $7.9 + 3.6$ mm for control and test group, respectively ($P > 0.05$). RFA values were lower for the control group when compared with baseline ($P < 0.05$). A significant positive correlation was found between the protruded implant length/bone gain and implant survival/sinusitis ($P < 0.0001$). The technique applied (placing implants simultaneously to sinus membrane elevation without graft material) resulted in bone formation over a period of 6 months.
Conclusions and clinical implications: Implants placed simultaneously to sinus membrane elevation without graft material resulted in bone formation over a period of 6 months.

Immediate loading with definitive prosthesis and flapless surgery: a clinical study

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Background: CAD/CAM systems with flapless surgery have been more used in implantology. The software joins the prosthetic planning and the bone anatomic disposal. Immediate loading and and flapless surgery leading to a reduction of the surgical time, and it also lessens the post-operative discomfort for the patient.
Aim: The purpose of this study was to evaluate the implant placement with flapless surgery, immediate loading and definitive prosthesis on the same day. The analysis was conducted under two aspects: the accuracy and the clinical condition during 24 months.
Methods: Fifty-nine implants were placed in 12 patients, eight females (66.7%) and four males (66.7%), with an average age of 60.3 years old. Radiographic templates were using for the one-beam-computerized tomography. The data were used to produce an implant planning, and this planning was transferred to surgery using rapid prototype surgical guides. All implants were immediately loaded supported by a titanium framework. The clinical stability of each single implant and the prosthesis were evaluated after restoration removing at 6 months post-surgery. Pre-operative cone-beam CT images were matched with the post-operative ones to calculate the deviation between planned and placed implants.
Results: The cases included in this study achieved 98.3% implant and 100% of the prosthesis survival. No serious biological and technical complications were recorded. Only one implant was lost during the immediate post-operative period; however, it did not imply any damage to the prosthesis. There were two sites in which the ridges were too narrow, and a flap was necessary to place the implants. Nevertheless, these flaps were not included in the statistics analysis. The placed implants (length: 10–15 mm) showed an average angular deviation of 6.45° (SD: 4.3°, range: 0.00°–18.64°) as compared with the planning ones, while the mean linear deviation was 1.43 mm (SD: 0.79 mm, range 0.09–4.12 mm) at the hex.
Conclusions and clinical implications: This study demonstrated that it is possible to successfully rehabilitate the edentulous patients on the same day by placing the implants with a

permanent restoration supported by titanium framework attached by laser joint with connection implants.

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Graftless rehabilitatin of the edentulous jaws with immediate function

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Background: Very often the placement of implants in the posterior maxilla and mandible is impossible without previous bone grafting. Graftless rehabilitation by placing implants in the remaining bone volume is a challenge. Immediate function and immediate loading on implants placed in post-extraction sockets add to this challenge.

Aim: • The surgical outcome of tilted implants as alternative to bone grafting.

• Predictability of immediate loading especially in the maxilla.

• Predictability of immediate implantation with and without immediate loading.

• Predictability of cemented and screw-retained porcelain fused to metal fixed restorations seated on tilted implants.

Methods: Two hundred and twenty-two patients (93 males and 129 females) with the mean age of 59 years were participated in this clinical study.

One hundred and sixty-one full arches, 22 hemi arches and 82 posterior partial segments (all in both jaws) were restored without previous grafting, by the use of 433 tilted implants and 810 axial implants (total 1243 implants).

The tilted implants were placed in extreme angularity up to 45° located mesially to the maxillary sinuses, or to the mental foramens.

Immediate function was applied on 240 tilted implants, and on 304 axial implants (total 544 implants).

Immediate implantation in post-extraction sockets was applied with 110 tilted implants and with 452 axial implants (total 562 implants).

Immediate implantation followed by immediate loading was applied on 54 tilted implants and on 197 axial implants (total 251 implants).

The patients were followed periodically for 6–60 months after the surgery, with clinical and radiographic evaluation.

Results: Fifteen titled implants were failed (CSR = 96.54%), from which eight implants were immediate loaded (CSR = 96.67%), and two implants were immediate implanted (CSR = 98.18%).

Twenty-one axial implants were failed (CSR = 97.41%), from which 10 implants were immediate loaded (CSR = 96.71%), and 10 implants were immediate implanted (CSR = 97.79%).

No significant differences were detected in referring to CSR of implants, neither between maxilla and mandible nor between method of implantation: immediate loading, delayed loading, immediate implantation with and without immediate loading.

Hundred percent success in cases, after re-implantation of strategicfailed implants, with almost no mechanical complications.

Conclusions and clinical implications: Graftless rehabilitation of the atrophied maxilla and mandible using titled implants with immediate function and immediate implantation should be considered as a viable treatment approach with considerable benefits.

Sinus grafting and onlay bone grafting can be avoided in majority of cases.

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Survival rate of short implants in oral rehabilitation

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Background: Several studies reported higher survival rate of short implants in alternative of massive bone augmentation procedures.

Aim: The aim of the present clinical study was to report the clinical performance and survival rate of short implants with at least 1 year of function.

Methods: In this prospective study, 43 consecutive patients (27 females and 16 males) treated with at least one short implant (8 mm) were enrolled. A total of 117 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were inserted in 39 partially edentulous patients and in four patients with edentulous maxilla. Implant length ranged from 8 to 14 mm. Sixty-two (52.9%) were short implants and in particular 39 were in Maxilla, while 23 in Mandible. Forty-one of the short implants have diameter of 3.5 mm. Patients were scheduled for follow-up at 6 months, 1 year and annually. mPlI, mSBI, standardized periapical radiographs, technical complications and patients satisfaction were recorded.

Results: After 10 days of implantation, one short implants was removed in posterior mandible for suppuration. After conventional submerged healing period of 3–4 months all others implants were osseointegrated. All implants were restored with full occlusal contact. Thirty-seven implants were loaded with single crowns, in particular 29 of them were short implants. Forty-two implants with 19 bridgework, 21 implants to support three full-arch bridges and four implants to retain two ball-attachment denture in mandible, 13 implants were used to restore three edentulous maxilla using pre-fabricated SynCone components to retain overdenture. During a total loading period of 18.4 months (range 12–34 months), no implant was lost. Survival rate of short implants was 98.4%. The majority of implants presented healthy peri-implant soft tissue conditions (mPlI = 1, mSBI > 1). Radiografic mean bone loss evaluating both interproximal surfaces was 0.58 mm. No significant differences was found in clinical and radiographic parameters between short implants and all others implants.

Conclusions and clinical implications: The prognosis of short implants is comparable with that of long implant. Implant–prosthetic treatment using short implants instead of performing

extended augmentation procedures before installation of long implants might be considered as a predictable alternative treatment options.

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Three-dimensional treatment planning – new possibilities of flapless implant dentistry

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Background: Three-dimensional hard tissue visualisations with additional radiographic templates move the difficult implant positioning decision-making from the surgical stage to the diagnostic phase. The insight into the palato-buccal dimesion of the alveolar ridge due to the transsectal reslicing enhances the implant positioning, within the maxillary sinus area, giving new possibilities of flapless implant placement.
Aim: The aim of the present study is to propose new possible sites for flapless implant placement in the maxilla due to the three-dimensional treatment planning and its transfer to the patient by the means of stereolithographic surgical templates.
Methods: The research group consisted of 41 patients: 30 with partially and 11 with fully edentulous maxillae introduced into the diagnostic procedures according to the NobelGuide concept. The patients had the radiographic guides with guttapercha markers prepared and the CTs were performed in the double scanning protocol. The treatment plan was prepared using the three-dimensional virtual models of the maxillae. Seven patients with fully edentulous maxillae and 11 with partially edentulous maxillae were finally qualified for the flapless procedure with the use of stereolithographic templates.
Results: Eighteen flapless surgeries were performed using the stereolithographic templates made according to the treatment plan. A total of 101 implants were placed: 51 in the fully edentulous cases and 50 in the partial cases. The majority of implants were placed in the proximity of maxillary sinus, angulated mesially, distally, or palatally following the individual geometry of alveolar ridge of the patients. The maxilary sinus septa if found with proper dimensions were also used for flapless implant placement. In the partial cases, the implants in the positions of first premolars were placed palatally with the apices under the distally angulated root apices of the canines that often are positioned near the buccal wall of the alveolar ridge.
Conclusions and clinical implications: Within the limitations of the study the three-dimensional treatment planing and its transfer to the patients by means of flapless surgery with the use of stereolithographic templates seems a predictable and effective method of treatment, often allowing to avoid the augmentation procedures in the area of maxillary sinus in cases of partial and full edentulism when the planning is performed using the virtual models of the tissues, and the meticulous analysis of the anatomical conditions at the planning phase makes the augmentation procedures more predictable in patients who do not qualify for the angulated implant placement using the stereolithographic templates.

169 | Topic – Implant Therapy Outcomes, Surgical Aspects

Factors influencing resonance frequency analysis (RFA) assessed by Osstell™ mentor during implant tissue integration

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Background: Resonance frequency analysis (RFA) may be affected by a number of parameters both implant and hoist related.
Aim: To monitor the development of implant stability of SLA Straumann® tissue-level implants using RFA and to determine the influence of instrument positioning, bone morphology, implant length, diameter and surface modification on RFA.
Methods: In a first study, 32 patients received either 8 mm, ø 4.1 mm ($n = 16$: Group A) or 10 mm, ø 4.1 mm Straumann Standard Plus tissue-level implants ($n = 16$: Group B). During healing, RFA was performed on weeks 0, 1, 2, 3, 4, 5, 6, 8 and 12. The implants were restored after 10.

Moreover, twenty-five 10 mm length implants including 12 SLA RN Ø: 4.1 mm implants, eight SLActive RN Ø: 4.1 mm and five SLA WN Ø: 4.8 mm implants were placed. ISQ values were determined at intervals similar to those of the first study. ISQ values were compared between implant types and Groups (A and B) using unpaired *t*-tests and longitudinally within implant types using paired *t*-tests.
Results: Positioning of the Osstell™ *mentor* device did not affect ISQ values. ISQ values increased continuously during healing from a mean of 65.1 (SD 16.97) to 74.7 (SD 5.17). Lower bone density (Types III or IV) resulted in significantly lower ISQ values up to week 10. While no increase was observed with 10 mm implants, ISQ values of 8 mm implants increased significantly from week 0 to weeks 6, 8 and 12. During healing, ISQ decreased by 3–4 values after installation and reached the lowest values at 3 weeks. Following this, ISQ values increased steadily up to 12 weeks. No significant differences were noted over time. The longitudinal changes of ISQ values showed the same patterns for SLA implants, SLActive implants and WB implants. At placement, the mean ISQ values were 72.6, 75.7 and 74.4, respectively. At 12 weeks, the mean ISQ values were 76.5, 78.8 and 77.8, respectively. The mean ISQ values at all observation periods did not differ significantly among the various types. Single ISQ values ranged from 55–84 during the entire healing period.
Conclusions and clinical implications: Using Osstell™ *mentor*, ISQ values are reproducible irrespective of instrument positioning. All ISQ values indicated stability of Straumann® implants over a 12 weeks healing period. All implants showed a slight

decrease after installation with the lowest ISQ values being reached at 3 weeks. It is recommended to monitor implant stability by RFA at 3 and 8 weeks post-surgically.

ISQ values are affected by the bone morphology and implant length. Hence, no predictive values can be attributed to implant stability. However, neither implant surface modifications (SLActive), nor implant diameter were revealed by RFA.

170 | Topic – Implant Therapy Outcomes, Surgical Aspects

Comparison of SLA surface implant with SLActive surface imaplant, clinical and experimental study

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Background: This study investigated the effects of implant surface in osseointegration and healing period by evaluate changes in stability and marginal bone loss for hydrophilic chemistry implant surface (SLActive) and to compare with sand-blasted and acid-etched implant surface (control) during healing period clinically and experimentally.

Aim: The purpose of this prospective study was to evaluate changes in stability and marginal bone loss for SLActive implant surface (test) and to compare with SLA implant surface (control) during healing period.

Methods: In clinical study, 48 control and 48 test implants were placed to 22 patients. Each patient has the same number of test and control implants. Implant stability was measured with RFA at the time of surgery, before flap closure, 1, 3, 6 weeks and at the time of loading (2 months for mandible, 3 months for maxilla). Marginal bone level changes measured at the time of loading and 6 month after loading in mesial and distal for each implant.

In experimental study, 30 implants (15 control and 15 test) were inserted to metaphasial region of tibia of three sheeps (each sheep received five control and five test implants). Removal torque test (RFA) histologic and histomorphometric analysis were performed in 3 and 6 weeks.

Results: Result of clinical study, one implant failed in control group. The RFA for both group were not significantly different ($P > 0.05$) (mean values for test group is 56.64 $\pm$ 7.38 and control group is 56.88 $\pm$ 4.96). But after 6 week to the time of loading was statistically higher for test implants compared with control implants ($P < 0.01$). Marginal bone loss of test group is lower than control group ($P < 0.05$).

Result of experimental study, histomorphometric analysis did not show statistically significant difference between the control group and test group (mean values of BIC for 3 week healing period test group: 79.50% $\pm$ 7.62, control group: 67.28% $\pm$ 14.81) and for 6 week healing period test group: 86.71% $\pm$ 3.77, control group: 83.38% $\pm$ 6.10. In removal torque test no differences were found between two groups. In histologic analysis there was more new bone formation in test implants surface.

Conclusions and clinical implications: The mean RFA for both groups did not show significant difference. But the increase recorded in the RFA in the test implant after 6 weeks suggested that the test implant were more favorable regarding bone formation, in the same time. According to result of experimental study, new surface have advantage in bone formation but there need to develop it by making more in-depth studies.

171 | Topic – Implant Therapy Outcomes, Surgical Aspects

Clinical review of the implant system with a resorbable coating

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Background: The success rate of dental implants has been shown to be very high for many different designs and brands of implants and it depends of primary and secondary stability. In addition to established parameters of the stability, the implant surface osteologic characteristics are factors which affect the implant bone response and quality of the bone–implant interface. Recently a new surface implant system with a completely resorbable, fixed adhesive calcium phosphate coating (CaP) is available.

Aim: To investigate the clinical benefits of the dental implants with the Bioactive CaP coating in the fist year of usage in different clinical situations.

Methods: A total of 311 conical, self-drilling and self-tapping Bioactive® implants (Alfa Gate, Israel) were placed in 124 patients (71 males; 53 females), with a mean age of 41.44 years. One hundred and sixty-three implants were placed in the posterior mandible, 117 in the posterior maxilla. In the frontal maxilla, 25 implants and in the frontal mandible, eight implants were inserted. The aetiology was periodontitis ($n = 284$), trauma ($n = 14$), orthodontic ($n = 6$), blade implants ($n = 6$). In 126 cases, guided bone regeneration and sinus lift were performed concomitant with implant placement. Seventy-two implants were loaded 2 weeks after implantation and in 239 implants the loading time was 6 months. The primary outcome criteria were implant survival rate and success rate according to the criteria of Albrektsson and Buser. The following paraclinical analyses were determined: resonance frequency analysis (Osstell AB, Sweden) and Periotest (Siemens AG, Germany) as well as radiological outcomes of the bone changes around implants.

Results: All 124 patients with 311 implants were seen at 6-month and at 1-year clinical follow-up. Altogether, the survival rate summed up to 99.7%. Under analysis with different implant success-assessment criteria the criteria of Albrektsson displayed a successful assessment in 94.2% of the implants. The criteria of Buser demonstrate a success in 99.7% of the implants.

Conclusions and clinical implications: The comparison of the clinical outcomes in this study with the results of aftercare examinations of other implant systems indicates a good 1-year survival and success rate for the studied system. This applies to the partial edentulous jaws and should be interpreted with respect to the critical patient selection in this study (rate of augmentations procedures). With the patient selection examined, the prognosis of success shows a positive effect.

172 | Topic – Implant Therapy Outcomes, Surgical Aspects

Quantitative sinus membrane evaluation in CT before vs. after maxillary sinus floor elevation

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Background: So far the majority of investigations on maxillary sinus augmentation have focused on implant survival and morphologic aspects of bone regeneration. Literature provides few details concerning physiologic reactions of the maxillary sinus membrane to bone augmentation.
Aim: The aim of the present radiologic study was to quantify three-dimensional changes in sinus membrane thickness after maxillary sinus floor augmentation.
Methods: Pre- and post-operative CT scans were assessed to investigate 65 maxillary sinus floor augmentation procedures in 35 patients without clinical signs of sinus pathology. Two different techniques for quantitative CT evaluation were used to assess sinus membrane thickness before as well as after maxillary sinus floor augmentation.
Results: Intra-individual comparison revealed significantly higher values of post-operative membrane thickness (1.5 ± 1.3 mm, range: 0–7.1 mm) compared with pre-operative conditions (0.8 ± 1.6 mm, range: 0–4.8 mm) with a mean increase of 0.8 ± 1.6 mm. The two evaluation techniques demonstrated strong statistical correlation ($r = 0.994$, $P < 0.001$) with a mean deviation of 0.1 mm. Higher values of sinus membrane thickness were found in smokers (2.7 ± 1.5 mm) compared with non-smoking patients (1.4 ± 1.2 mm).
Conclusions and clinical implications: It can be concluded that increased sinus membrane thickness in healthy patients following maxillary sinus floor augmentation may not be considered pathologic. Compared with non-grafted patients, a greater range of tolerance may be considered in the radiologic diagnosis of sinus pathology.

173 | Topic – Implant Therapy Outcomes, Surgical Aspects

Autotransplantation of teeth with complete root formation

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Background: Autotransplantation is a viable option for treating missing teeth when a donor tooth is available.
Aim: In spite of the fact that the donor tooth has complete root formation, autotransplantation can be a satisfactory treatment option with a high success rate when performed according to a strict case selection and treatment protocol.

This study reports the success rate of 19 autotransplantations of molars with complete root formations.
Methods: The study was conducted on 19 patients (11 males and 8 females), each of whom had a molar transplanted. The mean age was 38.5 years (range 19–67). Computer-aided rapid prototyping (CARP) was used in the case(s) that 3D CT image was available. Autogenous bone or allogenic bone was implemented around the transplanted tooth after transplantation, and with the recipient site close to the maxillary sinus, septal bone sinus augmentation was performed before transplantation. There were some cases in which the donor tooth was rotated for the initial fixation. The transplanted third molars (the third transplanted molars) were stabilized with silk sutures or resin-wire splint for 2–3 weeks. In six cases, endodontic treatment was carried out before transplantation and this was done 1 or 2 weeks after the transplant for the other 13 cases. Postoperatively, marginal and periapical conditions were examined clinically and radiographically.
Results: Sixteen cases were performed to the standard, resulting in an 84% success rate.
Conclusions and clinical implications: In spite of the fact that the donor tooth has complete root formation, autotransplantation can be a satisfactory treatment option with a high success rate when performed according to a strict case selection and treatment protocol.

174 | Topic – Implant Therapy Outcomes, Surgical Aspects

Clinical outcome of sinus bone graft and simultaneous implant placement

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Background: Sinus bone graft is needed for implant placement in the case of sinus pnuematization or low residual bone height.
Aim: The aim of this study is to compare the survival rate and surrounding tissue condition of sinus bone graft and simultaneous implant placement between 4-month and 6-month occlusal loading after implantation.
Methods: Twenty-seven patients (61 implants) treated with sinus bone graft (sinus lateral approach) and simultaneous Osstem® GS II implant placement from July 2007 to June 2008 were included in this study. Among these patients, 14 (31 implants) were included in the 4-month loading group and 13 (30 implants) were in the 6-month loading group. We investigated implantation type (submerged vs. non-submerged), sinus membrane perforation, the type of prosthesis, the opposed tooth type, primary and secondary stability of implants, the survival rate of implants, crestal bone loss around the implant, and surrounding tissue conditions.
Results: The crestal bone loss at the final recall time (12.56 ± 5.95 months after loading) of 4-month and 6-month loading group were 0.19 ± 0.33 and 0.39 ± 0.86 mm, respectively. However, there was no statistical significance between groups ($P = 0.211$). The width of attached mucosa, gingival index, plaque index and pocket depth of 4-month and 6-month loading group were 2.5 ± 1.69 and 1.73 ± 1.4 mm ($P = 0.081$), 0.72 ± 0.83 and 0.59 ± 0.69 ($P = 0.671$), 1.11 ± 0.96 and 0.76 ± 0.79 ($P = 0.226$), 3.56 ± 0.98 and 3.65 ± 1.06 mm ($P = 0.758$), respectively. The primary stability of implants in the 4-month and 6-month loading groups were 61.96 ± 12.84 and 56.06 ± 15.55 ($P = 0.120$), and secondary stability were 71.85 ± 6.8 and 66.51 ± 11.28 ($P = 0.026$), respectively. The secondary stability of the 4-month group was significantly higher than the 6-month group ($P = 0.026$). There is no statistical difference ($P > 0.05$) between the 4-month and 6-month loading groups in relation with implantation type (submerged or non-submerged), sinus membrane perforation, the type of prosthesis, and the opposed tooth type. In the 4-month and 6-month groups, all of the implants survived until the final recall time.
Conclusions and clinical implications: Loading is likely to be possible 4 months after sinus bone graft and simultaneous implant placement when residual bone height is 3 mm or longer and primary implant stability is secured.

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Primary stability determination by means of insertion torque and RFA in a sample of 4135 implants

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Background: Primary stability was always considered a fundamental prerequisite to acquiring osteointegration and it is now even more important, whenever clinicians want to use immediate loading protocols. Different methods to evaluate primary stability were proposed: in particular insertion torque (IT) and resonance frequency analysis (RFA) seem to be the most trustworthy.
Aim: The aims of the present study are to evaluate the primary stability of a sample of 4135 implants and to investigate the correlations between primary stability and mechanical characteristic of the implant and bone density at insertion time.
Methods: The study was conducted from March 2002 to January 2009 at a private practice in Bologna (Italy). Patients were eligible for the study if they needed the insertion of single or multiple implants. Bone density, length and diameter of each implant were recorded. During surgery for each implant maximum insertion torque was recorded; the RFA values were also collected. Finally, it was recorded whether an implant was lost or removed at an early stage (within 6 months from insertion surgery).
Results: One thousand and forty-five consecutive patients were included in the study. A total of 4135 of implants were inserted. The sample presented 1184 implants inserted in a post-exctractive site. Twenty-eight (0.7%) implants were considered to have failed and removed within 6 months. The mean insertion torque was 34.82 (SD = 19.36) N cm. The mean RFA was 71.57 (SD = 10.63) ISQ. Pearson's correlation analysis shows the presence of a weak positive correlation between IT and RFA. The statistical analysis shows a relevant dependency between IT and bone quality and a very weak dependency between RFA and bone quality. Again the statistical analysis shows a quite weak correlation between length or diameter and IT, but it shows a relevant correlation between length and RFA. Post-extractive implants presented a higher mean insertion torque and RFA compared to implants inserted in healed sites.
Conclusions and clinical implications: The results show that the implants studied obtain a good primary stability in different clinical situations. Data show that only insertion torque is influenced by bone density as well as only RFA is correlated

to the diameter of implants used. Finally it is possible to obtain a good primary stability also in post-extractive sites.

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A 5-year outcome of All-on-Four concept correlated to edentulous and extraction sites

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Background: The current knowledge has been showed equivalence to the functional concepts about delay and immediate load. The *All-on-Four* concept showed to be a safe and predictable technique to settle the difficulties in the treatment of the atrophic mandibles and maxillae moreover with the complexity of the bone grafts procedures.

Aim: The aim of this study was to clinically evaluate the outcome of 5 years of the *All-on-Four* concept to restore mandible and maxillae with a complete fixed dental prostheses made with a metal framework and acrylic base, 24 h after surgery, using dental implants immediately load in edentulous and fresh extraction sites.

Methods: This retrospective clinical study included 100 patients with 400 immediately loaded implants (Nobel Biocare®, Sweden) placed in the anterior region of the mandibles and maxillae with the bilateral posterior implants tilted about 30° relative to the occlusal plane in edentulous and after teeth extraction residual ridge. Multifunctional trays were used to guide the location of the implants during the surgery and as an individual tray in the prosthetic phase. Fixed dental prostheses made with a metal framework and two types of acrylic base were used to rehabilitate the patients.

Results: Tilting of the posterior implants allows the prostheses to hold 12 teeth with only a short cantilever and a favorable inter-implant distance. Statistical analyses were performed and *P*-values <0.05 were accepted for statistical significance. No statistically significant difference was observed. The overall implant success based on the sampling of the total number of the implants were 98% for the edentulous areas and 99.58% for the extractions areas, and the prostheses survival rates were 100%, suggesting the viability of the proposed treatment in edentulous and extractions areas.

Conclusions and clinical implications: Continuous development is ongoing to find simple and low-cost protocols for their use. The high implant and prostheses survival rates in the maxillae and mandible using the immediate loading following the *All-on-Four* concept even into fresh extraction sockets can be carried out successfully, showing to be a safe and predictable technique to settle the difficulties in the treatment of the atrophic mandibles and maxillae likewise with the complexity of the bone grafts procedures.

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Bone resorption around self-tapping implants in bone-class I and II

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Background: Cortical stress is assumed to enhance peri-implant bone resorption. SICace is a cylindrical, bone level, titanium implant with a medium rough surface up to the shoulder and an internal hex abutment connection with platform switching. The implant has a self-tapping thread design leading to controlled bone compression adapted to cortical bone quality (depending on the insertion protocol).

Aim: The aim was to measure crestal bone level changes and to evaluate the clinical performance of SICace implants inserted in bone class I–II supporting single crowns.

Methods: Twenty-six patients received a total of 96 SICace implants (length 9.5 mm, diameter 4 and 5 mm) that were placed in healed bone mainly in the posterior mandible with flap procedure. After a submerged 3-months healing period, the re-entry surgery was performed and the prosthetic treatment started. Four months after implant placement, the crowns were delivered, and the patients had to follow a strict monitoring protocol with seven follow-up visits. Biological and technical complications were registered and radiographs taken at five time points. Three calibrated investigators measured radiographically crestal bone level changes with the baseline time 0 = implant surgery. The hypothesis was that due to the implant design the mean crestal bone loss would be significantly reduced after 24 months, i.e., <1.5 mm, which is considered an accepted success criterion (Albrektsson & Isidor 1994).

Results: After the healing period, all implants were clinically stable and during the follow-up period no implant failure or drop out were registered. Minimal bone loss of -0.56 mm (CI 95% -0.69; -0.42) was observed from the time point of surgery to the delivery of the crown. During the following 21 months after loading, the additional bone loss was in average -0.08 mm (CI 95% -0.20; 0.04). Good oral hygiene was observed with a plaque index of 0.52 (CI 95% 0.46; 0.58) and bleeding index of 0.37 (CI 95% 0.32; 0.42). No significant changes in probing depth measurements around the implants were observed: mean probing depth 2.39 (CI 95% 2.34; 2.44). Technical complications did not occur, but two crowns exhibited minimal chipping of the ceramic veneering.

Conclusions and clinical implications: The treatment outcome with SICace implants was excellent with regard to biological and technical parameters. Two years after implant placement,

the mean crestal bone loss was significantly smaller than claimed by the common implant success criteria.

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Individual healing abutment for immediate implantation in single molar teeth

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Background: Immediate implantation offers significant benefits. It is a high-risk to make the provisional crown after molar teeth immediate implantation with immediate temporalization because of occlusal loading. Standard healing abutments require flap elevation to get tight contact between abutment and gingival margin. Individual healing abutment let avoid raising flap and critical loading.

Aim: The purpose of the study was to evaluate the effectiveness of individual healing abutment, which is well fitted to wound margins after immediate implantation in single molar cases. Could this method help to avoid raising the flap and use of augmentation materials and procedures?

Methods: Twenty randomly selected patients aged 25–54 were included in this study with 20 implants placed in first molar areas (10 implants in the maxilla, four were placed in palatal radix alveolus, six – with sinus floor elevation using osteotomies and xenograft bone [Bio-Oss 1–2 mm granules; Geistlich] and 10 in the mandible). After atraumatic tooth extraction, the implants were immediately placed without flap elevation and augmentation materials using NobelReplace Tapered Groovy implants (Nobel Biocare AB) in blood-filled alveolus. Primary implant stability varied from 20–60 N/cm^2. 6 mm diameter implants with lengths range from 8 to 13 mm were used in the study. On the temporary titanium abutment (Non-engaging, NobelReplace 6 mm; Nobel Biocare AB) were made individual healing abutments (Voco Structur 2 SC) and fixed to the implants. All surgical wound margins were adapted to the abutments using non-resorbable sutures (CV-5 GoreTex). Follow-up examinations were performed at 1 week (suture removal), 4 month (checking implant stability using 35 N/cm^2 playback test), 6 month (preparing definitive prosthesis) and 3 years (evaluate final clinical results). Radiographic examinations were performed at the time of implant insertion, at 4 month and after 3 year using parallel radiographic technique to evaluate interproximal bone level. Clinically papillae, margin of the vestibular mucosa were evaluated as acceptable or not acceptable.

Results: Implant survival rate after 3 years was 100%. All implants were in function. Vestibular soft tissue margin and papillae were aesthetically acceptable in all cases. Interproximal bone level shifted from 1 to 2 mm from implant–abutment junction.

Conclusions and clinical implications: Technique using individual healing abutment is reliable because of high survival rate, no need of complicated augmentation procedures and flap elevation. This technique shows acceptable clinical aesthetic outcomes. Individual healing abutment can be successfully used in clinical practice. However, more high-level evidence-based studies are needed to demonstrate this technique.

179 | Topic – Implant Therapy Outcomes, Surgical Aspects

Stability behaviour of orthodontic miniscrews measured with RFA – a pilot study

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Background: Immediate and early loading of orthodontic miniscrews is controversially discussed in literature. At present there are no human *in vivo* studies dealing with RFA measurements and miniscrews.

Aim: (1) Investigate the stability behaviour of orthodontic miniscrews over a period of 12 weeks post-surgery, using resonance frequency analysis. (2) Establish a basis for determining the optimal healing period before loading. (3) Assess initial reference ISQ values for the clinical use of miniscrews.

Methods: Thirteen patients were treated with 17 self-drilling OrthoEasy Pins® (length: 8 mm, diameter: 1.7 mm; Forestadent, Germany). The miniscrews were placed in the premolar region of the mandible for the purpose of skeletal anchorage. An adapter between miniscrew head and measuring element was designed in order to render possible RFA measurements with the Osstell Mentor™ (Diagnostics AB, Gothenburg, Sweden). The screw stability (ISQ) was measured immediately after screw insertion and subsequently once a week over a period of 12 weeks. Categorial data were described with frequencies and percentages, and continuous data were described with median, minimum and maximum and first and third quartile. Spearman correlation coefficient was calculated and Student's *t*-test was carried out.

Results: One patient with one miniscrew was excluded for not keeping the appointments. Measuring four miniscrews was discontinued due to clinically detectable mobility. For 12 miniscrews in 10 patients (8 females, 2 males), the stability was examined weekly. The miniscrews were immediately loaded with an average orthodontic force of 83.3 ± 38.9 cN. The median ISQ of all measured time points ranged from 42 to 44. During the course of measuring, the stability remained unchanged and the initial stability corresponded to the secondary one. No stability gap was discernible in the first 12 weeks post-surgery. The ISQ values observed before obvious clinical mobility did not differ from the measurements taken of stable miniscrews.

Conclusions and clinical implications: In the present investigation, the stability remained unchanged during the observation period. Therefore, immediate loading of miniscrews seems justified. The results do not allow any conclusions regarding a

safe ISQ value indicating sufficient primary or secondary stability of a miniscrew. Moreover, no level of critical stability may be concluded. Because of the limited number of miniscrews in this pilot study, it was not possible to demonstrate that resonance frequency analysis is a reliable method for assessing the stability of orthodontic miniscrews.

180 | Topic – Implant Therapy Outcomes, Surgical Aspects

Socket-shield technique for immediate implant placement – preliminary results of a prospective-cohort study

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Background: Tooth extraction is followed by substantial resorptive processes thus making single-tooth replacement in the esthetic zone one of the most challenging issues in modern implant dentistry. It has been demonstrated that neither immediate implant installation nor common techniques presented for socket preservation may avoid resorption of the buccal bone plate which is assumed to be mainly accountable for the volumetric tissue decline after tooth extraction. A recently accomplished proof-of-principle experiment, however, has given histologic evidence that retaining the buccal aspect of the root in conjunction with immediate implant installation (socket-shield technique) preserves the buccal periodontal ligament and the buccal bone plate from resorption and seems to have the potential to entirely preserve the alveolar ridge.
Aim: The objective of this study was to evaluate the predictability and the volumetric alterations of sites treated with the socket-shield technique.
Methods: Thirteen patients were consecutively recruited from a private practice setup, all presenting for replacement of one single upper incisor or premolar. Immediate implant installation was carried out applying the socket-shield concept: after decoronation of the tooth, osteotomy drills were performed through the lingual aspect of the root. Leaving only the buccal portion of the root in place, all other root fragments were removed. Following application of enamel matrix derivate on the internal aspect of the retained root fragment, an implant was inserted and either immediately provisionalized or a healing abutment connected. Before surgery, a first precise gypsum model of the treated site was gained (baseline) – 5 months later, before impression taking, a second (follow-up). Optical scans of both models created digital three-dimensional models which were virtually superimposed for evaluation of localised volumetric changes.
Results: Preliminary results include data of the first six patients. Healing was uneventful in every patient – no complications occurred. All implants osseointegrated – no implant was lost during follow-up. All implants presented healthy peri-implant soft and hard tissue conditions and favourable soft tissue esthetics. Volumetric assessment of the alveolar ridge contour revealed negligible tissue alterations in the area of the attached gingiva/mucosa between baseline and follow-up examinations amounting to -0.04 ± 0.15 mm in horizontal dimension. Implants having been provided with healing abutments showed little tissue decline of the marginal tissues.
Conclusions and clinical implications: The socket-shield technique for immediate implant placement seems to be a suitable technique to preserve the alveolar ridge contour after tooth extraction. Further controlled clinical trials are necessary to provide evidence for the predictability and long-term volumetric stability of this approach.

181 | Topic – Implant Therapy Outcomes, Surgical Aspects

Treatment of agressive giant cell reperative granuloma with composite bone augmentation and dental implant

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Background: Giant cell reperative granuloma is a benign and local aggressive lesion with unknown etiology. Head and neck involvement is frequently seen in mandible and maxilla. The traditional treatment of the lesion has been local curettage. However, aggressive sub-types of the lesion show a tendency to recur and necessitate bone resection that may determine extensive defects in jaws.
Aim: In our article, it was presented a giant cell reperative granuloma which has a great dimensions of lesion in an 8-year-old child and was discussed its etiology, clinical, radiological and therapeutic features in the light of the current literature.
Methods: An 8-year-old boy presented to our department in April 1998 with a history of 2 months of swelling and pain in the maxillary anterior region. He reported no pain and no sensory disturbance of the left upper lip and left maxillary anterior region. Intraoral examination revealed an expansive bony mass in the left maxillary vestibule from the central incisor to the first left molar. Intraoral biopsy performed revealed a large number of multinucleated giant cells, areas of haemorrhage, hemosiderin in deposits, some reactive woven bone and osteoid. The diagnosis was compatible with giant cell reperative granuloma. The patient underwent curettage of the lesion followed by removal of the peripheral bony margins through an intraoral approach. Twenty-four months later a 4×5 cm of diameter ill-defined radiolucidency was detected in the panoramic radiograph. After local bone resection and defect regeneration with a

composite bone graft, a temporary prosthesis was constructed. Eight years later, maxillary bone defect was reconstructed with composit bone grafts and two dental implants were placed. Following a healing period of 16 weeks, final implant-supported prosthesis was constructed.

Results: No recurrence was observed during the post-operative course. Maxillary defect was successfully restored. Two implants osseointegrated uneventfully with no complications. Implants were stable at the 12- and 24-month post-restoration evaluations.

Conclusions and clinical implications: Giant cell reperative granuloma is a rare lesion of the head and neck region. Differentiation of lesions from other giant-cell granulomas should be made. Traditional treatment of the lesion has been local curettage. However, aggressive sub-types of the lesion show a tendency to recur and necessitate bone resection that may determine extensive defects in jaws. Augmentation of this severe bone defects with composite bone grafts often provides the desired gain of bone, allows for the ideal placement of dental implants, and improves any discrepancy between the upper and lower arches.

182 | Topic – Implant Therapy Outcomes, Surgical Aspects

Lateral subperiosteal bone augmentation around immediate implants without flap elevation: a pilot study

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Background: Implants are usually placed after soft tissue flap elevation to visualize better the bone sites where the implant will be placed but flap surgery for implant placement may negatively influence implant esthetic outcomes, especially in the anterior maxilla. Flapless implant surgery has been suggested as a treatment modality for the preservation of the soft tissue, for increasing patient comfort and satisfaction, but this technique cannot be used in presence of bone defect requiring augmentation procedures. Implants are usually placed after soft tissue flap elevation to visualize better the bone sites where the implant will be placed but flap surgery for implant placement may negatively influence implant esthetic outcomes, especially in the anterior maxilla. Flapless implant surgery has been suggested as a treatment modality for the preservation of the soft tissue, for increasing patient comfort and satisfaction, but this technique cannot be used in presence of bone defect requiring augmentation procedures.

Aim: The aim of this study was to evaluate the clinical success and bone healing of implants placed in fresh extraction sockets using GBR and a mini-invasive procedure.

Methods: The technique consisted of positioning a dental implant immediately after the dental extraction, performing a small incision apically and laterally the defect to insert graft material and a regenerative membrane. Three to four months after implant placement prosthetic rehabilitation was initiated. Success criteria included effective placement and primary stability of the planned implant, implant stability, absence of pain or any subjective sensation, absence of peri-implant infection with suppuration, and absence of continuous radiolucency around the implant. TC scan was performed in all patients six months after surgery.

Results: Eleven healthy adults with a missing tooth in the maxillary anterior region were treated by this technique. All implants were positioned in the anterior region by the same surgeon and all the sites showed a complete bone defect at the facial wall. Follow-up ranged from 6 to 18 months. All 11 completed implants fulfilled the pre-defined criteria of success, based on clinical and radiographic examination (panoramic and TC). Moreover, all patients had acceptable function of the implant-supported prostheses, with no pathologic signs or symptoms and a satisfactory esthetic results.

Conclusions and clinical implications: Data from this study showed that immediate implants with a lateral subperiosteal flap elevation can be successfully used in the presence of bone defects requiring augmentation procedures. The technique appeared to be relatively simple and the incidence of intraoperative and post-operative complications was limited, success and survival rates of implants placed in the expanded areas were within the limits of criteria proposed by Albrektsson. However, a larger sample size is raccomanded to verify the conclusions drawn in this preliminary study.

183 | Topic – Implant Therapy Outcomes, Surgical Aspects

A simple way to improve guided implant surgery irrigation

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Background: In the past few years, the possibility of CAD–CAM procedures has been added to the implant dentistry planning and surgery. This system includes a template, which has drill guide rings. A potential clinical problem of this procedure is that the irrigation of the hand-piece goes to the steam of the drill; from a heat generation standpoint, preparing an implant site using surgical drill guides generates heat more than the classical implant site preparation regardless of the irrigation type; along with the temperature increase, the area of dead osteocytes increased and regeneration of the periosteal membrane was delayed.

Aim: To show a new procedure aimed to give a suitable irrigation to the implant site through the template.

Methods: A modified template could be available by placing a single tube/s under each drill guide ring. During surgery, the hand-piece irrigation system is inserted successively in each tube corresponding to each implant site.

Results: The template modification allows a direct refrigeration of the implant site through the template expecting a drastic

reduction of the bone temperature during biomechanical preparation.

Conclusions and clinical implications: We have not seen any difficulty on the procedure. The inconvenients are (1) it requires laboratory modification; (2) place under each guide ring a cooling device; (3) the template volume increase slightly so as the potential damage to the adjacent tissues. In our experience it seems to improve the prognosis of the implants placed under this profuse direct selective irrigation.

184 | Topic – Implant Therapy Outcomes, Surgical Aspects

Long-term follow-up implant therapy in cleidocranial dysplasia patient (a case report)

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Background: Cleidocranial dysplasia is an autosomaldominant disease rarely seen with many congenital anomalies. Deciduous teeth are often retained for longer than usual, with delayed eruption of the permanent teeth and a variable number of supernumerary teeth. Besides multiple impact teeth are seen. After the extraction of these teeth, edantulism can be treated by dental implants that is a popular therapy choice in recent years.

Aim: The aim of this case report was to provide patient's comfort with dental implants following multiple impact teeth extractions.

Methods: The clinical examination of male patient who applied our clinic with odontogenic problems (such as absence of some teeth, problems with nutrition) showed shortness in height, a sagitally narrow and transversally expansive skull, a wide and prominent forehead. In radiographic analysis multiple impact teeth were detected. The extractions of these teeth were planned after the orthodontic consultation was made. The impact teeth extracted surgically one by one in following sessions. Four astra tech implants were inserted in mandibula when the extractions were over. In maxilla eruption of the teeth with number 11, 21 and 23 was provided by gold chain application. Gold chain was activated monthly and at the end of 15 months orthodontic therapy was completed. Then missing teeth was rehabilitated with a full mouth prothesis in maxilla following the preparation of remaining maxillary teeth and an implant overdenture in mandibula.

Results: The patient who applied to our clinic in 2003 was treated with a successful orthodontic therapy after the extractions of impact teeth. Four dental implants were inserted in posterior mandibula and followed for 2 years. In clinical and radiographic controls no problem was observed.

Conclusions and clinical implications: In cleido cranial dysplasia, a rarely seen sendrome, providing a fixed denture for these patients will positively effect them psychologically and functionally.

185 | Topic – Implant Therapy Outcomes, Surgical Aspects

New protocol for 3D physical analysis of angular deviation on guided implant surgery

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Background: Implant angular deviation during guided surgery can be obtained by image interpolation on appropriate software. However, real-time measurement can also be made on a 3D way.

Aim: The aim of this study was to evaluate the angular deviation of implants in guided-surgery using dental stone casts as reference.

Methods: Five patients were selected. After reverse treatment planning and computed tomography (0.4 mm thick slices, Toshiba Xvision), the implants were virtually positioned using the Procera NobelGuide software. Then, the implant replicas were attached to obtain the model A. Brånemark NobelSpeedy implants (4.0 mm in diameter × 11.5–18.0 mm in length) were inserted. Impressions were taken to obtain the models B. All definitive prostheses were inserted after 12 h. A CCM (Tesa Micro-Hite 3D, Switzerland) was used to measure the implant angulation in *X*, *Y* and *Z* planes. The angular deviation (qZ, difference between models A and B) for each implant was measured in degrees, minutes and seconds.

Results: The mean angular deviation recorded was 0.82 ± 0.71° (range of 0–4.13°). The obtained values were within the means reported in the literature.

Conclusions and clinical implications: This 3D measuring protocol is reliable and allows additional studies.

186 | Topic – Implant Therapy Outcomes, Surgical Aspects

Clinical evaluation of small diameter implants in partially edentulous patients followed for 1–4 years

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Background: Small diameter implants (3 mm) are generally used for alveolar ridges that are too thin for regular implants with a diameter of approximately 4 mm to avoid advanced surgical procedures, such as local bone augmentation. They are also indicated when the bone deficiency is circumferential around an implant or interdental space is limited, as in the replacement of mandibular incisors and maxillary lateral incisors or when the proposed implant site is not suitable for bone grafting or orthodontic repositioning of teeth.

Aim: The aim of the present study was to retrospectively evaluate small diameters (3 mm) implants after followed for 1–4 years.

Methods: Thirty-seven consecutive patients, 16 males and 22 females with a mean age of 40.7 ± 16.3 years, with partial edentulism were treated with 67 restored 3.0-mm diameter implants (67 Xive®S Implant, Dentsply Friadent,). Thirty-seven and 30 implants were placed in the maxilla and mandible, respectively. After the standard healing period (3–6 months), the implants were restored with single-tooth prosthesis or fixed partial dentures. The mean duration of follow-up was 2.4 years. All patients were followed according to a strict maintenance program, with regular recalls. Mean marginal bone loss, probing depth, and bleeding on probing were assessed at 6-, 12-, 24-, 36-, and 48-month follow-up examinations. Prosthetic complications were assessed.

Results: Sixty-seven 3-mm diameter implants were placed between July 2006 and September 2009. All implants osseointegrated and were clinically stable at the 3 and 6-month follow-up. No implant fractures occurred. Over a 4-year period, the accumulated mean marginal bone loss and probing depth were 1.16 ± 0.90 mm and 1.91 ± 0.59 mm, respectively. Bleeding on probing was recorded as a mean of 35%. The most common prosthetic complication was the loosing of occlusal screw.

Conclusions and clinical implications: Within the limited observation period and the number of patients included in this study, it can be concluded that the use of 3 mm small-diameter implants appears to be predictable if clinical guidelines are followed and appropriate prosthetic restorations are provided.

187 | Topic – Implant Therapy Outcomes, Surgical Aspects

Implant placement and simultaneous localized ridge augmentation using micro titanium mesh fixed by cover screws: a clinical study in humans

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Background: Placement of dental titanium implants is a well-established treatment modality in edentulous areas of the jaws. However, in areas with limited alveolar bone height and thickness, installation of implants may not be possible. An adequate bone volume for complete circumferential coverage of the implants is very important in obtaining long-term success of oral implants.

Aim: The present study evaluates the efficacy of a mixture of deproteinized bovine bone mineral (DBBM) and autogenous bone chip graft associated with a micro titanium mesh fixed by cover screws, for localized ridge augmentation simultaneous to implant placement.

Methods: In 260 partially edentulous patients, 296 titanium meshes were placed and 514 implants (350 Pitt Easy and 164 3i Osseotite NT) were inserted. After a mean interval of 4.5 months (range of 4–6 months) the augmented site was reopened for grid removal. To evaluate the amount of bone regeneration, intrasurgical measurements were taken at first surgery and at titanium mesh removal.

Results: The healing was uneventful in 258 Bio-grid (87.2%) and 455 implants (95.55%). In 38 surgical sites, the titanium grid was exposed and 23 implants out of 59 (4.45% of total implant) had to be removed at re-entry. In a total of 296 grids and 514 implants, a mean crestal bone regeneration of 4.45 mm (SD ± 2.11; range 2–11 mm) was found. The mean overall bone fill of the original peri-implant defects was 94.68%.

Conclusions and clinical implications: In this clinical human study, the results show excellent bone regeneration of peri-implant bone defects using autogenous bone chips and DBBM grafts in conjunction with a titanium grid, without membrane barrier. The mechanical properties, the design and the procedure to secure this specific titanium grid ensured optimal graft integration by firm immobilization and contour stability. In addition, complications included the exposure of the grid, but to a very low percentage. Only 4.45% of total implants were removed and in the other surgical sites with exposure the per-implant bone exhibited a partial loss of the bone graft. In the 258 surgical sites (87%) healings were uneventful, all implants appeared stable and submerged into a hard regenerated tissue clinically similar to bone.

188 | Topic – Implant Therapy Outcomes, Surgical Aspects

Osseointegrated dental implants in orthodontic treatment

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Background: A large part of the adult population suffers from chronic periodontal disease with loosening teeth and migration of remaining teeth. Frequently the periodontal conditions of remaining teeth do not allow the orthodontic treatment before the prosthetic rehabilitation.

Aim: This study will report on the clinical outcome of osseointegrated dental implants used for orthodontic anchorage.

Methods: Between 2002 and 2007, 33 partial edentulous patients (31 females and 2 males) were enrolled in this study. The mean age of patients at the beginning of therapy was 57.6 years (range 48–71). A total of 42 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were inserted to replace missing teeth and used for orthodontic anchorage. Implant length ranged between 8 and 11 mm. In particular, after appropriate periodontal treatment 34 implants were inserted in 27 patients with periodontal disease and migration of remaining teeth, while eight implants in six patients with maxillary canine inclusion. During and after treatment all patients were submitted to maintenance therapy. Clinical and radiographic parameters were evaluated in different time intervals. Patients' satisfaction and mechanical complications were also recorded.

Results: After submerged healing period, all implants became osseointegrated and were loaded with cemented temporary crown. All implants were used for orthodontic anchorage. Following orthodontic treatment, all implants received definitive

crowns. After total observation period of 4.7 years (range 2–7) none implant was lost and all implants presented healthy peri-implant soft tissue conditions (mPlI > 1, mSBI < 1). Standardized periapical radiographs showed a stable peri-implant bone level. Radiographic mean bone loss evaluating both interproximal surfaces was 0.77 mm (range 0.42–1.43). Only 14% of the sites showed a crestal bone loss > 1 mm. All patients were satisfied about time and modality of treatment.

Conclusions and clinical implications: The implant design with its internal-tapered implant-abutment connection allows to insert implants in tight edentulous space before starting orthodontic treatment. The results of this study suggest that osseointegrated implants are ideal anchorage for orthodontist. So the presence of fixtures in the partially edentulous arches, placed for prosthetic purposes, may not only simplify but also enable orthodontic treatment that are not feasible using only the remaining teeth. Additionally have a positive effect on the patient from a social and psychological point of view.

189 | Topic – Implant Therapy Outcomes, Surgical Aspects

Complex esthetic index for anterior maxillary implant supported restoration

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Background: Esthetic outcome assessment has become an emerging focus area for implant dentistry. This is particular true for anterior maxillary implant supported restorations. It is quiet evident that when the esthetic is considered clinicians should not only examine either the soft or hard tissue characters or prosthetic components but all of them because all these factors influence their prognostic value and long-term esthetic stability.

Aim: The aim of this study was not only to develop but also to validate a complex esthetic index that is intended for rating esthetics of anterior maxillary implant supported restoration from surrounding soft and hard tissues.

Methods: Fifty patients, 31 men and 19 women (age: 18–50 years; mean ± SD: 32.4 ± 9.1), previously treated with dental implants were investigated for esthetic result using the proposed complex esthetic index (CEI). Two calibrated oral surgeons did the evaluation and recording. The evaluation was carried out twice by each of the examiners at an interval of 2 weeks. Weighted Cohen's κ was used to calculate intra- and inter-observer agreement.

Results: An analysis of CEI for 50 anterior maxillary implant supported restorations showed good S and R indexes between intra- and inter-observer agreements. Only inter-observer agreement for overall implant supported restoration index was rated as moderate (0.54 and 0.52). Single parameters analysis showed that the lowest (moderate) intra- and inter-observer agreement was the subjective parameters of S (soft tissue color and texture variations) and R (crown surface roughness and ridges, and color and translucency) indexes. Adequate esthetic index of S100, P100, R100 was scored by both examiners in 10% and 12% of cases for evaluation I and II, respectively.

Conclusions and clinical implications: The complex esthetic index consists of adjacent soft and hard tissues as well as implant restoration, developed here can be a reproducible and prognostic (i.e., long-term stability) tool for scoring anterior implant esthetics predictably.

190 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediate loading in periodontally susceptible patients: descriptive analysis of 51 implants

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Background: Periodontal disease is one of the main oral health problems. The progression of the disease leads to loss of attachment, reduced bone support, teeth mobility, sensitiveness, mucogingival problems, bony defects, furcation exposure, among others. Posterior loss of teeth is often fast and the replacement with implants may be chalenging because periodontal disease is a well-known risk factor that can affect osteointegration. More over patient's motivation are not compatible with long treatment plans.

Aim: The aim of this study was to evaluate the success rate of dental implants in periodontally susceptible patients using immediate loading/restoration protocols and the factors that affect this response.

Methods: Systemically healthy patients who were treated previously for chronic periodontitis and who required implant therapy were recruited. Following data collection, ''surgical templates'' and provisional fixed restorations were fabricated. Fifty-one implants were inserted, and surgical measurements were performed. All implants had a rough surface. After abutment connection, the crown/bridge was relined and cemented. Patients were monitored 6 months after definitive crown were placed, at which time final measurements were performed. All provisional crowns were splinted regardless the number of implants. Several parameters were analysed such as tobacco use, parafuncional habits, implants length and anatomical location.

Results: Thirty-four implants were placed in males and 17 in females; three implants failed and were removed during the period of osteointegration, with an overall success rate of 94.2%. Radiographic bone loss ranged between 0 and 2.5 mm (mean: 1.08 mm). Lost implants had no relation with gender, location or tobacco habits.

Conclusions and clinical implications: Immediate loading protocols are predictable alternatives in periodontally susceptible patients once that a high motivational hygiene protocol is established. Results in the upper molar regions suggested that no differences with other areas were seen, but these results may be misleading regarding the few implants that were lost. Long-term success in these patients has not been addressed.

The results show that periodontal patient may be elected for immediate loading procedures with similar success rates of non-periodontal patients.

191 | Topic – Implant Therapy Outcomes, Surgical Aspects

Titanium implants in general practice: clinical and radiological outcome

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Background: Pure titanium dental implants are current gold standard for tooth replacement. Commercially available implants vary considerably in geometry, macro- and micro-design. SPI® implants cover the entire range of clinical indications. Implant geometry and osteoconductive properties of its sand-blasted and thermically acid etched surface lead to excellent bone to implant contact properties.

Aim: Clinical experience suggested excellent survival rate and minimal peri-implant bone loss pertinent to the use of SPI® ELEMENT implants. The goal of this prospective observational study was to confirm the clinical experience under general practice conditions.

Methods: Seventy partially edentulous patients were randomly recruited from five general practices in Switzerland. Before insertion, risk factors (periodontitis pre-treatment, smoking), planned position, previous and simultaneous site augmentation, and bone quality were recorded along with the healing protocol (non-submerged vs. submerged) and insertion torque force. Loading was 12 weeks post-insertion. Conventional X-rays were taken using the parallel/perpendicular technique post-surgery, immediately after loading, at 6 and 12 months. X-rays were digitalized and bone level changes were quantitatively evaluated (Image J 1.33u). Probing depth and attachment height were assessed 6 and 12 months after implant insertion together with assessment of implant mobility. At the final 12 months assessment, prosthetic reconstruction was revised.

Results: Seventy patients received 112 implants. Forty-six (65%) patients were treated with single implants, 18 (25%) with two and 8 (10%) with 3–4 implants. Sixty-seven (60%) implant sites were augmented. Eighty-four (75%) implants were placed using the two-stage approach (submerged). All implants were inserted into Class I–III bone, in both lateral and frontal regions. One implant has been lost in the early healing phase due to peri-implant infection of unknown etiology. The cumulative survival rate was therefore 99.1%. One patient developed peri-implantitis. The site was surgically revised and healed successfully; loading was done 1 year later. Parodontal measurements revealed no significant probing depth or attachment height loss at 6 or 12 months. The X-ray showed bone loss <0.6 mm at 6 months (mesial and distal), with no additional bone loss apparent at 1 year. Only four prosthetic complications have been reported (3 × porcelain fracture, 1 × broken implant screw).

Conclusions and clinical implications: The presented results confirm the excellent clinical experience. One year post-surgery marginal bone stabilized at the level of the first implant thread (SPI® ELEMENT). Minimal parodontal changes were observed while favorable prosthetic outcome was achieved.

192 | Topic – Implant Therapy Outcomes, Surgical Aspects

Dental implant in the upper front of a professional clarinettist – problems and results

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Background: There exists a complex interplay betweeen the tension of the lip muscles, the pressure by the mouthpiece on the frontal teeth and the regulation of the airflow to produce a tone out of woodwind instruments. The loss of frontal upper teeth hampers this interplay. It can be compensated by a dental bridge or by an implant. However, problems result by clarinettists due to the strain on implants by the instrument.

Aim: A professional clarinettist lost 21 as the result of an assault. The situation was complicated due to a wide diasthema.

Methods: With respect to the esthetic outcome it was unacceptable to incorporate a teeth-borne bridge. In 2000, we inserted an implant. The insertion was guided in the axis of the alveolar bone. By the opening operation we inserted an individually constructed abutment and a provisional crown. Two month later the prosthodontist incorporated a permanent crown. In experiments the strain of the music instrument on the crown was optimized.

Results:

Subjective defects: In the beginning problems with the high notes due to the lack of positon control of the clarinet as the result of missing tactility of the implantat. This problem was reduced by training. There was also a feeling of pressure to the lateral nasal wall after longtime play.

Clinical: Optimal stability of the implant, the abutment and the crown. Traces of the implant – borne crown on the mouthpiece due to the difference of fixation (elastic-teeth, ancyloticimplant). The experiment to eliminate this problem by an infraocclusion of the crown had an inverse result: The mouthpiece was rotating around to the crown and the tone production was uncontrollable.

Up to now the professional musician can perform tones on a formerly high level.

Conclusions and clinical implications: Because of the specific way of playing the clarinet a loss of upper frontal teeth can cause even loss of the ability to work as a professional musician. The case demonstrates the rehabilitation after implant insertion.

Problems remain:

1. the long treatment period and the long-time inability to work.

2. the eccentric strain on the implant due to the pressure of the mouthpiece. In the long run, this maybe can overload the implant bed, the implant–abutment connection or the implant material.

3. the reduced tactile control of the regulation of instrument position. It is important for high-class clarinettists sometimes it can be compensated by training.

193 | Topic – Implant Therapy Outcomes, Surgical Aspects

A prospective clinico-radiological study of short threaded implants

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Background: A ''short'' implant has been dened as a device with a designed intra-bony length of 8 mm or less, a ''wide'' implant as one in which the stated diameter was 4.5 mm or more.

Results from literature shows that implant length does not appear to signicantly inuence the survival rate, and in particular, articles which focused specically on short implants indicated that these provided similar outcomes to those reported for longer implants, with survival rates of 88–100%.

No relationship between marginal bone loss and implant diameter has been seen in most of the studies, which reported rather low changes in crestal bone levels.

More recent studies which have used surgical preparation adapted to the bone density, textured-surfaced implants, and modified case selection have reported survival rates for short implants and for wide diameter implants which were comparable with those obtained with long-implants and standard-diameter implants.

Aim: Aim of the study is to analyse the survival rate and clinical bone loss of 6 mm implants with SLA surface.

Methods: Eighty short 6 mm lenght implant has been positioned in the posterior area of the maxilla and in the mandible following manufacturer protocol.

A healing screw has been fitted at time of the surgery with a lenght compatible with the height of the soft tissues (3–5 mm) and left for a period of 12 weeks. At 12 weeks all implants were loaded with provisional crown for 4 weeks and then a final restoration was performed. All OH parameters were recorded and listed in tables. All patients have been checked to fit in the inclusion–exclusion criteria table and an informed consent form was signed by every patient.

Results: A perfect healing of the surgical wound have been observed in all patients within 10 days from the surgery. At 3 months follow-up control, an optimal osseointegration have been noted. The osseointegration level has been studied with Ostell and mean, median and *P*-values has been reported.

Bone loss or conical resorption around implants was not observed and some bone overgrowth was observed.

The bone level in all groups has been studied with digital radiography and mean, median and *P*-values will be reported at final draft of the results paper.

Conclusions and clinical implications: This study has reported positive results and confirmed survival rates for short implants and for wide diameter implants compared with standard implants.

194 | Topic – Implant Therapy Outcomes, Surgical Aspects

The controversy of short porous-surfaced implants and sinus lift with conventional implants in upper jaw

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Background: Usual decision in the case of deficiency of bone height in the posterior maxilla is sinus lifting by lateral window method and using of conventional length implants. However, such treatment is difficult, long and expensive. Thus the steady tendency of modern development considers that it is necessary to facilitate application of dental implantation at patients with severe bone atrophy. Short porous-surfaced implants cansolve this problem.

Aim: Aim is comparative examination of short porous-surfaced implants vs. sinus lift and conventional length implants in posterior maxilla.

Methods: Test: 55 patients with 92 endopore dental implants 7 mm long and 4.1 mm wide or 5 mm long and 5.0 mm wide; 53 of them were placed without any augment procedures and 39 – with closed sinus lifting by special endopore osteotomes.

Control: 34 patients with 40 open sinus lifting by lateral window method and appliance of 100 conventional size implants (10, 12 and 14 mm long, 3.75, 4.0 and 4.9 mm wide).

Implantation sites located in the maxilla subantrum area. All implants were submerged. A radiographic evaluation and Periotest were performed.

Results: The general duration of treatment with Endopore implants was from 3.5 to 4.2 months, on the average 3.7 ± 0.2. Only one implant was lost before loading. In 3 months after surgery and in a year after loading mean implant stability were -2.78 ± 0.81 and -5.31 ± 1.49. No implants were lost after loading. Overall survival rate was 98.9% and success rate was 98.2%.

The duration of treatment in control group was from 8.5 till 12 months, on the average 10.0 ± 0.1. Four patients suffer pain and edema for more than 3 days. Sinus lifting was unsuccessful in one case. Three implants within patients with sinus lifting were lost before loading. In general, initially planned implant treatment became impossible in two cases. In 2–3 months after implantation and in a year after loading implant stability were -1.53 ± 0.64 and -3.82 ± 1.71. No implants were lost after loading. Overall survival rate was 97.0% and success rate was 94.1%.

Conclusions and clinical implications: Short endopore dental implants have shown higher degree of clinical efficiency than sinus lifting and conventional length implants. The treatment with use of porous-surfaced implants was found less long, less heavy and less expensive.

Porous-surfaced implants expand dental implantation options possibilities.

195 | Topic – Implant Therapy Outcomes, Surgical Aspects

Bone densitometry during osseointegration processes. Piezosurgery vs. traditional protocol

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Background: In recent years, numerous efforts have been made to make implant therapy more safe and with certain clinical results for potential patients by simplifying clinical procedures. One of these efforts has been the reduction of the healing period using new implant surfaces that may shorten and improve the osseointegration process. Piezoelectric osteotomy is a tecnique based on ultrasonic vibration of an osteotomic device that permits precise cutting of bone structures without damaging adjacent soft tissues. To date, however, there have been no studies on the outcome of osseointegration of alveolar bone around dental implants inserted with piezoelectric osteotomy vs. conventional osteotomy.

Aim: The aim of this study is to compare the radiographic differences, through the evaluation the bone perimplant density, between traditional surgical tecnique and piezosurgical tecnique of implant insertion.

Methods: Forty patients have been selected to be enrolled in this study. All patients were healthy, not under drug medications that could alter bone metabolism or bone calcification and needed an implant therapy of minimum two contigue implants. All implant sites have been randomly performed in non-pathologic native bone.

A single kind of implant surface (SLA) has been chosen. The implant insertion has been performed following the manufacturer protocol for traditional surgical technique and piezosurgical technique.

Radiographs have been taken at time 0, 30, 60 and 90 days after surgery. The bone density has been studied with the densitometry application. All data have been recognized and the mean and the median values have been compared.

Results: All patients completed the study period with success. All implants were stable and osseointegrated and no inflammation was recorded during the healing time.

The mean value of bone density of all implants after bone piezosurgical implant insertion (bone density at T0 = 167) was higher than traditional drilling procedure (bone density at T0 = 135), and did change after a 6-month period (bone density at T1 = 168 vs. 142).

Conclusions and clinical implications: Considering the importance of bone quality in implant surgery or related integration, the need for an accurate and reliable clinical tool for quantifying this is evident.

Despite a limited number of treated patients, the results of this pilot tudy demonstrated that: (1) Piezosurgical implant site preparation promote a better bone density and osteogenesis, (2) the piesurgical technique without doubt is predictable and the success rate was 100%. Further studies are needed to evaluate the fate of the newly formed bone over time.

196 | Topic – Implant Therapy Outcomes, Surgical Aspects

''All-on Four flat'' in full-arch implant restoration

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Background: Immediate loading of full-arch implant restorations is today considered a good therapeutic option for edentulous patients but became a difficult surgical procedure in a patient with atrophic mandibula. ''Malo' All-on-Four'' concept associated with using flat-one abutment Intralock® system could simplify surgical procedures.

Aim: The aim of the present study was to develop and document a simple, original and an efficient surgical and prosthetic protocol for immediate function, in atrophic mandibule, within 48 h.

Methods: The clinical study analyzed retrospectively 10 patients treated with four post-extractive fixtures, immediately loaded, placed in the mandibular anterior region (two axial and two distal tilted implants). Intra-Lock® Implant System with Flat-one-abutment connection support fixed definitive full-arch mandibular acrilc/titanius prosthesis. Titanius bar component was made with CAD/CAM technology in two cases and conventional welding in the other.

Results: ''Flat one abutment system'' has concurred to obtain passivated implant also in presence of inclinate fixture. During planning the corrected position of the fixture and range inclination (from 37° to 45°) on cone beam analysis were established. The use of an apposite surgical guide was necessary for the right positioning of the fixtures. Post-extractive surgery was suitable for appropriate size fixtures.

The cumulative survival rate was 100% for all implants after 24 months. Patients were scheduled for follow-up every 6 months up to 2 years, radiographic evaluation of marginal bone level was performed and the average bone resorpt was very low. We did not observe prosthetic complication.

Conclusions and clinical implications: The results observed in this study indicate that flat one abutment when associated to use of fixed full-arch dental implant restoration concur to carry out immediate load procedures in a simple way and with optimal clinic results.

Dental implants rehabilitation and biphosphonates

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Background: An increasing number of patients affected by oncologic and osteoporotic pathology in treatment with biphosphonates develop osteonecrotic lesions localized in the maxillary bone. The implant failure is associated by some authors to all the biphosphonate drugs. In these patients the oral surgery is avoided.

Aim: The purpose of this study was to develop and document a simple, safe, and effective surgical and pharmacological protocol for implant restoration in patients with biphosphonates history.

Methods: The authors analyzed retrospectively a series of 15 patients with history of biphosphonates therapy and implant dental surgery.

In four analyzed cases, implant rehabilitation was preceded by intravenous clodronato administration. In six patients the pharmacological treatment was alendronatus, and risendronatus in five patients. A condition of atrophic and completely edentulous mandibles indicated a rehabilitation with overdenture, supported by fixtures placed in the anterior region. We have used Ankilos® Dentsply implants system. Biochemical markers of bone metabolism (cross-linked C-telopeptide of type I collagen) have been used in all patients to evaluate the level of risk of developing ONJ. The load of the fixture has been carried out after 3 months from their insertion.

Results: No observed morbidity at clinical control 24 months later, the radiological examination concurs to find an optimal osteointegration of implants and the absence of gaps indicated by premature deterioration.

The cumulative survival rate was 100% for all implants after 24 months, and the marginal bone level was on average 0.8 mm (SD = 1.0 mm) from the implant/abutment junction after 2 year.

In the patients with monoaminobiphosphonates treatment one good bone vascolarizzation, and excellent primary stability have been noted.

Conclusions and clinical implications: The chemical structure of BP and a right choice of the implant system can condition the result. We observed a hight level of biochemical markers bone metabolism but for many authors is not a valid preoperative test to accurately assess the level of surgical risk.

Immediate loading of two unsplinted NobelActive™ implants supporting mandibular overdentures

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Background: The McGill consensus statement on overdentures gives evidence, from randomized control trials, that mandibular two-implant overdentures are the first choice standard of care for edentulous patients. They ask for reduced healing times and comfort what encourages clinicians to study simplified treatment protocols.

Aim: The aim of this study is to demonstrate that two NobelActive™ implants can function immediately loaded in an unsplinted way to retain mandibular removable overdentures, and compare these results with those for delayed-loaded implants.

Methods: In this prospective clinical study eight patients received two interforaminal implants, according to the one-stage surgical protocol, and were randomly divided into two groups: test group, in which the overdenture was connected within 48 h after surgery, and control group, in which the overdenture was connected 3 months after surgery. Locator® abutments were used in all cases. Standardized periapical radiographies and stability measurements by means of resonance frequency analysis, soft tissue health and patient satisfaction were recorded at surgery, and after 1, 3 and 6 months.

Results: The preliminary results suggest that there are no clinical and radiological differences between the two groups. Unsplinted implants maintained osseointegration when immediately loaded with removable mandibular overdentures. No implants were lost and peri-implant parameters were stable. Patient satisfaction was higher among the test group.

Conclusions and clinical implications: Considering implant success rates and peri-implant parameters outcomes two unsplinted interforaminal implants can be used immediately loaded to retain a mandibular overdenture.

Pterygoid implants. An alternative to treatment in posterior atrophic maxilla

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Background: Several techniques have been proposed to restore the atrophic posterior maxilla: short implants, prosthetic cantilevers, sinus bone graft, zigomatic fixtures. Pterygoid implants are other possible treatment of the atrophic edentulous posterior maxilla.

Pterygoid implants are 13–20 mm fixtures length when located in pterygoid process allow the prosthetic rehabilitation without graft in posterior maxilla.

The original technique described by Tulasne, consists in expose the maxilla tuberosity and begin a drilling by a straight handpiece in posterior direction (45°) and oblique (15°) to palate.

Aim: The aim of this poster is to analyst indications, surgical procedure, complications and survival rates of pterygoid implants in the posterior atrophic maxilla.

Methods: Twenty-five implants cases:

1. Indication: Prosthetic rehabilitation of posterior area in the atrophic maxilla, without bone grafts.

2. The pterygoid implants could be indicated when an anterior pillar be present (implant or tooth) nearly to support the prosthesis mesially.

3. Contraindications of this technique are the same as whatever standard implant rehabilitation and the lack of bone in pterygomaxillary area.

The disadvantages of this technique are mostly pterygomaxilary area anatomic knowledge to obtain a good anchorage. A CT is advised to study the region and its limits. Sometimes, a special skill is needed in the prosthetic procedure due to the emergency to the tuberosity level.

Results: In our 25 implants cases, there were only two complications. The first was a intraoperatory bleeding that stopped with the implant location. The second was a palatine nerve hypoesthesia that was over in 3 weeks. We had only one patient with implant failure (no initial stabilty).

Conclusions and clinical implications: Pterygoid implant is a good technique to rehabilitate the posterior area of the atrophic maxilla and shows a low morbility and complications.

Short (6-mm) dental implants and computer-assisted implant placement: two cases

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Background: Implant prosthesis are often used to restore partially or completely edentulous patients. The posterior regions of the mouth often have less available bone height than the anterior regions. The bone density of the remaining bone after tooth loss is often less in the posterior regions than the anterior region of the mouth. The use of computer technology in implantology has been a major advantage. Starting from a CT scan – during which the patient is wearing a scannographic template – implant planning in dedicated SimPlant software can be done.

Aim: This study aimed to evaluate the clinical effectiveness of short dental implant sizes (6-mm length and 4.0-mm diameter) in diverse host bone sites in a selected sample of partially edentulous patients and to discuss the use of scanning appliances and Safe-System to transfer clinically relevant prosthetic outcome information to a CT dataset.

Methods: Using principles of computer-assisted design and rapid manufacturing, the data acquisitioned from computerized tomography were used to plan implant rehabilitation and to transfer this information to the surgery as well. A total of six (three ITI and three Astra Tech®) short (6-mm length and 4.0-mm diameter) implants were inserted in the posterior mandible of two partially edentulous patients. To avoid disruption of important anatomical structures specially the alveolar nerve pre-operative taken images were converted to a SimPlant file. The patients were recalled at weeks 4, 8, and 12 after insertion of the implants for monitoring and assessment of clinical and radiological parameters. After a healing period of 12 weeks, implant stability quotient (ISQ) measurements were taken, all implants were functionally loaded with a screw-retained crown or fixed dental prosthesis. All patients were followed up for 6, 12, 24 and 36 months.

Results: The Safe-System provides a perfect positioning, angulation and depth of the implants without disruption of important anatomical structures; the patient had no signs of post-operative sensory changes in the lip or chin region. None of the implants failed to integrate. All six short implants showed favorable clinical and radiographic findings at the 3-year follow-up examination. At the time of implant placement, the range of ISQ values exhibited a mean of 74.33, and by week 12, a mean value of 83.82 was recorded. Based on strict criteria, all implants were considered successfully integrated, resulting in a 3-year survival and success rate of 100%.

Conclusions and clinical implications: Surgical guides of various configurations have been proposed to aid implant placement.

Although the clinical results of these short implants were favorable, it is recommended that they be used in combination with longer implants, especially when used in the less dense bone that is often seen in the maxilla.

201 | Topic – Implant Therapy Outcomes, Surgical Aspects

Maintenance of marginal bone support at osseospeed profile implants

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Background: In situations where the alveolar crest anatomy is sloped in a lingual to buccal direction, the placement of a regular implant is not optimal. A dental implant with a sloped marginal contour, OsseoSpeed Profile (AstraTech AB, Mölndal, Sweden), has been developed to optimize implant placement in such situations.
Aim: The aim of the study was to evaluate the maintenance of lingual/palatinal and buccal marginal bone support when placing OsseoSpeed Profile implants in healed ridge sites, where the alveolar crest anatomy was sloped in a lingual to buccal direction.
Methods: In this prospective, open, multicenter study, 60 patients with a need for a single implant replacement in any location will be included. The recipient sites presented with a lingual-buccal bone height difference of 2–5 mm and a history of edentulism of at least 3 months. A one-stage surgical protocol was utilized. Lingual and buccal bone level alterations were assessed using a periodontal probe at the time of implant placement and the surgical re-entry visit 16 weeks after implant placement. Data from the first 30 study subjects are presented.
Results: The mean lingual marginal bone level alteration during the 16 weeks was -0.3 mm (range: -1.5 to 0.5) while the corresponding change of the buccal marginal bone level was -0.2 mm (range: -2.0 to 2.0).
Conclusions and clinical implications: Early results from this multicenter study revealed small marginal bone level alterations at the buccal, and lingual/palatal aspect of the OsseoSpeed Profile implant.

202 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediate implant placement

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Background: Immediate implant placement both decreases the cost and time between extraction and the final restoration.
Aim: The purpose of this poster is to present 15 cases of immediate implant insertion following tooth extraction.
Methods: Fifteen patients (10 females, 5 males) aged 24–60 years having root fractures and dental caries were included. Inclusion criteria for the patients were presence of at least 4 mm of bone beyond the root apex, the absence of acute signs of infection or inflammation in the treatment area and the absence of systemic pathologies that would contraindicate bone healing around implants. Heavy smokers were not included in the study. Following extraction, implant sites were prepared and implants were inserted.
Results: Healing progressed uneventfully in all cases. At second-stage surgery, all implants were asymptomatic, immobile and osseointegrated. The soft tissue anatomy was clinically acceptable in all patients. Radiographic examination of all implants showed no peri-implant radiolucency at the end of 1 year. One implant was fractured after loading.
Conclusions and clinical implications: Successful osseointegration and complete bone healing can be obtained following immediate insertion of dental implants.

203 | Topic – Implant Therapy Outcomes, Surgical Aspects

Dehiscence treatment in molar region using Duo-Teck membrane: prospective clinical study

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Background: In immediate placement we are facing two challenges: the coronal gap between the implant, the existing bone and the soft tissue management. Different augmentation material and techniques can be utilized to solve this challenge.
Aim: Aim of this prospective study is to evaluate the outcome of Duo-Teck® membrane lyophilized collagen of equine origin, coated on one side with a film of equine micronized bone in the treatment of implant dehiscence after implant placement in extraction sockets.
Methods: • Eighteen patients (10 females, 8 males) indicated for extraction in molar region, indicated for implant therapy
- Age range from 18 to 60 years (mean 39)
- Horizontal defect depth $\leq$ 2 mm
- Extraction of defected tooth according to surgical protocol
- Curettage of the socket and removal of all granulation tissues

- Closure of the socket with suturing and waiting for 3 weeks for tissue healing
- Surgical intervention and removal of granulation tissue and insertion of wide implants (6 mm) according to the manufacturer protocol
- Measurements of exposed implants threads and marginal bone defects
- All exposed threads covered with Duo-Tech® membrane, ensuring covering of the whole implants and soft tissue closure
- X-ray post-operative was performed for all cases
- Secondary surgery was performed after 12 weeks
- Measurements of the number of exposed threads and marginal bone fill around implants
- Insertion of healing screw for two weeks
- All cases received definitive restoration and X-ray evaluation.

Results: This prospective clinical study was performed in molar region, all the patients received wide implants diameter 6 mm, length varies from 8 to 13 mm

Horizontal bone defects $\leq$ 2 mm, exposed threads from 3 to 9 threads.

In this study, all the implants were successfully osseointegrated with complete coverage of implants threads was seen in 17 of 18 implant site.

Three cases show over bone growth over the covering screw

One site shows from 1 to 2 exposed threads of total eight threads.

Conclusions and clinical implications: The results of this clinical study show that it is possible to gain bone coverage over the exposed implants threads by using Duo-Tech® membrane.

204 | Topic – Implant Therapy Outcomes, Surgical Aspects

On the correlation between Hounsfield units in CTs and insertion torque measurements at implant placement

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Background: Computerized tomographs (CTs) are commonly used for presurgical planning of dental implant placement. It is possible to obtain information about the bone density at the upcoming implants sites in Hounsfield units (HU).

Aim: The aim was to in three patients evaluate if there is a correlation between bone density at upcoming implant sites as measured in HU in CTs and insertion torque measurements when placing the planned implants.

Methods: The pilot study comprised three patients in whom presurgical CTs had been used to plan implant treatment. A total of 21 implants were placed in the totally edentulous maxilla ($n = 2$) or mandible ($n = 1$). Insertion torque was measured during implant insertion with an Elcomed SA200C drilling unit (W&H, Bürmoos, Austria) at 20 rpm and 8 Hz to a maximum torque of 50 N cm. The data were imported and analysed in specially designed software (Impdat, Kea Software GmbH, Poecking, Germany). The torque/time curves were examined for mean IT (N cm) and consumed energy (mJ) over the total curve. A second CT was taken after placement of the implants. Special software (Geomagic Studio 11, Research Triangle Park, NC, USA) was used to superimpose the positions of the implants as extracted from the postoperative CT to the preoperative one. With another software (3Diagnosys 3.0, 3Diemme, Cantu, Italy), a hollow cylindrical matrix, mimicking the implant length and the bone within 1 mm from the implant walls, was created. The matrixes were placed in the presurgical CT in exact positions as the implants. Bone density data were exported for every voxel inside the matrix, expressed as the total sum of HU and mean HU. The Spearman's σ test was used to find possible correlations between IT and HU.

Results: There was a significant correlation ($P < 0.01$) between bone density and insertion torque for all parameters.

Conclusions and clinical implications: This pilot study showed a correlation between bone density in planned implant sites, as measured in HU in preoperative CTs, and insertion torque measurements at the surgical placement of the implants. It is suggested that the 3Diagnosys software can be used to plan implant sites where optimal stability can be achieved.

205 | Topic – Implant Therapy Outcomes, Surgical Aspects

Implant-based prosthetic rehabilitation after removal of arteriovenous malformation of mandible

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Background: Arteriovenous malformations of the mandible are rarely encountered in clinical practise, yet 50% of all intraosseous AVMs occur in the maxillofacial region. Dentists, oral and maxillofacialsurgeons and radiologists need to be able to recognise these lesions because of their potentially life-threatheningcomplications.

Aim: We present a case of an intraosseous mandibular AVM with its surgical treatment option and the following prosthodontic rehabilitation using dental implants.

Methods: A 16-year-old girl was referred to Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Istanbul University, by her general dental practitioner (GDP) because of amassive bleeding during extraction of her right mandibular first molar. Clinical and radiological examinations revealed the presence of an AVM of the mandible located in the apical region of the right premolar–molar teeth.

A selective arterial embolisation of the AVM was performed in interdisciplinary cooperation with the Department of Neuroradiology. Embolisation of the AVM was achieved with an application of butyl-2-cyanoacrylate (Histoacryl®, Braun, Melsungen, Germany). Four weeks after the embolisation of the AVM, the curettage of the lesion was performed. During the operation, mandibular left premolars, the first and the second molars were extracted.

One year after the operation, patient's mandible was evaluated with cone beam CT for dental implant placement. A favourable bone healing was observed, as a result, three dental implants were placed using surgical guides.

Results: Six months after the implant placement, prosthodontic rehabilitation was accomplished. At the 3 month's control examination, patient's prosthesis was found to be functionally and physiologically successful.

Conclusions and clinical implications: The surgical intervention of AVM's in the maxillofacial region implies a partial or complete resection of the mandible. Repair of form and function may be challenging. In the present case complete curettage of the lesion was performed through a bony window on occlusal side of the alveolar ridge and provided the continuance of the buccal and lingual bony walls of mandible. Eighteen months after the operation, patient's implant-based prostodontic rehabilitation was achieved successfully.

206 | Topic – Implant Therapy Outcomes, Surgical Aspects

Multiple immediate implantation with connective tissue graft for esthetic results: case reports

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Background: It is difficult to obtain esthetic result of gingival level in anterior multiple implant case.

Immediate implantation takes less time than delayed implantation usually, but it has low predictability, possibility of additional surgery if we need ridge augmentation.

We need new surgical technique of immediate implantation for overcoming the drawback.

Aim: The aim is to find out the benefits of subepithelial connective tissue graft without flap reflection in immediate implantation of anterior multiple extraction case.

Methods: First case

Two implants are placed in both lateral incisor immediately after extraction of esthetically compromised four maxillary anterior teeth.

We grafted connective tissue after formation of the partial thickness flap maintaining papilla like tunnel.

Second operation (punch) was performed after 3 months.

Final restoration was delivered after gingival molding using provisional restoration

Second case

Hopeless central incisor and latral incisor were extracted carefully.

Two implants were placed immediately with connective tissue graft with same protocol of the first case.

Provisional restoration was made after about 3 months.

Results: Multiple immediate implantation with connective tissue graft in anterior region show good esthetic results.

Conclusions and clinical implications: We can obtain clinical implications as following through multiple immediate implantation with connective tissue graft.

1. Less surgical intervention
2. Less total treatment time
3. No change of mucogingival junction
4. Favorable blood supply for grafted tissue through formation of partial thickness flap and maintaining of papilla.

207 | Topic – Implant Therapy Outcomes, Surgical Aspects

Immediate loading of oral implants with advanced surgery: case report

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Background: Immediate implant restoration with functional loading provides better patient comfort, allows quick chewing function and esthetics. However, information on immediate loading protocols with advanced surgical techniques is limited.

Aim: The aim of this clinical case is to present the preliminary clinical outcome of immediately, implant-supported posteiror fixed dental prostheses (FDPs) in edentulous maxilla.

Methods: Deproteinized bovine bone granules (DBBG), demineralized freeze-dried bone (DDFB) and autogenous bone (AB) were placed as a grafting material for sinus flor elevation in the bilateral posterior maxilla. After six mounts healing a total of six sandblasted, large-grit and acid-etched (SLA-Straumann-ITI) and SLActive dental implants were inserted and specimens were taken with a trephine drill, and the site of the specimen was enlarged to accept an implant. Implant-supported fixed provisional prostheses were fabricated within 48 h after surgery. After 16 weeks of healing time, definitive, solid/angled-screw retained, implant-supported ceramometal FDPs were fabricated. Resonance fequency analysis (RFA) evaluations were recorded at surgery, after 1 month of loading with the provisional implant-supported FDPs as well as 24 months after definitive implant-supported FDPs. Calculations of marginal bone loss (MBL) were performed in radiographs taken at placement, 6, 12, and 24 months of loading.

Results: The mean RFA values at surgery and the first month were 61.4 ± 4.5 and 80.3 ± 5.4, respectively, while the mean values at 24-month follow-up were 81.9 ± 6.7. MBL (mm) for advanced surgery applied implants were higher (2.8 ± 1.6) than implants placed without advanced surgery (1.8 ± 1.2) during the follow-up.

Conclusions and clinical implications: Immediate loading of implants placed with advanced surgical techniques and fixed dental prostheses demonstrated a good short-term clinical outcome, however, long-term studies should be conducted.

Using xenografts in 3D bone reconstruction surgery. A case report

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Background: Autogenous bone grafts have been for many years the gold standard in bone regeneration surgeries. The use of biomaterials as an alternative it is still controversial especially in critical defects such as vertical–horizontal alveolar defects. In such situations Khoury has developed some years ago the 3D bone reconstruction, where the autogenous cortical blocks serve as a buccal and palatal walls and the space between them are filled with cortical and/or cancellous autogenous bone particles. This technique has been shown to be a predictable technique for vertical bone augmentation with low rate of complications. However, using this technique, sometimes is needed a big amount of bone particles to fill such space.

Aim: The aim of this paper is to show, through a clinical case, the use and the histological evaluation of a xenograft as an alternative for filling the space between the blocks during a 3D bone reconstruction surgery.

Methods: A 35-year-old healthy woman was treated in our private office to reconstruct a vertical defect of 6 mm in her upper posterior maxillary area. A 3D bone reconstruction technique was performed using a mandibular block harvested from the mandibular ramus area. The space left was filled with xenograft cancellous bone particles (0.25–1 mm), once the particles were well packed, a collagen resorbable membrane of 0.3 mm in thickness was placed over the particles to prevent soft tissue migration. A 5-month healing period was left to accomplish bone regeneration. Then, three bone biopsies were taken from the xenograft area using a 2 mm internal diameter trephine. This trephine served as a drill to prepare the implant site. A 3.7 × 10 mm implants were inserted in each biopsy. Then, the biopsies were sent for histological evaluation.

Results: High amount of vital osteocytes has been found in the biopses as well as large amounts of mineralized bone surrounding the xenograft particles. Similar observations were in accordance to those found by Khoury in biopses obtained in areas where autogenous bone particles were used.

Conclusions and clinical implications: Within the limits of this case report, we can conclude that the use of xenograft particles can be a good option when the space between cortical blocks is large and the obtention of big amounts of autogenous particles cannot be done during the 3D-bone reconstruction. More controlled and prospective studies are needed to determine the effectiveness of such material compared with the autogenous bone particles.

Posters: Topic – Implant Therapy Outcomes, Prosthetic Aspects (Abstracts 209–277)

209 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Revisited rules of papilla level adjacent to single-tooth dental implants according recent implant designs. A retrospective study

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Background: According to Choquet and Tarnow principles (2001), a papilla is always present if the distance from the base of the contact point between two crowns to the crest of the bone is 5 mm or less. The arrival of new designs in implantology suggested more tissue preservation and so a possible evolution for the aesthetic treatments.

Aim: This study was designed to determine wether the distance from the base of the contact point to the crest of the bone would correlate with the presence or absence of the interproximal papillae adjacent to single-tooth implants using the recent implant designs.

Methods: A clinical, photographical and radiographical retrospective evaluation of the papilla level around single-dental implants and their adjacent teeth was performed in the anterior maxilla in 34 patients restored with 39 implants. This implants were loaded at least 6 months and present a modified profile (Implants: *NobelConcept* and *NobelActive*, Nobel Biocare; *Bone Level*, Straumann. Abutments: Platform switching and curvy). Sixty-three papillae were available for evaluation. The vertical distance between the base of the contact point and the bone crest, the vertical relation between the papilla height and the crest of bone and the vertical relation between the papilla level and the contact point were measured. The measurements were rounded off to the nearest 0.001 mm and used with calibration computer programs (ImageJ) to be analysed. The statistical analyses were realised with SAS program (SAS Institute, Cary, NC, USA).

Results: When the measurements from the contact point to the crest of bone was 5 mm or less, the papilla was present 100% of the time. When the distance was 6 mm, the papilla was present 96% of the time. And when the distance was 7 and 8 mm, the papilla was present 57.14% and 50% of the time.

Conclusions and clinical implications: These results show the influence of the bone crest on the presence or absence of papillae between implants and adjacent teeth. The data also show a positive influence for recent designs of implant and abutment systems. These designs shift the actual critical bone distance under the contact point from 5 to 6 mm and could improve the aesthetic outcome.

210 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implants as strategic abutments to improve removable partial dentures function and esthetics – a 10 years follow-up

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Background: Because of successful preventive procedures and the predictable use of osseointegrated implants the need for removable partial dentures (RPDs) has reduced. However, for a variety of reasons, many patients can continue to benefit from RPD therapy, and these patients deserve the best functional and esthetic results possible.

This presentation describes a clinical strategy to eliminate the display of the clasp assembly and provide an improved esthetic and functional implants-teeth removable prosthesis by the use of strategically placed dental implants.

Aim: The purpose of this longitudinal, large-sample study was to evaluate the treatment outcome of RPDs in partially edentulous patients treated with dental implants as additional strategic abutments.

Methods: Seventy-eight partially edentulous patients with 132 dental implants in conjunction with RPDs participated in this study. Treatments were followed-up for a period of up to 10 years (3–10). The prosthetic elements that were used with the implants to support the RPDs were ball attachments, telescopes and bar connections. All patients were followed-up every 6 months. The presence of clinical signs of mobility and gingival inflammation around implants and teeth was evaluated. Prosthetic complications and patient satisfaction were evaluated.

Results: During the follow-up period, only five implants failed resulting in 96.2% implants success rate. During this period, prosthetic complications were minor without affecting the prostheses function. No significant clinical signs of mobility or gingival inflammation around implants and teeth were reported. Patients reported good chewing ability and stability of the prosthetic devices. The analysis of the costs of implant with RPDs (IRPDs) compared with implant-supported FPDs showed that patients save more than 50% on treatment costs when IRPDs are used.

Conclusions and clinical implications: On the basis of this longitudinal, large-sample clinical study, the following conclusions were drawn: (1) successful function over a prolonged period and a minor complication rate of implant-tooth-supported RPDs may be anticipated (2) the great variety of treatment modalities offered by tooth-implant-supported RPDs, appears to be useful as a treatment option for the partially edentulous patients.

211 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Improving quality of life with implant-supported overdenture

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Background: Over the past years, clinicians have been restoring aesthetics and function in edentulous patients with implant-supported overdentures using different retention systems. The choice of prosthesis retention has significant economic implications but it is not well known if there are specific clinical implications, particularly with regard of treatment's success as well as patient satisfaction therefore is important to determine whether there are meaningful differences in outcomes, based on the type of retention used.

Aim: Our prospective clinical trial compare the Locator® System with two other types of stress-breaking retention (Retentive Anchors and Magnets) for implant-supported overdenture in atrophic edentulous mandible, with the use of Straumann Dental Implant System.

Methods: The study was divided in two parts – in the first part 46 fully mandibular edentulous patients were enrolled (age 42–84 years). Each patient received two screw-type Straumann standard implants Ø4.1 mm, with SLA surface in the canine region of the mandible, in a one-stage non-submerged procedure according to a strict protocol. After 6 weeks healing period implants were loaded and the patients randomly assigned to one of two groups: Group B (23 patients) received retentive anchors and Group M (23 patients) received magnets. The two groups of patients were compared in the second part of the study with 23 patients (age 47–80 years) receiving Locator system abutments (Group L) following same research protocol (ClinicalTrials.govID: NCT01034930). New mandibular overdenture with metal reinforcement was made.

Total costs of the surgical, prosthetic and maintenance procedure were calculated for all the three attachment systems used after 12 months. Patient satisfaction was assessed with the aid of questionnaires adapted from the index Oral Heath Impact Profile in Edentulous Adults (OHIP-EDENT), initial (with the original denture), after 6 (T), 12 (T1) and 24 months (T2). For statistical analysis SPSS-PASW18 software was used.

Results: Four implants failed before loading were replaced and healed uneventfully (97.1% success rate after 2 years).

Surgical and prosthetic costs were similar, but components costs were highest at M group and lowest at B group.

Patient satisfaction improved significantly in the three groups across all variables including esthetics ($P < 0.05$), except ease of cleaning – the B and L group had higher maintenance necessities. M group scored lower stability but also lower maintenance requirements.

Conclusions and clinical implications: Implant-supported overdenture improves quality of life, despite the system used.

The clinical decision on the type of implant-supported prosthesis should be case specific focusing on providing the patient with optimal clinical and psychosocial outcomes.

Acknowledgment: This study was supported by Grant no. 316/2003 and no. 507/207 from the ITI Foundation for the Promotion of Oral Implantology, Switzerland.

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Immediate loading of short implants in edentulous free-ends

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Background: Short implants emerge as a reliable alternative in cases where atrophy of the upper maxilla and mandible compromises the outcome of implant treatment and more invasive surgical techniques are required.

Aim: The purpose of this prospective study was to assess the immediate loading outcomes of short implants in edentulous free-ends.

Methods: Twenty-four patients were enrolled in the study fulfilling the inclusion criteria of having at least an edentulous atrophic free-end. Short (7 mm) implants (NobelSpeedy™ and Brånemark System®Shorty, Nobel Biocare, Göteborg, Sweden) were loaded immediately or left submerged depending on the primary stability (35 N or more for immediate loading). Features of location, torque, immediate loading, type of splint (only short implants or with other lengths), opposing arch and residual bone (computerized tomography) were collected. Immediate loaded implants were evaluated monthly until the final restoration (probing depth, bleeding, mobility and bone loss assessed by periapical radiography). The implant survival and radiographic bone loss were evaluated at the time of placement the final restoration. The data were analyzed using the SPSS 15.0 statistical software packaged (Pearson χ^2 test, significance 5%).

Results: A total of 54 short implants (41 in mandible and 13 in upper maxilla) were placed in 24 patients with a mean age of 53.58 years. The survival rate at the time of placement the final restoration was 90.32% (five implants failed) after a mean follow-up of 8 months of load. The mean insertion torque was 40.12 N (10–50) and the mean available residual bone was 8.2 mm length (5–10.9). Twenty-three implants followed a two-stage surgical protocol with delayed loading (6–11 months), while 31 were loaded immediately, 20 of them splinted in an implant bridge supported only by short implants. All failures were associated with short-implant bridges ($P = 0.043$) with no differences between immediate or delayed loading (table 1). A marginal bone loss of 1 mm or less was seen at the time of placement the final restoration in 74.19% of immediate loaded implants, while 25.81% presented between 1 and 2 mm of marginal bone loss. There were no differences in bone loss rates between immediate or delayed loading.

Table 1. **Failures associated with immediate or delayed loading**

Loading	Implants		Total
	Survival	Failures	
Delayed	21	2	23
Immediate	28	3	31
Total	49	5	54

Conclusions and clinical implications: Immediate loading of short implants may be considered as a treatment option in edentulous atrophic free-end, especially if they are splinted with implants of greater length. Further results will be presented.

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''One abutment-one time'': optimizing platform-switching concept. Three-year controlled prospective study

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Background: The ''platform-switching'' concept showed better peri-implant crestal bone preservation in post-extraction immediately restored implants when compared with matching diameter abutment configuration. However, repeated abutment dis/reconnections during restorative procedures from provisional to final crown could produce apical shifting of peri-implant tissues.

Aim: Aim of this controlled prospective study was to evaluate on bone levels (MBL) the influence of restoration using immediately definitive abutments (one abutment-one time concept) vs. provisional abutment later replaced by a definitive abutment.

Methods: Twenty-six patients with 26 hopeless maxillary premolars received a post-extraction wide diameter implant.

Immediately after insertion, 11 patients (Control Group, CG) were immediately restored using a platform-switched provisional titanium abutment. In 15 patients (Test Group, TG), definitive platform-switched titanium abutments were tightened.

In both groups, provisional crowns were adapted, avoiding occlusal contacts.

All implants were definitively restored after 3 months: for the final impression, in CG, traditional impression technique with coping transfer was adopted, dis/reconnecting abutments several times; in TG, metal prefabricated coping was used and final restoration was seated avoiding abutment disconnection.

Digital standardized periapical radiographs using a customized film holder were recorded at baseline (T_0 = implant insertion), final restoration (T_1 = 3 months after), 18 (T_2) and 36 months (T_3) follow-ups. The MBL was evaluated with a computerized measuring technique applied to radiographs.

Digital subtraction radiography software was used to evaluate radiographic density of bone tissue around implants.

The Student's *t*-test (confidence level: $P < 0.05$) was selected to identify differences between test and control groups at different follow-ups concerning MBL values.

Results: In the CG peri-implant bone resorption was 0.41 mm (SD = 0.15 mm) at T_1, 0.38 mm (SD = 0.12 mm) at T_2, 0.53 mm (SD = 0.13 mm) at T_3.

In the TG, on average, peri-implant bone resorption was 0.59 mm (SD = 0.19 mm) at T_1, 0.31 mm (SD = 0.11 mm) at T_2, 0.32 mm (SD = 0.16 mm) at T_3.

Statistically significant difference between groups was only found at T_3.

At the same follow-up period, higher density in radiographic bone appearance around implant neck was recorded in the TG compared with CG.

Conclusions and clinical implications: The implant/abutment stability following the minimally invasive prosthetic strategy adopted (''platform-switching'' and ''one abutment-one time'') could longitudinally produce additional hard tissue preservation compared with implants restored according to ''platform-switching'' only.

Despite of the encouraging data reported, however, controlled clinical studies on larger patient sample and histologic investigations are required to confirm this hypothesis, analyzing biologic mechanism.

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A 3-year prospective radiographic evaluation of marginal bone level around different implant systems

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Background: The successful replacement of lost natural teeth by osseointegrated implants is a major advance in clinical dental treatment. The basis of these successful long-term results of endosseous implants depends mainly on the preservation of bone support. Therefore, maintenance of osseointegration and a steady state in marginal bone level are imperative features. The radiographic image is the most important source of information for determining the amount of cervical alveolar bone loss around dental implants.

Aim: The aim of this study was to evaluate the change of marginal bone level radiographically around three different implant systems after 3 years in function.

Methods: Fifty-four patients were included and randomly assigned to three treatment groups of rough-surface implants (TiUnite, $n = 37$), hybrid of smooth and rough surface implants (Restore, $n = 38$), and rough-surface with microthread implants (Hexplant, $n = 45$). Clinical and radiographic examinations were conducted at the time of implant loading (baseline), 1 and 3 years after loading. A three-level mixed-effect analysis of

covariance (ANCOVA) was used to test the significance of the mean marginal bone change of the three implant groups.

Results: A total 120 out of 135 implants completed the study. None of the implants failed to integrate. Significant differences were noted in the marginal bone loss recorded for the three groups ($P < 0.0001$). At 3 years, the rough surface with microthread implants had a mean crestal bone loss of 0.59 ± 0.3 mm; the rough surface implants, 0.95 ± 0.27 mm; and the hybrid surface implants, 1.05 ± 0.34 mm.

Conclusions and clinical implications: Within the limitations of this study, rough-surface implants with microthread at the coronal part might have a long-term positive effect in maintaining the marginal bone level against functional loading in comparison to implants without these two features.

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Immediate loading of the edentulous maxilla with a final restoration supported by an intra-oral welded titanium bar and tilted implants

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Background: Because early studies on osseointegration, the rehabilitation of an edentulous atrophic maxilla with a complete-arch, implant-supported prostheses was considered one of the most challenging clinical case.

Aim: The aim of this prospective study was to evaluate the concept of intra-oral welding as a suitable technique for the manufacture of a restoration for edentulous atrophic maxilla on the same day as surgery using axial and tilted implants.

Methods: Each of 30 patients had an edentulous maxilla and received three axial and four tilted implants. All implants were immediately loaded with a fixed restoration supported by an intra-orally welded titanium framework. Final abutments were connected to the implants and then a titanium bar was welded to them using an intra-oral welding unit. This framework was used as a support for the final restoration, which was fitted on the same day as implant placement. Mean marginal bone loss and radiographically detectable alteration of the welded framework were assessed using periapical radiographs immediately after surgery, and at 6, 12, 24, and 36 months follow-up examinations.

Results: Sixteen males and 14 females, with an average age of 58.1 years (SD = 13.6; $n = 30$), were consecutively treated with 210 immediately loaded implants. No fractures or radiographically detectable alterations of the welded frameworks were evident. The cases included in this study achieved a 100% prosthetic success rate at the 36 months follow-up. Three (1.4%) implants had serious biological complications, resulting in a success rate of 97.8% for the axial implants and 99.2% for the tilted implants. The accumulated mean marginal bone loss was 0.92 mm (SD = 0.75; $n = 90$) for the axial implants and 1.03 mm (SD = 0.69; $n = 120$) for the tilted implants. At the same follow-up the average pocket probing depth was 1.87 mm (SD = 0.98; $n = 90$) for the axial implants and 1.95 mm (SD = 0.81; $n = 120$) for the tilted implants.

Conclusions and clinical implications: It is possible on the same day of surgery to successfully rehabilitate the edentulous atrophic maxilla with a fixed, permanent restoration supported by an intra-orally welded titanium framework attached to axial and tilted implants.

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Immediate provisional CadCam restoration of zirconia single-piece implants

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Background: Zirconia has been increasingly discussed and questioned as an alternative implant material to titanium. So far no reliable clinical data are available on zirconia implants.

Aim: Aim of this prospective pilote study was to evaluate the outcome of immediately provisionally restored single-piece zirconia implants in the upper and lower jaw.

Methods: Twenty zirconia implants were inserted primary stable (> 45 N cm) in single-tooth gaps, requiring neither bone nor soft tissue augmentation, in 20 patients (11 males/9 females) in the maxilla (12) and mandible (8). Implants were restored adhesively with all-ceramic CadCam provisionals immediately after placement. Permanent all-ceramic restoration was performed 4 months after surgery. Radiographic coronal bone levels, implant survival and success were evaluated up to 18 months after placement.

Results: Measurements of mean marginal bone levels 18 months after surgery showed a significant bone loss of 0.89 mm ($P < 0.001$). One implant was lost 3 months after provisional restoration. No further complications were recorded resulting in an overall survival and success rate of 95% after an observation period of up to 18 months in clinical function.

Conclusions and clinical implications: The present pilote study of immediately restored zirconia implants revealed results comparable with those of immediately restored titanium implants. As identified for titanium careful patient selection in combination with high primary stability seem to be key factors for immediately loaded zirconia implants. Yet, so far no final conclusions or clinical recommendations can be drawn from this uncontrolled trial. Larger long-term RCTs are needed to confirm predictability and evidence of this protocol and zirconia as an implant material.

Immediate loading of prostheses with or without framework: clinical findings

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Background: Immediate loading in the edentulous lower jaw is a treatment option with similar results to conventional load. There are different options to conduct this procedure: (1) use of titanium premade copings attached with acrylic resin or (2) regular frameworks, fabricated in metal.

Aim: The aims of the present study are to compare clinical findings of dental implants submitted with immediate load in edentulous mandibles rehabilitated with hybrid prostheses with or without rigid structure.

Methods: Fifteen patients, 53–80 years of age, totally edentulous, non-smokers and with good health were recruited for this study. The exclusion criteria were non-compensated diabetic patients, patients with immunodeficiencies, patients who had used bisphosphonate drugs or received radiation treatment in the last 5 years, and smokers. Firstly, all the patients were prepared by a clinician team to receive the prosthesis 1 day after the surgery. Five implants were installed (Titamax cortical Ti, Neodent, Curitiba, Brazil) in the lower jaws, every installation torque was recorded as well as the ISQ measures with an Osstell Mentor system (Gotemborg, Sweden). Standard digital X-ray positioners were used to analyse bone loss around the 75 implants. Records were made at the implant installation and 8 months later. Prosthesis stabilization and peri-implant health were also recorded. The surgical and prosthetic clinical procedures were similar to all patients; the difference was related to the prosthesis manufacturing. Group I received conventional hybrid prosthesis, with rigid bars. Group II received a premade bridge system with short titanium bars at the distal, all implants were splinted with acrylic resin. Patients were randomly placed in one of the two groups. The project was approved by the Ethics Committee of Pontifical Catholic University/PR, report number 02382/2008.

Results: Because a normal distribution of the variables was found (Kolmogorov–Smirnov), ANOVA tests were applied. There was no implant loss after 8 months any prosthesis presented mobility and no implant has showed inflammation. ISQ values have not presented statistically significant differences in relation to time, regardless of the prosthesis ($P > 0.05$). Fixed implant-supported prostheses with or without rigid structure presented statistically equivalent mean values of ISQ during the 8 months follow-up period.

Conclusions and clinical implications: The use of hybrid prostheses free of metallic structure under an immediate loading procedure is a relievable treatment option to rehabilitate edentulous mandibles in an 8 months period of time.

The accuracy of implant impression with digitally coded healing abutments

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Background: A digitally coded healing abutment (Encode®) that includes all necessary information on implant position and diameter on the top of the abutment has been launched. No comparative studies are available evaluating master cast fabrication using impressions of the digitally coded abutment and implant analog placement in the master cast by a robot technique (Robocast®) and conventional impression techniques using impression copings.

Aim: To compare the accuracy of implant analog placement in master casts with a robot technique using an impression of digitally coded healing abutments, and traditional technique using implant pick-up impression copings.

Methods: One acrylic master model was provided with three reference spheres and three implant analogs bilaterally. Three Encode®healing abutments were placed on the right side (test) and three conventional pick-up impression copings on the left side (control). Fifteen impressions were performed using silicone material and customized trays. Implant analogs were placed manually on the impression copings (control) in the impression before pouring with plaster. After setting of the stone cast, the analogs on the test side were placed by the Robocast®technique using information retrieved from the digitally coded abutments. Measuring of implant analog positions in the study casts were performed with a Laser Measuring Machine. The center-point position of each implant analog in *x*-, *y*-, *z*-axis and angular direction of center axis were registered. Analyses were performed with two-way ANOVA. The statistical significance was set at $P < 0.05$.

Results: None of the two techniques presented a cast without distortion of the implant analog position as compared with the master model. Implant analogs in the control presented less distortion than analogs in the test group. Mean (SD) center-point distortion for test and control groups were in *x*-axis 37 (28) and 18 (13) μm, respectively ($P < 0.005$), *y*-axis 47 (35) and 14 (11) μm, respectively ($P < 0.001$), and in *z*-axis 35 (29) and 15 (15) μm, respectively ($P < 0.05$). Mean angular distortion was 0.41° (0.25°) for the test and 0.14° (0.11°) for the control group ($P < 0.001$).

Conclusions and clinical implications: Both conventional and digital impression technique presented distortion of the implant analog positions in all casts. More distortion of the implant analog positioning was present for the digital technique when compared with conventional technique. However, differences in accuracy of implant analog placement were small. Both techniques are precise enough for single crowns and short span implant-supported-fixed partial prostheses when using customized abutments.

Three-year outcomes of early loaded implants in posterior maxilla

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Background: The purpose of this study is to investigate effects of early loading of dental implant Microthread™ OsseoSpeed™ (AstraTech AB) on implant stability, marginal bone loss, and survival.

Aim: Three years results are reported.

Methods: Forty-seven patients with edentulous posterior maxilla at three centers were treated with a total of 143 implants. Two to three, self-tapping implants were placed with a one-stage approach. Resonance Frequency Analysis (RFA) and radiological assessment were made. RFA values were recorded at 2 and 6 weeks following implant placement and then five times over the first year. After 6 weeks of healing, provisional restorations were fabricated.

Results: Eighty implants in 32 subjects were loaded within 56 days of placement (Early Load Group) while 51 implants in 17 subjects had a healing period greater than 56 days at the clinical discretion of the investigators due to reported lack of implant stability over first 6 weeks post-op. In the early load group, 41% of the patients were male and 59% female. Mean age was 59 ± 11 years. Sixty-two percent were non-smokers and 38% ex-smokers. Smokers were excluded from the study. In the early load group, 56% were placed with Osteotome technique and 98% had primary fixation at placement with 86% placed in type 3 and 4 bone. Installed implant positions were: first premolar 19%, second premolar 43%, first molar 30%, and second molar 8%. Initial implant stability measurements had median values of 66 ± 7 ISQ at placement in the early load group and a final median of 70 ± 7 ISQ at 60 weeks. There was no significant change in ISQ value over the repeated seven ISQ measurements over the 60 weeks following placement (repeated measures ANOVA, $P < 0.05$). There was no significant difference in implants placed with or without the osteotome technique ($P < 0.05$). Mean marginal bone loss over 3 years from implant placement was 0.37 mm ± 0.74 (range −2.70 loss to 1.55 mm gain). Cumulative Implant Survival Rate (CISR) for all implants at risk was 92% ($n = 10$ losses of a 143 at risk), 96% for the early load group (3 of 80 at risk) and 85% (7 of 63 followed) for the delayed loading group.

Conclusions and clinical implications: Three years results in posterior edentulous maxillas indicate satisfactory results with early loading of implants when implants have initial primary stability obtained by drilling or Osteotome indirect sinus lifting.

Four-unit anterior maxillary fixed dental prostheses (FDPs) based on two narrow-neck implants – a 5-year clinical study

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Background: In case of four missing maxillary incisors, clinicians still debate which treatment plan represents the optimum. Predictable and long-lasting restoration of oral function, including esthetics, is the primary objective, whereas cost effectiveness is the secondary goal. When implant therapy is chosen, open questions focus on the ideal number, dimension and localization of the implants to be used. One possible option is the insertion of two narrow-neck implants (NNI) at the lateral incisor sites to support a four-unit fixed dental prosthesis (FDP), comprising two central ovate pontics. Although the NNI was originally designed for small single-tooth gaps in the anterior region, it was progressively used to also support multi-unit FDPs replacing the maxillary incisors. Its narrow design corresponds perfectly to the average mesiodistal diameter of a lateral maxillary incisor, thus permitting to optimally develop an adequate emergence profile of the suprastructure and by this considering the esthetic aspect. Some concerns have been raised, however, related to the mechanical long-term resistance of that specific type of implant in this particular context.

Aim: The aim of this retrospective study was to evaluate the clinical outcome of nine four-unit FDPs, supported by 18-maxillary NNIs located at the lateral incisor sites, throughout a clinical observation time of 5 years. This included the assessment of the incidence of eventual mechanical complications concerning the supporting NNIs, their respective components and the suprastructures.

Methods: Nine patients treated with a four-unit anterior maxillary FDP supported by two NNIs were evaluated on a yearly basis during an observation time of up to 5 years (mean 3.2 years) after implant surgery. Examination included measurement of plaque index (mPI), probing pocket depth (PPD), bleeding on probing (BOP), standardized periapical radiographs, intraoral digital photographs and registration of any eventual adverse events.

Results: At all recall appointments, all 18 anterior maxillary narrow-neck implants supporting nine four-unit FDPs fulfilled strict success criteria, i.e. confirmed stable osseointegration status, including absence of peri-implant radiolucency, implant mobility, suppuration and pain. No mechanical failures related to the implants, their components or the four-unit FDPs were

detected. Furthermore, patient satisfaction, as assessed by questionnaire and visual analog scales (VAS), varied between good and excellent.

Conclusions and clinical implications: It can be concluded from this retrospective 5 years follow-up study that two NNIs supporting a four-unit FDP to replace the four missing maxillary incisors, may be considered a valid and predictable treatment modality. However, long-term prospective clinical studies are needed to confirm these favorable preliminary data.

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Survival and success rate of implants following alveolar ridge preservation

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Background: Various bone grafts and substitutes used in combination with GBR have been suggested for preservation of ridge dimensions (Darby et al. 2009). In a previous study by our group a synthetic bone substitute and a bovine xenograft equally preserved ridge dimensions and promoted bone regeneration in post-extraction sockets (Mardas et al. 2010, in press).

Aim: The aim of this randomized controlled trial was to evaluate the survival and success rate of dental implants placed in alveolar ridges previously preserved with a synthetic bone substitute or a bovine xenograft.

Methods: Alveolar ridge preservation was performed in 27 patients randomized in two groups. In the test group ($n = 14$), the extraction socket was treated with SBC (Straumann Bone Ceramic; Straumann AG, Basel, Switzerland) and a collagen barrier (Bio-Gide®), whereas, in the control group ($n = 13$) with DBBM (Bio-Oss; Geistlich Biomaterials, Wollhusen, Switzerland) and the same barrier. After 8 months, Straumann SLActive Standard Plus implants were placed in the preserved ridges. 9/13 implants in the SBC group and 8/12 implants in the DBBM group presented with either dehiscence or fenestration defects and required additional bone augmentation. The implants were loaded at 4 months following placement and were followed up for 1-year post-loading. Interproximal radiographic bone levels were evaluated in standardised periapical X-rays at different time points. Probing pocket depth, gingival recession, and bleeding upon probing were recorded in implants and neighbouring teeth. The success rate of the implants was evaluated according to Albrektsson et al. (1986).

Results: The survival rate of the implants in both groups was 100% at 1-year post-loading. No statistical significant differences in any of the clinical and radiographic measurements were detected between the two groups ($P < 0.05$). The success rate of the implants was 84.6% in the SBC group and 83.3% in the DBBM group.

Conclusions and clinical implications: Equal success and survival rates of dental implants placed in alveolar ridges previously preserved with SBC or DBBM should be anticipated.

222 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Angulated dental implants effect on impression technique and its accuracy

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Background: Making an accurate impression of implant is an important procedure due to the definitive role of prosthesis passive fitness in the long-term success of implant-supported restorations. Anatomic variations, surgical limitations, bone pattern resorption and less surgical experience can lead to unparallel implantation. Despite the efforts to reduce impression errors, few studies assessed the accuracy of impression technique used to transfer the angulated implants to definitive casts.

Aim: Evaluation of master cast accuracy due to the selected impression technique for angulated implants.

Methods: In this *in vitro* experimental study, an acrylic model of the lower jaw of a human being with two implants in position of teeth numbers 29 and 31 attached to an angulated implant imitator were used to provide two implants inclined 15° to −15° individually with 42 different positions. Open and closed impression techniques were used and 256 master casts were obtained. The implants positions were determined in *X*, *Y*, *Z* coordinates by Coordinate Measuring Machine and impression accuracy were analyzed regarding parallelism, convergence and divergence status of two implants in comparison with the model. The statistical analyzes were carried out using one-way analysis of variance.

Results: Divergence, especially more than 20° has more adverse effects on impression accuracy (significant differences). There is more superiority for open technique, with divergence and convergence more than 20° (significant differences).

Conclusions and clinical implications: Close technique impression is an easy and reliable method for limited numbers of implants but divergence and convergence more than 20° bring out limitations for ultimate precision, then the open technique could be a better method for impression, provided that there is unparallelism more than 20° as a turning point.

223 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Dimensional changes of mandibular dentures after integration of implant bars

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Background: The SFI Bar® (C + M, Biel, Switzerland) is a round clip bar which is chairside completed and mounted to the implants, allowing immediate loading.

Aim: The aim was (1) to measure the volumetric changes of the mandibular denture due to space required for placement of a bar, connecting two interforaminal implants (2) to investigate the patients' perception of these changes.

Methods: Twenty patients (8 males, 12 females) were recruited for this prospective controlled trial. Two implants were placed in the interforaminal area 20 mm apart. The bar was chairside completed and mounted immediately. The bar clips were polimerized intraorally. Mounting the bar and clips required some space within the lingual denture base. These dimensional changes of the denture base were measured by means of silicon impressions in two different colors: one color represented the denture base before and one color after implant treatment. The silicon indices were used to fabricate denture duplicates. Cross-sections were obtained form these duplicate dentures in the area of the symphyseal midline and the implant position. The measurements were performed with 10-fold magnification. Six months after delivery of the bar-retained dentures to the patients, they answered a structured questionnaire with 15 items that were related to the treatment.

Results: In all cases, the denture base thickness had increased lingually. In the symphyseal midline region (diagonal 4.2 ± 1.8 mm; horizontal 4.2 ± 1.5 mm; vertical: 1 ± 0.7 mm; area 55 ± 30 mm^2) these dimensional changes were significantly greater than in the region of the implants (diagonal 2.7 ± 1.6 mm; horizontal 2.6 ± 1.4 mm; vertical: 1.9 ± 0.7 mm; area 40 ± 26 mm^2). Eighteen patients (90%) did not perceive any difference in the denture base design while two patients (10%) were aware of the increased thickness. No functional impairment (phonation, chewing function) was reported by any patient. Satisfaction was high (20%) or very high (80%). All patients were pleased with esthetics. They did not regret their decision to have implants placed with a bar retention for their complete denture.

Conclusions and clinical implications: The space required for the bar housing leads to dimensional changes with greater thickness of the denture base. This increase is mainly caused by the connection of the bar in straight line between the two implants. This may interfere with the jaw curvature. The denture volume is not significantly increased in the area of the implants. The integration of the chairside-completed bar into the denture can easily be performed. The patients do not feel disturbed by the dimensional changes of the lingual denture base.

224	Topic – Implant Therapy Outcomes, Prosthetic Aspects

Minimally invasive treatment of atrophic posterior maxilla with guided surgery, tilted implants and CAD–CAM abutments

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Background: The technique of tilted implants was developed for improving bone anchorage and prosthesis support, avoiding bone-grafting procedures. Although this approach seems to be easier, it requires a high level of surgical skill and can be as invasive as sinus graft procedures. Today, imaging-guided surgery allows the clinician to place oral implants in an angulated position with high accuracy. The CAD–CAM technique enables manufacturing of customized abutments modifying the angulation of tilted implants according to prosthetic needs.

Aim: The aim of this study was to evaluate a minimally invasive treatment of atrophic posterior maxilla with guided surgery, CAD–CAM abutments and immediately loaded fixed partial prostheses anchored to both axial and tilted implants.

Methods: A prospective 3 years clinical study on 27 consecutive patients, aged between 38 and 77 years (average: 54.18) with severely atrophy of the posterior maxilla was carried out. The inclusion criteria were a residual alveolar crest at least 4 mm in height and 6 mm in width distal to the first premolar. All patients were treated by guided surgery (NobelGuide™, Nobel Biocare AB, Göteborg, Sweden), with axial (27) and tilted (54) implants, CAD–CAM titanium and zirconia abutments (NobelProcera™, NobelBiocare AB) and fixed partial prostheses immediately loaded.

Results: Overall 81 implants were placed with a flapless or mini-flap approach (38 NobelSpeedy™ Replace® implants and 43 NobelSpeedy™ Groovy®). The average follow-up period was 25 months. The implant cumulative survival rate at 1 year was 100% for all the implants. No other implants as so far failed. As regards radiological follow-up when compared with baseline the behaviour of axial and tilted implants was similar. The mean (SD) marginal bone remodeling (mesial + distal values average) from immediate loading to the 1-year time-point follow-up (81 implants) was 0.46 mm (± 0.14) for the axial implants and 0.67 mm (± 0.42) for the tilted ones. Between the 1-year and the 2 years follow-up, the mean marginal bone remodeling was − 0.06 mm (± 0.73) indicating a stable mean marginal bone level during the second year. No failure of abutments and prostheses occurred. No other biological complications were recorded.

Conclusions and clinical implications: This study suggests that the use of Guided Surgery to install both axial and tilted implants is predictable, while reducing the surgical invasivity. The combination of guided minimally invasive approach and the biological features of CAD–CAM abutments reduce bone resorption around implants. This treatment option is an effective and biologically beneficial alternative to maxillary sinus floor augmentation procedures.

225 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Full-arch reconstruction of edentulous maxilla with immediately loaded computer guided zirconium-dioxide implants. A case report

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Background: Recent studies have established that zirconium-dioxide, due to its high biocompatibility and enhanced mechanical characteristics, might be an alternative material for dental implants.

Aim: The aim of the present study was to demonstrate the possibility of a full arch reconstruction with immediately loaded zirconium-dioxide implants.

Methods: A 65-year-old female non-smoker with a complete denture in lower jaw and edentulous maxilla has been treated with zirconium-dioxide dental implants. The computer-guided procedure (Z-Scout) was used for a precise implant position planning and provisional bridge fabrication. Three mini implants were inserted 3 months before surgery for radiological and surgical guide stabilization. All eight implants were placed with good primary stability (< 35 N cm) using the miniimplant stabilized surgical guide and were immediately loaded with a provisional bridge. The provisional restoration was successfully replaced with a permanent full ceramic 12/14 unit zirconia bridge 6 month postoperative. Non-invasive evaluation methods (percussion, periotest, radiographs) were used to evaluate implant performance.

Results: At the 6 month and 1 year follow-up, all eight implants were successfully oseointegrated, with absence of radiolucency, suppuration, implant mobility or pain (CSR = 100%), and the patient was satisfied with achieved esthetic result and function of fixed restoration.

Conclusions and clinical implications: This study demonstrated that eight zirconium-dioxide implants placed with computer guided surgery and immediately loaded with a full arch bridge for the restoration of a fully edentulous maxilla can achieve and maintain osseointegration for the evaluation period of 1 year. Regarding the good clinical and radiological results shown in this case report, further prospective clinical trials with a representative sample size are needed to confirm the obtained results.

226 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

How implant therapy can improve oral health related quality of life? A cohort prospective study

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Background: Very few studies had been published on the impact of implant therapy on oral health related quality of life (OHRQoL) on partially edentulous patients.

Aim: To analyse patients' ''functional'', ''psychosocial'' and ''pain and discomfort'' progress perception following dental implant rehabilitation.

Methods: Within a prospective cohort study of patients with ITI and SPI dental implants, the OHRQoL of 55 patients (28 men and 27 women) was assessed by GOHAI questionnaire before and after implant setting. The degree of oral rehabilitation was predetermined in four classes: ''Single-Tooth Implant'', ''Fixed Partial Denture'', ''Full Fixed Prostheses'' and ''Implant Retained Complete Over-denture.'' Gender, periodontal treatment, tobacco habits were assessed at the beginning of the study.

Results: Before treatment, the GOHAI score was lower for subjects with bigger edentulism ($F = 4$, $P < 0.01$). After treatment, no difference was shown: significant improvements were observed in the scores obtained for GOHAI (repeated measures analysis ($F = 38$, $P > 0.001$), and for each field of GOHAI (functional, psychosocial and pain & discomfort) whatever the degree of rehabilitation. However, a better improvement was noted for the biggest treatments ($F = 4$, $P < 0.05$) and among females ($F = 4$, $P < 0.05$.) No statistically significant impact on these results was found in presence of preliminary periodontal treatment or tobacco.

Conclusions and clinical implications: These results show that implants may improve subjects' ability to manage oral rehabilitation and enhance their OHRQoL. A larger, prospective, multicenter study is subsequently needed to confirm these results.

227 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Fitness of titanium crowns according to the margin configurations

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Background: Titanium crowns have many advantages compared with gold crowns for the excellent biocompatibility, low density and high mechanical resistance of the titanium alloy. However, conventional titanium casting is quite difficult due to

its high melting point, extreme chemical reactivity with the element at elevated temperature. CAD/CAM techniques can be used to mill a titanium crown into a fine and homogenous structure without a reactive surface layer. Smaller marginal gaps of a crown produce less gingival irritation, and cement washout, thereby improving the clinical outcome and longevity of the restoration.

Aim: This study compared the marginal and internal fit of full veneer titanium crowns depending on the fabrication method (casting and CAD/CAM technique) and marginal configuration (shoulder, chamfer, and knife edge margin).

Methods: The crowns were fabricated using a casting method and CAD/CAM technique. A total of 40 crowns were produced, which were divided into two groups depending on the manufacturing methods and marginal configurations. Each crown was bonded to the original stone die using zinc phosphate cement, embedded in epoxy resin and sectioned. The margin of the crown, center point of the axial wall and occlusal area were measured three times using a three-dimensional measuring microscope at $\times$ 30 magnifications and observed by scanning electron microscopy at $\times$ 50 magnifications.

Results: Within the limitations of this study, the following results were obtained:

1. The mean marginal gap and occlusal gap of the cast titanium crowns were significantly smaller than those of the CAD/CAM titanium crowns. However, the mean axial gap of the CAD/CAM titanium crown was significantly smaller than that of the cast titanium crown ($P < 0.05$).

2. In the cast and CAD/CAM titanium crowns, the chamfer margin demonstrated the best marginal seal, followed by the shoulder and knife-edge margin. All marginal configurations were clinically acceptable.

3. At the shoulder margin, cast titanium crown group showed significant smaller marginal gaps than CAD/CAM titanium crown group.

Conclusions and clinical implications: These results show that the marginal fit of a full veneer titanium crown is acceptable in the clinical range. However, further technical improvement in CAD/CAM system for titanium will be needed to obtain better marginal adaptation.

228 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implant retained maxillary obturator in near-total bilateral maxillectomy

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Background: Maxillary obturator prostheses have evolved significantly since described by Ambrose Pare in the 16th century. With development of vascular free flaps, many partial maxillectomies are now restored surgically. Ideal treatment of large maxillary defects is surgical restoration using osteomyocutaneous free flaps and dental implants. Numerous factors enter into the decision to surgically reconstruct the large maxillary defect.

Aim: This poster will describe the dental implant restoration of an extensive partial bilateral maxillectomy, using available bone, including a remote site. The patient was an individual who had refused consideration of a surgical reconstruction.

Methods: A 69-year-old female underwent three surgical procedures, radiation and photodynamic therapy for squamous cell carcinoma between 2002 and 2009. Her most recent surgery left her with the entire oral maxilla missing, with exception of a small island of alveolar bone around her right central and lateral incisors. These teeth were extracted and 13 mm Astra implants placed. The only additional remaining available bone found on CT was the pterygoid plate complex on the right, where one Astra 9 mm implant was placed. Pterygoid plates on the left had been previously removed. No bone in the zygomatic area was found to be available for implant placement.

Results: The patient refused any surgical reconstruction, and accepted the option of an implant-retained obturator. Her definitive reconstruction consisted of an implant retained substructure consisting of a laser welded gold alloy bar with laser welded magnet keepers and attachment matrices. Her definitive prosthesis was then completed with embedded magnets and attachment particles. Upon insertion, the patient immediately demonstrated her ability to masticate a trial meal, using the right canine and premolar areas.

Conclusions and clinical implications: Over the past decade, the use of remote implant anchorage for retention of oral prostheses has been described. Although osteomyocutaneous vascular free flaps and dental implants have become state of art in large maxillary reconstructions, they are not always possible on an individual patient. In the case presented, an acceptable result was obtained through the use of implants placed in remaining native bone, including one remote site. Proper pre-operative planning and a team approach are mandatory in complex treatments such as the one described.

229 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implant-supported overdenture using prefabricated telescopic copings (syncone): case report

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Background: Several treatment options with implants have been described for edentulous patients. For many years, osseointegrated implant-supported overdentures have been used in the rehabilitation of the edentulous jaw with excellent results. The most commonly used abutments are bars, stud attachments, magnets and telescopic crowns, which offer different biomechanical features. Recently, a technique has been introduced using SynCone®, prefabricated telescopic copings (Ankylos DENTSPLY

Friadent GmbH, Mannheim, Germany) that can be incorporated in the overdentures chair-side. This simplified procedure provides secondary splinting of the implants and is especially useful for immediate loadings, but this procedure can also be applied to other implant prosthetic indications.

Aim: The aim of this case was to report the two-stage surgical protocol and delayed loading on implant-supported maxillary and mandibular overdenture using prefabricated telescopic copings (SynCone®).

Methods: A 65-year-old man presented with chewing deficiency and teeth mobility. Clinical and radiographic examination indicated generalized periodontitis. All remaining teeth were extracted on the day of ridge augmentation and sinus lifting operation except for the maxillary left canine that had been restored with cast coping. A trial complete denture was made to verify esthetics and interarch space availability. Treatment with implant-supported complete overdenture was planned. The trial denture was duplicated for subsequent fabrication of radiographic and surgical template. A CT scan was performed on the patient to identify locations and angulations of the implants. Five Ankylos® (DENTSPLY Friadent GmbH, Mannheim, Germany) implants were placed in the maxilla and four implants were placed in the mandible. After 3 months the stage II surgery was performed with healing abutments. The final complete denture was inserted and the prefabricated telescopic abutments (SynCone®, DENTSPLY Friadent GmbH, Mannheim, Germany) were installed. The SynCone®caps were placed into the denture via the direct pick up technique. Follow-up were conducted at 3 and 6 months.

Results: After follow-up periods, both clinical and radiographic evaluations were performed and all implants had osteointegration and no infection of peri-implant tissue was observed. The clinical assessment showed good retention stability and support. The patient was satisfied with the treatment outcome.

Conclusions and clinical implications: The SynCone® system can be used for implant-supported overdenture successfully, which provides less interarch space and laboratory level than bar attachments. Moreover the retention and support of prefabricated telescopic copings are better than stud attachments.

230 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Effect of implant types and bone resorption on the fatigue life and fracture characteristics of dental implants

Presenter: Won H-Y
Co-authors: Won H-Y, Cho I-H, Lee J-S, Keum E-C, Kim E-S, Song K-H

Background: Fracture of dental implants is a rare phenomenon, but it causes significant problems. The occlusal overload exerting a bending moment at the crestal bone results in fatigue fracture of implant system or marginal bone loss.

Aim: The purpose of this study was to investigate the effect of implant types and bone resorption on the fatigue life and fracture characteristics of dental implants.

Methods: Four types of Implant with 4 mm diameter and 13 mm height were chosen. The specimens were classified with EP (external parallel) group, IP (internal parallel) group, ET (external taper) group and IT (internal taper) group. Fatigue fracture test was carried out by the dynamic load fatigue testing machine with load of 60–600 N and frequency of 14 Hz. Fractured specimens were observed with the Hitachi S-3000 H scanning electron microscope.

Results: 1. In 2 mm exposed implants group, highest fatigue test value was measured in group ET2. Tapered type had higher fatigue life than parallel ones. External connected types had higher fatigue life than internal ones.

2. In 4 mm exposed implants group, highest fatigue test value was measured in group EP4. Parallel type had higher fatigue life than taper ones. External connected types had higher fatigue life than internal ones.

3. The fracture patterns of all the 4 mm exposed implants were appeared transversely near the dead space of the fixture. In 2 mm exposed implants, internally connected types were fractured transversely at the platform of fixture facing the abutment. But externally connected types were fractured at the fillet of abutment body and hexa of fixture or were fractured near the dead space of the fixture.

4. Von Mises effective stress at buccal site with compressive stress is higher than that of at lingual site with tensile stress and the effective stress acting on the fixture is higher than that of the abutment screw. Maximum effective stress acting on the parallel type fixtures is higher than that of the tapered type fixtures.

Conclusions and clinical implications: The findings of this experiment reveal that a countermeasure is needed for the patients with Para function habits to prevent fracture when the implants are placed in posterior areas. An internal type implant should not be placed at a posterior area as possible.

231 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Retrospective study of narrow or small implant

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Background: There is limited evidence for the use of narrow-diameter implants for rehabilitation of the jaws.

Aim: The aim of this retrospective clinical study was to investigate the clinical performance of narrow or small implants. In addition, we focus on clinical procedure to reduce the potential risk factors for narrow implant failure.

Methods: The clinical performance of narrow implant was studied under well-controlled conditions. This study included 87 patients (65 males and 32 females), with an age range of 26–77 years (mean = 47.5 years), with a total of 98 implants inserted and followed between 1 and 3 years. The patients were in need of fixed prosthetic implant-supported rehabilitations in the jaw, presenting a reduced interradicular bone or a thin alveolar crest.

The implant survival estimate was computed using the Kaplan–Meier product limit estimator. And also investigate the frequency and type of complication.

Results: The survival rate for small diameter implants was 95.1% at 3 years. Backward conditional logistic regression identified ''type of rehabilitation'' as a strong risk factor for implant failure (partial rehabilitations compared with single-tooth rehabilitations; OR = 4.75). Four cases are reported about complication, such as frequent screw loosening and failure of osseointegration.

Conclusions and clinical implications: The results indicate that within the limitations of this study, the use of narrow-diameter implants for the prosthetic rehabilitation oft he jaws is viable, with good outcomes in the 3 years result. When planning the treatment of edentulous resorptive jaw, this possibility has to be considered as an alternative to more demanding grafting techniques

232 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Two methods of mandibular edentulous treatment with implant-supported overdenture

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Background: A method of retrofitting a mandibular complete denture for two implants in the anterior for support of the denture is taught in the preclinical course at Baylor College of Dentistry. When this method was applied to the clinic, these observations were noted: (1) The pickup technique in the mouth student was difficult and unpredictable. (2) The prosthesis was too thin causing breakage during the reduction or use. (3) The students' learning was minimal. (4) Patient satisfaction was low.

Aim: This study compares different methods of patient treatment for mandibular overdenture supported by two dental implants with regards to both patient satisfaction and student learning.

Methods: An alternative technique was introduced. Patients needing a replacement mandibular denture are consulted for an implant-supported mandibular denture. Two or four implants are offered. Patients frequently settle for two with lower expectations. Newly edentulous patients receive a temporary denture as an experimental prosthesis to act as a guide for establishing the new vertical dimension of occlusion and jaw relation. It acts as a surgical guide for placing implants and helps determine the number of implants placed. After healing, the numbers of the implants that are decided for a removable overdenture are placed and the existing mandibular denture is modified. If it is required, a fixture level impression with open tray and correct border extension is made. The implant analogues are placed and the cast is poured. Fabrication of the mandibular overdenture is followed similar to the conventional denture until the denture wax up. The proper length attachment is placed on the cast and tightened. The female portion is attached. The denture is made. After deflasking, the locator attachments are retrieved from the cast and sterilized for placement in the patient's mouth. At the delivery the reprocessing elements of the attachments are not removed and the denture is delivered with the retention given by the processing rings.

Results: This method gives the patient a clear picture of the treatment choices and gives the clinician a better prediction of patient satisfaction. Dentists can decide if a patient will be satisfied with two implants or if they need more. Mandibular dentures could be made stronger due to the lack of self-curing resin.

Conclusions and clinical implications: The patient has a clear vision of the final treatment so his expectation is adjusted to the outcome. The student is exposed to all phases of the treatment and gains a better knowledge of patient treatment.

233 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Patients's perception on implant rehabilitation

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Background: Functional, esthetic, phonetic and psychological problems cause discomfort for the patients with edentulism.

Aim: The objective of this study was to evaluate the perception of patients treated with implant-supported protheses.

Methods: One hundred and thirty-eight patients treated with 289 dental implants (Straumann, Switzerland; Bego, Germany; Astra, Sweden, Friadent, Germany) were included in the study. Patients were asked to fill out a questionnaire regarding function, phonetics, hygiene, esthetics, overall satisfaction and cost.

Results: Overall patient satisfaction was reported to be 91.4% for function while unsatisfaction was 7.3% regardless of the denture type. Implant-supported removable denture wearers reported a satisfaction ratio of 73.6% while 81.1% of fixed partial denture wearers were satisfied. The majority of the patients (83.7%) exhibited high satisfaction regarding esthetics and phonetics. The majority (81.8%) of the patients reported no difficulties in cleaning their dentures. A ratio of 93.1% revealed that implant therapy fulfilled the expectations of most of the patients. 84.4% of the patients reported they would recommend a similar treatment to their friends and relatives. The cost of implant treatment was acceptable for most of the patients (64.1%).

Conclusions and clinical implications: The patients' perception on implant therapy was found to be favorable. Implant therapy has become a routine treatment option for the patients.

Implant neck configurations for preservation of marginal bone level: a systematic review

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Background: Various manipulations of the implant neck area have been proposed by several implant manufactures to prevent or control marginal bone loss. Among different methods suggested, a clinician's preference for a specific method should be based mainly on its effectiveness supported by scientific evidence. Therefore, there is an immediate need for identifying the mechanism of marginal bone loss and the methods to prevent or control it.

Aim: The aim of this article was to evaluate the effectiveness of various implant neck configurations on the preservation of marginal bone level as well as to identify available scientific evidence.

Methods: An online and hand search of the literature published from 1976 through 2009 was conducted to identify studies dealing with modifications in the implant neck area and marginal bone loss for at least a 5-year observation period. The search terms that were used, in simple or multiple conjunctions, were ''implant neck'', ''marginal bone loss'', ''neck design'', ''bone resorption'', ''bone remodelling'' and ''implant collar''. Relevant studies were selected according to predetermined inclusion and exclusion criteria.

Results: The initial search yielded 3517 relevant titles and revealed eight different implant neck configurations and/or methods suggested for the preservation of marginal bone level. These methods include changes in implant neck length and design, microthreads, implant surface characteristics, implant diameter, insertion depth, one-piece implants and the concept of platform switching. After subsequent filtering process, 21 studies were finally selected and involved the following methods: microthreads (one study), implant surface characteristics (10 studies), modifications in implant diameter (five studies), insertion depth (two studies), one-piece implants (three studies) and platform switching (one study). Because of the heterogeneity of the studies, it was not possible to analyze the data statistically. No evidence was identified about the effectiveness of a specific modification in the implant neck area in preserving marginal bone level or preventing marginal bone loss.

Conclusions and clinical implications: The current literature provides insufficient evidence about the effectiveness of different implant neck configurations in the preservation of marginal bone level. Long-term randomized controlled clinical trials are needed to elucidate the outcome of such modifications.

Five-year treatment outcomes with four brands of implants in the posterior maxilla and mandible in partially edentulous patients

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Background: Dental implants have been accepted as a viable option for the treatment of fully and partially edentulous patients. Favorable functional, aesthetic, physiological outcomes and psychological benefits of implant-supported-fixed partial dentures on the patients who disregard to use removable partial dentures have been reported.

Aim: The aim of this clinical study was to evaluate the outcome of four brands of implants in the posterior maxilla and mandible in 83 patients after 5 years of functional loading. Clinical performance of all implants was assessed according to implant type, location, patient gender, periodontal status and prosthesis type.

Methods: A total of 244 implants: 86 ITI (ITI), 35 Swiss Plus (SW), 90 Camlog (CAM), 33 Frialit (FRI) were placed in 83 patients. One hundred and thirty three of the implants were in the posterior segment of the mandible and 111 in the posterior segment of the maxilla. Patients received 93 single crowns and 71 FPDs. While nine FPDs were cemented on both the implants and the natural teeth, 62 FPDs were supported by implants only. Following osseointegration and insertion of the prosthesis the implants were evaluated by clinical and radiographic parameters. Clinical parameters like plaque index (PI), sulcus bleeding index (BI), peri-implant probing depth (PD), and marginal bone loss (MBL) were recorded along with any biological and mechanical complications at baseline and recall evaluations. Repeated-measurement ANOVA, Kruskal–Wallis test, Wilcoxon signed rank test and paired samples test were used for statistical analysis ($P = 0.05$).

Results: In a male patient one implant was lost due to peri-implant infection. Cumulative implant survival rate was 99.59%. At the 5-year recall, plaque accumulation was significantly higher than baseline scores ($P = 0.01$). At all time points, no significant difference was found for BI values. Mean PD was 1.8 mm for maxilla and 1.6 mm for mandible. The influence of observation time was found to be significant for the mean MBL values between groups ($P = 0.001$). MBL was 0.19 in ITI, 0.27 in CAM, 0.26 in SW, 0.24 in FRI groups at 5 years. When MBL values were compared between groups, MBL of ITI was significantly lower than the other three groups ($P = 0.001$). There were no significant differences between SW, CAM and FRI according to MBL at 5 years.

Conclusions and clinical implications: The four brands of implants, either placed after one-stage or two-stage surgery, resulted in similar clinical success after 5 years.

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Experimental custom-made zirconia abutments for implant supported all ceramic restorations: 5 years follow-up

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Background: Ceramic implant abutments are gaining in popularity because of their biocompatibility and esthetics. Ceramic abutments are especially desirable when fabricating implant-supported restorations in the anterior maxilla, where mucogingival esthetics is of utmost importance. Long-term functional and esthetic success with implant-supported single-tooth restorations requires a comprehensive and interdisciplinary treatment approach.

Aim: This prospective clinical study evaluated an experimental custom-made zirconia abutment with respect to peri-implant hard and soft tissue reaction.

Methods: Six consecutively treated patients with 11 implants (4 ITI, 3 ITI narrow neck, 4 Astra) were included. Zirconia abutments (Zirkonzahn) were individually shaped and set on the implants with titanium screws. All ceramic (Empress II) crowns were fabricated and cemented with resin cement (Variolink). Clinical parameters like plaque index, sulcus bleeding index, peri-implant probing depth, and radiographic marginal bone loss levels measured were recorded along with any biological and mechanical complications at baseline and up to 5 years.

Results: No abutment fractures occurred. Abutment screw loosening was reported for one restoration at 6 months. Mean marginal bone loss measured 0.21 mm after 5 years of functional loading.

Conclusions and clinical implications: Zirconia abutments offered sufficient stability to support all ceramic restorations in anterior regions. The soft and hard tissue reactions toward zirconia were favorable but long-term follow-up studies are necessary to evaluate the clinical outcome.

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Hard and soft tissue changes around immediately loaded southern co-axis implants

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Background: The co-axis implant (Southern Implants®, Irene, South Africa) has a 12° angle in the implant neck. Because of the shape of the alveolar bone in the pre-maxilla, this implant can overcome angulation and esthetical problems in the anterior zone.

Aim: To examine bone loss, peri-implant health and esthetical outcome after 1 year follow-up.

Methods: Fifteen single implants were placed in 14 patients in the pre-maxilla. All implants were immediately loaded with a screw-retained full ceramic crown. During control sessions, a periapical radiograph and standardized photographs were taken. Also, plaque and bleeding levels were assessed according to Mombelli et al. (1987).

Bone loss was evaluated using DBSWIN 4.0 software. Soft tissue changes were evaluated on the clinical pictures using GS. Statistics were carried out using PASW v18 with the level of significance set at $P < 0.05$.

Results: After 1 year, all implants had survived. The mean bone loss was 1.2 mm (SD = 0.22; range 1–1.8). 14/15 implants were successful according to the criteria of Albrektsson & Isidor (1994). No significant changes were observed after the initial 6 months of bone remodeling ($P = 0.052$).

A mean mid-facial recession of -0.37 mm (SD = 0.39, range -1–0.6) was observed from time of crown placement till 1 year post-op. Significant changes occurred over time ($P = 0.002$), with significant changes between all intervals. The mesial papilla showed no significant differences in height ($P = 0.467$), with a slight increase of 0.14 mm (SD = 0.96, range -1.3–2.1) after 1 year. The distal papilla showed a total decrease in height of -0.35 mm (SD = 0.93, range -2.9–1) after 1 year, which was only significant during the initial 3 months ($P = 0.023$).

Plaque levels were low with a mean value of 0.13 after 1 year. No significant changes were observed during the 1 year follow-up ($P = 0.757$). No bleeding was seen after 1 year, demonstrating very good mucosal health. Bleeding levels decreased during the initial 3 months ($P = 0.001$), but were consistent thereafter.

Conclusions and clinical implications: With a 100% survival and stable bone levels after 6 months, the Co-Axis implant showed a good clinical outcome when immediately loaded. The use of a full ceramic crown as a first and final restoration resulted in a good esthetic outcome with few changes in papilla fill. The long time needed to achieve mid-facial soft tissue stability demonstrates the importance of careful abutment selection.

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Influence of osteopenia on immediately loaded implants: 1 year follow-up

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Background: Immediate loading protocol is currently, a successful therapy in Oral Implantology. However, this successful outcome is influenced by a number of confounding factors, such as bone remodeling response and bone quality in the peri-implant site.

Aim: This prospective and controlled study evaluated immediately loaded implants in patients with and without osteopenia.

Methods: Twenty patients (mean age of 61 years old) were divided in two groups: Control ($n = 10$ patients without osteopenia with T-score > -1) and Test ($n = 10$ patients with osteopenia, $-1 < -2.5$) according with the standard established by World Health Organization (WHO). The implants were immediately loaded the lower jaws of the patients and evaluated after

120 days for the follow clinical parameters: probing depth, clinical attachment level, visible plaque, marginal bleeding, suppuration and marginal bone loss. Raman spectroscopy's associated with μ-EDXRF of the mineral components present in the bone specimens retrieved from the mandible of both groups were also performed.

Results: Seventy-six dental implants were placed, being 40 dental implants in control group and 35 implants in test group. Three implants were lost 30 days after surgery in control group ($P > 0.05$). Clinical and radiographic parameters obtained 365 days after therapy were similar between groups ($P > 0.05$) except for the marginal bleeding, which was higher in the control group ($P < 0.05$). The mean of bone loss range between 0.85 and 0.79 mm to control and test group, respectively. These means were influenced more for local (immediate loaded and immediately restored) than systemic conditions of the patients. The control group presented higher means of mineral components such as phosphate (PO_4), amide I, carbonate (CO_3)/PO_4 and PO_4/amide I, although these differences did not show significance ($P > 0.05$).

Conclusions and clinical implications: Within the limits of this study, the immediate loaded implants in totally or partially edentulous mandible was not influenced by osteopenia, at least after 365 days of therapy.

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Clinical effects of fixed implant-supported bridges on edentulous patients

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Background: Edentulism condition could result in many general health problems, such as nutritional limitations, psychological conditions and facial muscular atrophy. Oral rehabilitations with dental implants could lead to improvement of these related conditions. Hybrid Bridge is a treatment option used for more than 40 years with high success levels.

Aim: The aim of this study was to evaluate the effect that the placement of a fixed implant-supported bridge would cause on the chewing performance, bite force, chewing ability and satisfaction index of complete edentulous patients.

Methods: Fifteen patients had participated of this study, 3 men and 12 women, non-smoking, with good general health, total edentulous, using or not complete dentures. Five implants were placed in the interforaminal region of each patient, and were loaded immediately with a fixed hybrid bridge. The patients were submitted to chewing performance tests and bite force in four moments: before and after rehabilitation (10 days), after 4 and 8 months. They also answered chewing ability and satisfaction questions before and after rehabilitation, and after 4 months. In the performance test was used the test-food Optocal, in 20 and 40 bites. A statistical analysis was performed, with significance level of 5% (Wilcoxon, Mann–Whitney U and Qui square test).

Results: The chewing ability and satisfaction index, evaluated by questionnaire and visual scale, respectively, presented improvement for almost all items. There was no significant difference between 4 and 8 months after implants placement, for the chewing performance values. The rehabilitation with mandibular implant-retained fixed prosthesis and maxillary complete dentures significantly enhanced the mean values of bite force until the 8 months period.

Conclusions and clinical implications: It could be concluded that the rehabilitations provided a statically significant improvement of the chewing performance of the patients, when compared with the initial performance.

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Survival rate of implants into extraction sockets: long-term results

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Background: Following tooth loss, there is continuous resorption and remodeling of the alveolar process and frequently results in insufficient alveolar bone width and height for optimal placement of endosseous implants. Furthermore, as alveolar bone remodels, the soft tissue dimensions are altered, which may compromise aesthetic outcomes.

Aim: The aim of this study was to determine the long-term survival rate of 563 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) placed direct into extraction sockets.

Methods: Between January 2000 and November 2007, 242 immediate implants and 321 delayed implants were placed in 335 patients to restore the missing teeth. The Patient population was 152 males and 183 females. The patient age at the implant positioning ranged between 22 and 67 years. The implant length ranged between 8 and 14 mm and 385 implants were inserted in Maxilla. Eighteen immediate implants were inserted without flap elevation. Different bone augmentation procedures were combined with implant placement. Seven days antibiotic therapy (amoxicyllin 2gr pro die) and chlorhexidine 0.2% mouth rinse was given as preventive measure. In different time intervals mPlI, mSBI, standardized peri-apical radiographs, technical and biological complications have been registered. Patients' satisfaction was also evaluated.

Results: After conventional healing period of 3–4 months, all implants were osseo-integrated from clinical and radiographic point of view, subsequently, the abutments were connected and

fixed restorations were inserted. Nine patients with a total of 22 implants were not present to recall. During a total observation period of 4.1 years (range 2–9 years), six implants were lost and the cumulative survival rate was 98.9%. The majority part of implants presented healthy peri-implant soft tissue conditions (mPlI > 1, mSBI = 1) and stable peri-implant bone level. Radiographic mean bone loss evaluating both interproximal surfaces was 0.92 mm (range 0.65–1.82). Only 9% of the sites showed a crestal bone loss > 1 mm. Eleven patients reported technical complications related supra-structures. Fourteen patients were not satisfied with the aesthetic result.

Conclusions and clinical implications: Immediate implants positioning is a predictable method to restore missing teeth with high survival rate. Technical complications can have a negative influence on the patient's comfort and clinical outcome. The internal-tapered implant-abutment connection can have a positive influence on the healing and long-term stability of peri-implant tissues.

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Immediate loading using transgingival implants to simplify rehabilitation in the edentulous jaw: clinical evaluation

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Background: The predictability of original treatment protocol for osseointegration has led to developments aimed at simplifying techniques, reducing healing time and minimizing the delay between the surgical and prosthetic phases.

With a transmucosal implant, it is possible to avoid the second surgery but this will not completely resolve the intolerable situation for patients during the healing period.

Good results have been achieved with immediate loading techniques, particularly using implants placed in the anterior mandible and several protocols have been proposed which allow patients to wear a fixed prosthesis during the osseointegration period without compromising long-term success.

Aim: The aim of this study is to evaluate 32 transgigngival immediatete loading implant, placed in eight lower edentulous patients (four implants for each patient). Four immediately loaded implant-retained mandibular overdentures are generally inserted into the intraforaminal area. They are rigidly connected with a U-shaped bar used to minimalize micromotion, thus guaranteeing the correct osseointegration, and then loaded with prosthetic rehabilitation. These three case reports also show three different prosthetic solutions starting with the same surgical approaches. Depending on each clinical situation and patient requests, it is possible to achieve three different prosthetic solutions, starting with the same surgical procedure.

Methods: After an X-ray (TC when necessary) examination the patients underwent the same surgical protocol: a crestal incision was made and a mucoperiosteal flap was raised. Then four transmucosal implants were placed in the intraforaminal area.

Good primary stability after placement is considered a basic requirement for success (at least 32 N).

In the immediate loading protocol an impression using vinyl polysiloxane was taken after surgery and the prosthesis was fitted to the patient within 24 h.

Depending on each clinical situation and patient requests, mandibular overdentures on a U-shaped bar (case 1) or Fixed Prostheses with or without pink gum (case 2 and case 3) are customised, and a rigid connection is always used to minimise micromotion and guarantee the correct osseointegration.

Results: After a 24-month clinical and X-ray follow-up, all 32 implants with different prosthetic solution showed great success and patient satisfaction.

Conclusions and clinical implications: As the literature shows, the rehabilitation of the mandible by immediate loading using four implants connected by a rigid bar can be a predictable and reliable method with a high survival and success rate, and the use of transgingival implants can simplify the techniques.

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Porous-surfaced implants: Are there controversies between deferent prostheses and crown/implant ratio?

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Background: The dental implant type is a basic factor that defines reasonability of prosthetics strategy in cases of severe resorbed bone. Others major factors are prostheses characteristics and a crown/implant ratio (CIR) variant.

Aim: Aim is the examination deferent types of prostheses and variants of crown/implant ratio with porous-surfaced implants.

Methods: Seventy-one patients with partial edentulous atrophic posterior jaws received 154 Endopore dental implants. One hundred and forty-five short implants of 5 mm long and 5 mm wide or 7 mm long and 4.1 mm wide were placed at the severe vertical atrophy; nine short and narrow implants of 9 mm long, 3.5 mm base wide and 2.2 mm apical diameter were applied at the horizontal deficiency of a bone.

Eight types of prostheses were made. Four categories leaned only on Endopore implants: (1) single crowns, (2) two or three splinted crowns, (3) bridgeworks, (4) single crowns on short and narrow implants. Other four categories were characterized by a combine leaning: (5) splinted crowns on Endopore and Pitt-Easy implants, (6) bridgeworks on Endopore and Pitt-Easy implants, (7) bridgeworks on Endopore implants and teeth, (8) bridgeworks on Endopore and Pitt-Easy implants and teeth. The following CIR variants were observed: less than 1–6 implants, 1–1.4–82, 1.5–1.9–51, 2 and more – 15.

Results: All implants and prostheses were successful during all the period of supervision, which lasted on the average 18.6 ± 4.7 months.

Distribution of bone decrease variants and Periotest implants stability values in dependence on a kind of the prostheses was the following: (1) 0.27 ± 0.27 mm, −5.25 ± 1.53, (2) 0.23 ± 0.27 mm, −5.55 ± 1.53, (3) 0.23 ± 0.2 mm, −5.44 ± 1.5, (4) 0.36 ± 0.32 mm, −5.33 ± 1.58, (5) 0.17 ± 0.15 mm, −5.54 ± 1.51, (6) 0.19 ± 0.17 mm, −5.31 ± 1.41, (7) 0.42 ± 0.29 mm, −5.14 ± 1.96, (8) 0.42 ± 0.25 mm, −5.19 ± 1.75. The same pairs of indexes for different CIR variants were 0.32 ± 0.31 mm and −5.33 ± 1.75 for less than 1, 0.25 ± 0.23 mm and −5.37 ± 1.59 for 1–1.4, 0.31 ± 0.26 mm and −5.27 ± 1.52 for 1.5–1.9, 0.32 ± 0.27 mm and −5.2 ± 1.66 for 2 and more. All differences were not statistically significant.

Conclusions and clinical implications: There are no controversies between deferent types of prostheses and variants of crown/implant ratio for porous-surfaced implants. Clinical effectiveness of these dental implants is high with no dependence on prostheses type and CIR variant.

100% survival and success rates after loading, low bone loss and high implant stability allow considering dental prosthetics on short Endopore implants a rational strategy of implant dentistry.

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Retrievement of a fractured ankylos abutment

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Background: A fractured abutment can be crucial where implant treatment is concerned. The removal of broken parts in a safe and easy way should be the goal of every implant manufacture.

Aim: Fractured parts of Ankylos friadent abutment were easily removed by simple and easy way.

Methods: In our clinical case presentation, the fractured Ankylos abutment parts were easily removed with the use of certain instruments – namely an unscrew driver for implant cover screws, which is part of the implant recovery cassette of the Ankylos Friadent Company (code 3103 3434), and a classic size two round bur.

Results: In the Ankylos implant-abutment system, a tapered interference fit provides a mechanically reliable retention; the abutment is secured by means of a screw. This taper-integrated screwed-in connection is enhanced mainly by frictional forces at the tapered section and resistance to loosening torques occurs in the tapered areas. In a single-tooth restoration, the axial component of the occlusal force is mainly compressive and the system is subjected either to loosening torques or bending. Fatigue loading can fracture the abutment. In our case, the fracture was at the cervical area of the conical tapered part of the abutment and was removed by the unscrew driver. The screw was not broken but the lower part remained threaded independently in the implant and was retrieved by the round bur.

Conclusions and clinical implications: Information being sparse in the literature concerning such cases any publication would significantly help clinicians.

244 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implant rehabilitation in the anterior region using zirconia abutments and ceramic restorations

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Background: Dental implant research is nowadays directed towards metal-free prosthetic restorations in order to improve aesthetical outcome of implant restorations. Natural look of soft tissue in contact with implant crown is influenced by mucosal thickness and typology of restorative material. Metal-free restorations and implant abutments allow preserving soft tissue color more similar to the natural one than metal abutments and restorations.

Aim: The aim of this study is to present the cases of anterior region implants restored with zirconia abutments and ceramic restorations.

Methods: Case reports will be presented.35-year-old patient was referred to the Istanbul University Faculty of Dentistry Department of Oral Implantology for implant placement in the left canine. Astra Tech (Mölndal, Sweden) dental implant that was 3.5 mm wide and 13 mm height was placed and immediately loaded with a temporary abutment and acrylic crown. The second case was a 19-year-old woman patient who was referred to our clinic for implant placement in the left lateral incisor. Astra Tech (Mölndal, Sweden) dental implant was placed which was 3.5 mm wide and 11 mm in length. The implant was loaded after suture removal in 7 days with temporary abutment and acrylic restoration. The third case was 40-year-old woman was referred to our clinic for implant placement in the left lateral incisor immediately. After tooth extraction Astra Tech (Mölndal, Sweden) dental implant was placed in 3.5 mm wide and 13 mm in length. The implant was loaded for soft tissue maturation with a temporary abutment and acrylic restoration 3 weeks later. All of the cases were loaded permanently with zirconia abutment and ceramic crown after shaping the peri-implant soft tissues properly.

Results: Peri-implant soft tissues are shaped aesthetically and all of the patients are glad with the aesthetic results.

Conclusions and clinical implications: Optimal aesthetic results can be achieved by using proper soft tissue maturation methods and proper abutments.

Immediate loading and immediate implant placement in flapless procedures: a new approach

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Background: Tooth extraction implies modifications of tissue architecture. Immediate implant placement can reduce dimensional changes of the alveolar ridge. It is generally accepted that a gap < 2 mm between the implant surface and the buccal bony wall can heal spontaneously even if a some vertical resorption occurs. Several authors suggested that even higher gaps could heal without compromising the degree of osteointegration. However, parameters for soft tissue changes in relation to bone remodeling are not clear. Some immediate loading protocols in literature present high success rates when a good cases selection is made. Moreover, the thickness of the buccal wall of the socket and the size of the horizontal gap may influence soft tissue margin recession. In recent reports, gaps over 2 mm after implant placement were filled with bone at re-entry even if the buccal ridge was markedly reduced. However, in most of these papers a full buccal flap was raised. This may increase soft tissue recession and decreases the stability of coagulum.

Aim: A three case presentation using a new flapless approach with immediate loading after tooth extraction is presented that may lead to a successful aesthetic outcome.

Methods: A no flap, in non-viable upper premolars, atraumatic extractions were carried out in three patients (age: 33, 43 and 56 years). The gingival sucular fibbers were preserved, the integrity of socket walls checked and an implant placed on the palatal side of the socket. Following the literature, we reached an insertion torque greater than 30 N cm to allow immediate loading. All gaps were higher than 3.5 mm and no graft biomaterials were used. A good stabilization of coagulum was achieved with both suture and provisional crown. A definitive abutment, similar to the one used for the definitive crown, was used in order to allow a gingival stabilization as fast as possible. Provisional crown was cemented but a hole was made to give access to the abutment screw. Abutment-provisional crown junction was polished outside oral environment and contacts in centric and eccentric movements were avoided. After osteointegration a definitive crown was delivered.

Results: This presentation points out that without a flap elevation, without rupture of gingival fibbers that supports the ''bundle'' bone, and with a provisional crown in order to achieve coagulum and soft tissue stability, tissue architecture changes may be reduced.

Conclusions and clinical implications: An immediate fixed provisionalization of implants in the premolar region, even in the presence of horizontal gaps over 2 mm, can be of great benefit in reducing the soft and hard tissue recession. This technique may have even more benefits in sites of thin buccal ridges and thin soft tissues.

Evaluation of an implant system: a 5 years prospective clinical trial

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Background: A well-designed clinical trial owns the characteristics to be inserted into a meta-analysis of the literature, the most precious instrument to evaluate any therapy according to the principles of the evidence based medicine.

Scientific literature on implant therapy shows a lack of studies with an adequate period of follow-up. Five years are universally considered enough to evaluate an implant system; moreover surgical and prosthetic protocols need to be clearly definite.

Aim: The aim of this study was to evaluate the reliability of Nobel Replace implant system. A long-term prospective clinical trial was designed according to the principles of evidence based dentistry.

Methods: Twenty-four patients needing oral implant therapy were selected through definite inclusion end exclusion criteria of good health; the recruitment was made in Milan within 2003 and 2005. After 5 years we registered the drop out of nine patients, so only 15 patients with a total of 35 Nobel Replace implants were observed during the full follow-up period. The only surface chosen was rough titanium (TiUnite) and both the shapes Tapered and Straight were used; at the time of implant insertion surgery technique, insertion torque, implant size, insertion site were recorded. No implant shorter than 10 mm was used. All implants were loaded with a standard timing protocol, 3 months after insertion in the lower jaw and 4 months in the maxilla.

Starting from the time of loading soft tissues conditions, radiographic bone loss and patient oral hygiene were periodically controlled. Radiographic exams were executed with an individual positioner and all measurements were calibrated on the known distance between two threads (0.6 mm). The follow-up period was 5 years.

Results: The implant survival rate at 5 years after loading was 97.14%. The average bone loss was 0.54 mm $\pm$ 0.49. Bone resorption around straight implants (0.86 mm $\pm$ 1.43) was greater than the one found around tapered implants (0.08 mm $\pm$ 0.21).

Conclusions and clinical implications: The use of Nobel Replace system in oral implant therapy showed an overall high reliability after 5 years; the difference observed between straight and tapered design is probably due to the small size of the sample.

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Novel clinical concept for the management of screw access channels in implant-supported prostheses: the PTFE technique

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Background: The choice of material to seal the screw access channel and protect the screw is an important issue in implant-supported restorations. Materials such as cotton, gutta-percha, vinyl polysiloxane, and autopolymerizing acrylic resin have been suggested for sealing the deep part of the screw access channel in screw-retained in-plant-supported restorations. The choice is dependent on the operator's preference and is influenced by different requirements, such as ease of manipulation, but is seldom scientifically supported. Cotton pellets have been commonly used, due to their low cost and ability to be sterilized. However, cotton pellets can be difficult to remove and may be associated with malodor. Gutta-percha and vinyl polysiloxane are easy to manipulate, but cannot be sterilized and require more time to apply. Autopolymerizing acrylic resin also requires more time, and presents the risk of damaging the head of the screw during removal.

Aim: The objective was to develop a simple and efficient technique to seal the screw access channels and to protect the screw head of abutment and crown screw in implant-supported prostheses.

Methods: The method proposed the use of polytetrafluoroethylene (PTFE) tape, commonly known as plumber's tape.

1. An adequate length of PTFE tape was cutten (Domit AG, Oberhasli, Switzerland), folded to a double layer, twisted into a spiral for ease of handling, and sterilized in an autoclave (Domina Plus B; Dental X Srl, Vicenza, Italy) for 19 minutes at 135–137°C.

2. The screw access channel was filled with one sterile piece of PTFE tape. A plugger (two Goldstein Flexi-Thin XTS Composite Instrument Hu-Friedy, Chicago, Ill) was used to compact it, leaving an occlusal space of 2 mm for the restorative material.

3. The channel surface was covered with silane (Monobond-S; Ivoclar Vivadent AG, Schaan, Liechtenstein) and a single coat of bonding resin was applied (OptiBond FL Adhesive; Kerr Corp, Orange, CA, USA).

4. The access opening was filled with light-polymerizing resin-based restorative material (Tetric EvoCeram; Ivoclar Vivadent AG).

Results: This procedure used a sterilized single PTFE tape component allowing an easy packing manipulation and removal when required. The material could be sterilized, was easy to manipulate, radiopaque and less associated with malodor when retrieved.

Conclusions and clinical implications: This PTFE technique is an efficient method for closure of screw access channels in implant-supported prostheses. This procedure allows retrieval of the material in one piece preventing unpredictable and time-consuming manipulations when removal of the screw-retained crown or abutment is required.

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All-ceramic one-piece telescopic abutments for implant-supported overdentures

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Background: Removable implant-supported prosthesis should combine easy handling and hygiene, suitable fixation and esthetic rehabilitation. Especially for elder and manually handicapped patients removable dentures are state of the art. There are different options of anchorage to attach removable overdentures to implants. Telescopic systems are established in conventional prosthetics for a long time. Alternatively to bars or balls telescopic retainers have advantages in implant dentistry concerning retention, maintenance, hygienic aspects, and in divergent implant angulations. Furthermore telescopic retainers enable an uncomplicated integration of implants and natural abutment teeth to support a removable prosthesis.

The use of all ceramic abutments offers various advantages like good biocompatibility to peri-implant tissues and low plaque accumulation. Furthermore esthetic outcome of ceramic abutments is often more attractive to many patients. Conventional telescopic abutments consist of two pieces from metal and ceramic often looted with a resulting gap. Contemporary computer-aided design/computer-assisted manufacturing technologies allow milling of one-piece abutments from ZrO_2 that can be torqued directly to the implant.

Aim: The aim of this report was to present the application of all-ceramic CAD/CAM milled zirconia one-piece implant telescopic abutments in complex clinical situations. Furthermore options for the integration of natural abutment teeth were demonstrated.

Methods: *Case reports*: In one edentulous maxilla six implants were inserted on bone level. Another patient received four implants in the edentulous maxilla and one implant in the mandible in addition to three natural abutment teeth. Both patients were treated with telescopic anchored prosthesis. All telescopic one-piece implant abutments and the telescopic copings were milled in zirconia by a special CAD/CAM system. To achieve passive fit highly precise electroplated gold mesostructures were luted intraoral with a cobalt-chromium-molybdenum framework.

Results: One year follow-ups showed good clinical results. Implant success and survival were 100%. Surgical or prosthetic complications did not occur. Patient satisfaction was very high.

Conclusions and clinical implications: The presented clinical cases demonstrated the application of an alternative type of

telescopic abutment from zirconia. The introduced one-piece and gap free telescopic abutment offers advantages compared with conventional two-piece implant abutments. Controlled clinical studies have to prove the success of this restorative option.

249 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Optimal emergence profile for implant-supported restorations. A prosthetic approach

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Background: A successful implant restoration in the esthetic zone is a challenging procedure. Proper emergence profile of an implant-supported restoration is important for hygiene and esthetics. Several techniques have been described for creating a favorable emergence profile around implant restorations.
Aim: This report aims to describe an innovative indirect impression technique that accurately captures the soft tissue contours around an implant-supported provisional restoration, through a series of clinical cases.
Methods: An optimal soft tissue architecture around implant prostheses was accomplished by the use of regularly adjusted screw retained provisional restorations. A silicon cast that accurately recorded the emergence profile of the provisional restoration was used in order to make customized impression elements. The acquired emergence profile was transferred to the final prostheses, by the use of customized impression copings that accurately captured the shape of the peri-implant sulcus.
Results: The use of individualized impression copings provides the dental technician with the exact shape of the peri-implant sulcus. The definitive abutments and final restoration have identical shape with the provisional restoration, thus maintaining the exact soft tissue architecture and optimizing esthetics.
Conclusions and clinical implications: Optimal esthetic results and healthy peri-implant tissues can be achieved with the described indirect impression technique that accurately captures the soft tissue contours around a provisional restoration and duplicates them for the creation of individualized impression copings.

250 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Improvement of masticatory function with telescopic type implant-supported overdentures

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Background: It is well established that implant-supported overdentures are beneficial for patients in whom the application of fixed implant prostheses is difficult.
Aim: This case report focused on the improvements of both masticatory function and the level of patient subjective satisfaction after treatment with telescopic type implant-supported overdentures.
Methods: Case 1: A 35-year-old female patient with defects of the left mandibular molars and alveolar bone owing to ameloblastoma visited our hospital with the chief complaints of occlusal instability and masticatory dysfunction. After a bone graft and distraction osteogenesis, three dental implants were inserted in the left mandibular molar region.

Case 2: A 61-year-old male patient visited our hospital with the chief complaints of occlusal instability and masticatory dysfunction with a removable partial denture. Because the patient had received radiation therapy for a malignant lymphoma, the regions in which we could place dental implants were limited. Three implants were inserted in the right mandibular region.

Case 3: A 60-year-old female patient visited our hospital with the chief complaints of occlusal instability and masticatory dysfunction with a mandibular removable partial denture. After extraction of the existing tooth, six implants were inserted in the fully edentulous mandibular bone.

In all cases, telescopic type implant-supported overdentures were selected as the final prostheses. The mastication score was calculated to examine the masticatory function, and the satisfaction of the patients was investigated using the visual analog scale.
Results: In all cases, the mastication score was improved, and the level of satisfaction was higher after wearing the final prostheses.
Conclusions and clinical implications: Telescopic type implant-supported overdentures are a possible treatment modality for improving both the masticatory function and the level of satisfaction because of their excellent stability. Furthermore, with their high cost-effectiveness, they have a wide range of indications compared with fixed prostheses. In future, use of telescopic type implant-supported overdentures will become widespread as one of the treatment options in patients with an insufficient amount of jawbone.

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Dental implants rehabilitation in patients with papillon-lefevre syndrome: multiple case reports

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Background: Papillon-lefevre syndrome is an autosomal recessive disorder characterized by hyperkeratosis of palm and soles and by a generalized aggressive periodontitis and premature loss of primary and permanent dentition. Severe periodontal disease plays an important role in PLS resulting in premature loss of primary and permanent dentition.

Previous studies done by KFSH&RC teams, revealed no clear-cut correlation between the severity of dermatological changes and the level of periodontal inflammation. Also considerable phenotypic

heterogeneity was observed within the two cardinal mutations and in the 189/189 genotype (cathespin C or CTSC gene) in Saudi population.

Extensive collaboration between the dental, genetic, pediatric and pathology departments and research center to continue study the mechanism of this syndrome, as well as registering them in the rare oral disorder registry database.

Aim: In the present study, the use of osseointegrated implants in patients with PLS is reported, both from surgical and prosthetic outcomes.

Methods: All patients with PLS are followed and registered through documentation. This provides an opportunity to discuss the objectives of the treatment planning with the patient and his or her family. Normally, a preliminary long-term treatment plan is established at younger age, as well as a detailed plan for the coming years.

All teeth with advanced periodontal disease were extracted to preserve alveolar bone, future advance bone augmentation/distraction were used when needed.

All patients have received fixed implant prosthesis and have been followed, clinical and radiographic recording were taken at 6 months and 1 year after.

Results: The results are based on the finding of PLS patients who underwent implant treatment and were followed over an average period of 5 years.

Clinical examination revealed that all implants were clinically stable, and the superstructures were functioning well. Bleeding on probing occurred around the implants with hyperplastic gingiva, few implants developed peri-implantitis and been surgically corrected, with localized bone loss around these implants, others were removed and replaced with new implants, both surgical and prosthetic outcomes are presented and discussed.

Conclusions and clinical implications: The outcome of dental implants in patients with PLS were successful, it promotes a higher self esteem and better social acceptance, tacking in account the early treatment intervention and patient/parents cooperation during this type of long-lasting treatment with multiple patient appointments.

Higher soft tissue complication and maintenance in this group were observed. Follow-up of these patients indicated that, although problems occur with dental implants treatment, the benefits of implants far outweigh the complications.

252 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Use of a palatal onlay-graft in aesthetics area – case report

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Background: Along with osseointegration and restoration of function, the patient's subjective satisfaction with the esthetic result is a touchstone of the success of implant therapy. Placement of an endosseous implant requires sufficient bone volume for complete bone coverage. Alveolar deficiency can prevent ideal implant placement. Local bone grafts are a convenient source of autogenous bone in alveolar reconstruction. This case report describes a technique to reconstruct horizontal bony defects with one graft of the autogenous bone in aesthetic zone.

Aim: The aim of this case was the bone regeneration of the edentulous zone and rehabilitation with an implant-supported restoration.

Methods: Twenty-year-old patient presented with absence of the tooth #11 (FDI) avulsed during childhood, which was rehabilitated with an adhesive bridge. The area presented a very thin ridge and a small gingival defect. Her main concerns were to restore function and natural aesthetics.

The rehabilitation has been carried out in three stages:

First, bone regeneration with autogenous bone graft harvested from the ramus at the time of thirdmolar extraction. The chosen receiver site was the palate because the patient presented a normal bone contour in the vestibular area.

Second, implant installation, a two-stage approach was used; at the second phase surgery a connective tissue graft was performed.

Third, prosthetics a provisional crown was made for tissue modulation and rehabilitation with a zirconia abutment (Nobel Procera®) and a cemented crown.

Results: Three years of follow-up the implant and the grafts were classified as a success.

Conclusions and clinical implications: Intraoral bone block grafting is a predictable operation with a high success rate for a long-span augmentation. The grafting has contributed for a better prognostic for the rehabilitation as it allowed not only for a correct with for implant placement but also for natural looking aesthetics.

253 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Maxillary implant and tooth position in virtual planning: clinical implications

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Background: Advanced atrophy of the edentulous maxilla causes disadvantageous sagittal and transversal relationship between prospective implant position and prosthetic crown. This may have an impact on facial morphology, esthetics and prosthetic design.

Aim: To analyze virtually, the dimensional relationship between prosthetic tooth position and prosthetically driven implant placement.

Methods: CT-scans of 24 females and 19 males ($n = 43$) with a mean age of 62 $\pm$ 8 years were analyzed for anterior teeth by means of an implant planning software (NobelGuide™). The tooth position of the radiographic template was based on a clinically well-fitting, functionally correct and esthetically pleasing set-up. A trained surgeon performed the virtual implant

planning in best 3D geometry regarding bone and prosthesis. The following landmarks were determined on virtual cross-sections in the center of each central incisor (CI), lateral incisor (LI) and canine (C): (1) center of implant-platform, (2) incisal crown point and (3) cervical crown point (gingival border). Absolute distances from platform-center to incisal (PID) and cervical (PCD) points as well as horizontal (HD) and vertical (VD) components between implant-platform and cervical point were measured. The angle between implant axis and occlusal plane was determined. Statistical analysis was done using descriptive methods and non-parametric tests (Mann–Whitney U test, Pearson's correlation).

Results: Mean values of PID for CI, LI and C were 16 mm, 15.8 mm and 15.6 mm, of PCD 8.5 mm, 9.1 mm and 8.7 mm, of HD 7.2 mm, 7.2 mm and 7 mm and of VD 4 mm, 4.9 mm and 4.7 mm, respectively. Mean implant inclination was 66.3–69.3° with a wide range between the subjects (46.8–84.5°). These values were not significantly different between the left and right side. Males had significantly higher values for PID and HD. No association with age was observed for any of the parameters.

Conclusions and clinical implications: Mean PID and PCD revealed an increased distance between prospective implant and prosthetic crown position and were representative for the resorption of tissue in the edentulous premaxilla. Mean HD and VD indicated a more significant resorption pattern in the horizontal plane. This anterior cantilever and implant inclination may provoke anesthetic long teeth and biomechanical complications. Thus, the use of pink porcelain for a fixed implant bridge or a buccal flange for a removable denture replacing the lost tissue between implant and crown may lead to a better esthetic result.

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Immediate temporization of implants in the aesthetic area

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Background: Many clinical studies reported high success rate using immediately loaded implants.

Aim: This study will report on the clinical result of 36 immediately loaded implants in the anterior region of maxilla.

Methods: A total of 36 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were placed in 29 patients (11 males, 18 females). Thirty-two implants were used for single-tooth restoration to replace 13 central incisors, 11 lateral incisors and three canines in Maxilla. While, five implants were used in mandible to replace three central and two lateral incisor. Two patients received two implants each to support a bridge of four mandibular incisors. Sixteen implants were immediately inserted after tooth extraction and without flap elevation. All implants were immediately restorated with pre-fabricated abutments cement-retained provisional crowns. At insertion, none of the restorations had centric or eccentric occlusal contacts with the oppositing dentitions (immediate non-occlusal loading). Seven days antibiotic therapy (amoxicyllin 2gr pro die) and chlorhexidine 0.2% mouth rinse was given as preventive measure. Additionally, 2 months nutritional limitations are advised. The implants were restored with definitive restorations (fully functional occlusion) 4–6 months after implant placement. Standardized Periapical radiographs, mSBI and mPlI, technical complications, were recorded in different time intervals. Patient' satisfaction was also evaluated.

Results: One implant was removed for mobility five weeks after placement. All other implants became osseoinegrated. After a total loading period of 24 months (range 10–52 months) the overall survival rate was 97.3%. All implants presented a healthy peri-implant soft tissue conditions and stable gingival contour. Radiografic mean bone loss evaluating both interproximal surfaces was 0.96 mm. The majority part of bone loss was observed 6 months after implantation, in particular around immediate implants. No technical complication occured. All patients appreciated treatment modality, while one patient was not satisfied with the aesthetic of the rehabilitation.

Conclusions and clinical implications: The results of this study suggest that immediate temporization of implants in the aesthetic area is a technique that seems to give a satisfactory results in selected cases. Primary stability of implants is a prerequisite to achieve osseointegration. The implant design and surface make a significant contribution to the initial implant stability. Moreover, The characteristic design of the implant-abutment connection plays an important role for the stability of peri-implant tissues.

255 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Removable partial denture implant-supported in partially edentulous patients

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Background: The loss of the natural teeth especially in the maxilla represents a particularly difficult clinical situation for the fixed restorations implants supported that is both aesthetically and functionally acceptable. Additionally, many patients are not able to accept the removable partial denture and the desire for stable denture retention is very understandable.

Aim: This paper will report the preliminary results on the new treatment concept in partially edentulous patients usingpartial removable denture (PRD) implants supported.

Methods: Six patients with partially edentulous Maxilla (4 females and 2 males) were rehabilitated with PRD implants supported. Patients' age at implants placement ranged between 58 and 73 years (mean 60.9 years). Four patients were smokers. All participants gave informed consent. A total of 21 Ankylos

implants (Dentsply, Friadent, Mannheim, Germany) were inserted. Implants length ranged from 8 to 11 mm. Nine implants were immediately inserted into fresh extraction sockets, five implants after 4–10 weeks. The total units replaced by the PRDs were 32. Patients were scheduled for follow-up at 6 months, 1 year and annually, clinical and radiographic parameters, technical complications and patient satisfaction were recorded.

Results: After 4 months of submerged healing all implants were osseointegrated from clinical and radiographic point of view. SynCone prefabricated conical abutments and secondary copings were selected for retaining the overdenture. These prefabricated copings are polymerised into partial denture base directly in the mouth of the patients. After total functional period of 16 months (range 12–24 months) none implants were removed, mucositis and/or peri-implantitis were not observed. All implants showed low value of clinical parameters (mSBI > 1; mPlI = 1). Standardized periapical radiographs showed an excellent bone healing and stable bone level. Bone loss ranged between 0.4 and 1.2 mm. No technical complications occurred. The patient's acceptance on function and aesthetic on this restoration was high.

Conclusions and clinical implications: Conical anchorage of removable partial denture implant supported is a favourable alternative to fixed bridges solutions, with supreme hygiene and aesthetic. Additionally, this solution provides considerable reduction of treatment time and costs.

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Immediate loading with overdenture in the edentulous jaws: long-term results

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Background: The desire of the edentulous patients for stable denture retention is very understandable. Many clinical studies reported high success rate using immediately loaded implants.

Aim: This multicenter study will evaluate the clinical efficacy and long-term results of implants immediately loaded with overdenture retained by prefabricated conical copings in the edentulous jaws.

Methods: Between January 2002 and May 2007 a total of 636 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were placed in 77 edentulous mandibles and in 82 edentulous maxilla (four implants in each jaw) and immediately loaded. Two hundred and thirty-five implants were immediately inserted into fresh extraction sockets; 94 within 3 months. Implant length ranged from 9.5 to 17 mm. One hundred and forty-five patients (82 females and 63 males) were monitored in this study. Fourteen patients received the same treatment in both jaws. Patient's age at implants placement ranged between 42 and 82 years, the mean age was 62.3 years. Thirty-eight patients (26.2%) were heavy smokers. All participants gave informed consent. Following surgery all implants were connected with prefabricated conical abutments that are manufactured with a precise fit to secondary conical copings. These prefabricated copings are polymerised into denture base directly in the mouth of the patients. Panoramic X-ray was taken at implants placement after 6 months and yearly. mSBI and mPlI, patient' satisfaction, technical complications were recorded in different time and intervals.

Results: Four implants in the mandible and seven implants in the maxilla were removed during observation period and could be successful replaced but are not included in our statistics that lead to an implants cumulative survival rate of 98.3% (mandible 98.7%, maxilla 97.9%), the prosthesis survival rate was 100%. After a total observation period of 38.2 months (range 24–74 months) all other implants presented healthy peri-implant hard and soft tissue conditions (mSBI > 1; mPlI = 1). Radiographic examination showed an excellent bone healing and stable bone level. During the observation period 11 cases of abutments screws loosening occurred. Fourteen partial break denture bases were observed and were quickly repaired. The majority part of the patients was satisfied about time and modality of treatment. Six patients were not satisfied with aesthetic; all other appreciated function, aesthetic and retention of the restoration.

Conclusions and clinical implications: Basing on the present long-term data it was concluded that four implants may support immediate loading in edentulous mandible as well as in edentulous maxilla with reduction of treatment time and cost and considerable satisfaction for the patients.

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Immediate vs. delayed endosseous integration of maxi implants: a torque removal animal study

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Background: Delayed loading is one of the anxieties of implant patients. Immediate loading can solve the problem and make patients more satisfied.

Aim: The present study aimed to compare the removal torque of maxi implants under different loading (immediate and delayed) patterns.

Methods: This split mouth experimental study included two dogs. Impressions were made and then all premolars were extracted under general anesthesia. After a 3 months healing period, three implants were inserted in each quadrant (24 implants). Anterior and posterior implants (case group) were splinted by an acrylic temporary bridge, in order to make middle implants (control group) off the occlusion. Dogs were sacrificed after 6 weeks and bone blocks were submitted for removal torque test. Data were analyzed using Kruskal–Wallis test ($\alpha = 0.05$).

Results: Mean torque values for the case and the control groups were, respectively, 46.82 ± 25.58 and 59.87 ± 15.19 (P-value = 0.667; not significant).

Conclusions and clinical implications: Within the limitations of the present study, it may be concluded that immediate loading does not reduce the reverse torque values of the Maxi implants. This supports the advantages of immediate loading for Maxi implants.

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Platform switching enhances soft tissue healing

Dr Thomas Sefranek

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Background: The so-called platform switch is often claimed to result in an improved health of the soft tissue and may thus improve the clinical out-come. Still the scientific evidence of such statements is sparse.

Aim: The aim of this study was to evaluate the difference in bone level findings between a platform switching implant-to-abutment interface using a tight seal and a flat-to-flat interface.

Methods: *Methods* 37 consecutive patients received 40 study implants (Ospol AB, Malmö, Sweden, implant diameter of 4 mm, implant length of 10, 12 and 15 mm, respectively) and Southern Implant (Irene, 0062, Irene, South Africa).

TriNex implant diameter of 3.5 mm, implant length of 10.5, and 13.5 mm supporting single crowns. The majority (28 implants) were single-tooth replacements in lateral parts of both maxilla (70%) and mandible (30%). A baseline radiograph was acquired when implant was placed, when crown was seated after 3 months in the mandibula and after 6 months in the maxilla. Additionally12 month after implant placement this study. All patients were followed-up during the osseointegration process with various frequencies.

Results: There were no significant differences in radiograpfic bone levels at 6 and 12 months or in bleeding on probing (BOP) index.

The OSPOL implants seem to have a tighter gingival sealing than the Southern implant implants.

Conclusions and clinical implications: The results of the present pilot study indicate that ''platform-switch'' enables clinicians to obtain stable bone level around ''switched'' titanium abutments, together with acceptable esthetics and completely osseointegrated implants.

259 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Dental implants as strategic abutments to improve the function and aesthetics of fixed prostheses

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Background: The absence of some teeth can force the dentist to recommend removable partial dentures as a prosthetic solution to the problem. Instead of removable dentures, however, the use of dental implants can offer the necessary strength and stability of fixed bridges, and provide the patient with optimal mastication ability and excellent aesthetics.

Aim: In our clinical presentation, the treatment of a patient with excessive tooth abrasion and upper lateral tooth loss involved the fixing of implants in the anodontia areas and the fabrication of crowns and bridges to reconstruct the diminished vertical dimension.

Methods: The 63-year-old male patient received a pretreatment cast waxing evaluation of the vertical dimension, which was estimated at up to 7 mm. After the necessary period of implant osseointegration, temporary metal-acrylic fixed prostheses were applied to the new vertical dimension. On future visits to our surgery, minor acrylic substance loss was recorded. The patient expressed very satisfactory mastication ability and pleasure regarding the aesthetics of the treatment. Finally, both teeth and implants were fitted with ceramic-fused-to-metal crowns.

Results: Our patient has achieved a significant improvement in all daily activities and the quality of his life is considerably better.

Conclusions and clinical implications: Osseointegrated implants have become an extremely valuable treatment option in oral and maxillofacial reconstruction.

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Rehabilitation of post-extractive implants with immediate loading on the superior maxillary: follow-up to 3 years

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Background: Several studies show the success of the immediate loading of the dental implants.

Aim: The aim of our study was to evaluate in the long-term the survival of implants immediately placed in fresh extraction sites in the superior maxillary with immediate provisional restoration and non in operation, besides the loss of marginal bone in the time.

Methods: Twenty-four implants Astra Tech Osseospeed^{TM} in all have been placed in 10 patients, with torque $\geq$ 25 N cm. Where the bone –implant gap was > 1 mm it has been filled using BioOss (Geistlich Biomaterials). The provisional fixed restorations have been connected at the most within 48 h from the implants installation. Obstructed contacts have been avoided. After 3 months the implants have been permanently loaded. Follow-up visits have begun from the same day of the implants placement and varied from 36 to 40 months.

Results: Survival rate the implants and the prosthesis was 100%. The average loss of marginal bone ranged between 0.2 $\pm$ 0.5 mm beginning from the implant placement.

Conclusions and clinical implications: The results pointed out that success can be reached in the immediate not functional load of implants placed in post-extraction sites in the anterior

superior maxillary with conservation of the marginal bone level and optimum conservation and integration of the peri-implant bone and soft- tissue levels. Therefore, we have a high predictability of the results with a protocol of immediate loading in post-extractive sites, both in the short and long term.

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Immediate vs. delayed load prostesic in aesthetic area with low diameter implant: 1 year clinical and radiographic analysis

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Background: As largely demonstrated in literature (Douglas WH, DeLong R. et al.), early and immediate loading leads to increased bone formation and decreased crestal bone loss.
Aim: This clinical case wants to explain the rehabilitation of a bilateral agenesis in the aesthetic area, with immediate and delayed implant prosthetic treatment. It will be verify, through clinical and radiographic controls, the actual indication to the use of low diameter implant with both methods of prosthetic load.
Methods: Patient occurred to our observation with bilateral agenesis of upper lateral incisors and two Maryland Bridge prosthesis that gave a good function and aesthetic. Upon request of the patient, it was planned a prosthetic and implant-supported rehabilitation.

We decided for the insertion of one Astratech Implant (3 × 11 mm) with immediate prosthetic load, and one Astratech Implant (3 × 11 mm) with traditional prosthetic load. Both rehabilitations were concluded with cemented prosthesis, first provisional with resin and then definitive with oro - ceramic. Radiographic controls were performed at the implant insertion (To), after 1 month (T1), after 3 months (T2), after 6 months (T3), and 1 year later (T4).
Results: Radiographic and clinical analysis showed the survival of the implant after 1 year with lack or peri-implant bone resorption.
Conclusions and clinical implications: This clinical case wants to show how immediate and delayed prosthetic load do not have differences in the peri-implant zone.

Other case had to be considerated, but is opinion of the authors to show in this clinical case, how a good stability in the marginal bone has been obtained, using low diameter implants, with both loading procedures.

262 | Implant Therapy Outcomes, Prosthetic Aspects

The use of pink porcelain in implant-supported fixed prosthetic rehabilitation

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Background: The implant-supported rehabilitation demands sometimes the restoration not only of missing teeth but also of soft tissues. These restorations can be carried out by means of previous tissue grafts, or by means of porcelain gum included in the prosthetic fixed rehabilitation.
Aim: The aim of this study is the evaluation of pink porcelain as a method of restoration of missing amounts of tissue, incorporating this pink porcelain into the fixed prosthetic rehabilitation.
Methods: We review in this study a total of forty-four fixed rehabilitations, placed in the last 5 years, which include a variable amount of pink porcelain. We check the gingival health, the bone loss and the stability of the porcelain, fixing special attention on porcelain fracture, wear of deterioration, as well as the esthetic result and the satisfaction of the patients.
Results: The pink porcelain showed a high degree of stabily and resistance to fracture. There was only noticeable a great fracture in one patient, but not of pink porcelain but occlusal porcelain, in a case of titanium-porcelain restoration. The satisfaction of the patients in terms of esthetic and functional results was usually high, and the bone and gingival levels remained stable beyond the first year.
Conclusions and clinical implications: Pink porcelain is a valid material in most cases for the restoration of great amounts of lost tissues. The material shows a high stability and resistance and the patient satisfaction with the esthetic and functional results is remarkable.

263 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Clinical evaluation of virtual abutment design appliance in maxillary anterior single-tooth implants

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Background: Computer-aided design/computer-aided manufacturing (CAD/CAM) systems have evolved over the last two decades and have been used by dental health professionals for over twenty years. Nowadays interest in the CAD/CAM systems for implant-supported prosthesis is related with the fact they have been used for the manufacture of implant abutments.
Aim: The aim of this study was to evaluate the clinical

response of CAD/CAM abutments in aesthetic areas, such as the maxillary anterior region, based in esthetic and radiographic features.

Methods: In this study, 10 patients treated with 22 single-tooth implants, restored with abutments made by virtual design and computer-assisted manufacturing, were evaluated. Marginal bone loss was assessed by standardized radiographic control at the end of first year in function. Two examiners made measures in the mesial and distal aspects, from a defined point at the top of the implant to the bone crest, with a digital X-ray system. All implant restorations and peri-implant tissues were then evaluated with two esthetic indexes: pink esthetic score (PES) and white esthetic score (WES).

Results: All implants were successfully osseointegrated in this study. After 1 year the mean bone level lost was 0.4 mm apical to the top of the implant. The mean total PES/WES was 14.1, corresponding the evaluation of total PES and total WES of the 22 implants.

Conclusions and clinical implications: This study demonstrates that anterior maxillary single-tooth implant replacement, with the use of this kind of abutments, is a predictable treatment modality from an esthetic point of view.

264 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Early loading of oral implants with advanced surgery: case series

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Background: Information on early loading protocols with advanced surgical techniques is limited.

Aim: The aim of this clinical case series is to present the preliminary clinical outcome of early loaded implant-supported full-arch fixed dental prostheses (FDPs) in edentulous maxilla and mandible.

Methods: Total/partially edentulous three patients (age range: 55–61) received a total of 48 sand-blasted, large-grit and acid-etched implants (SLA and SLActive-Straumann, Switzerland; Bego, Germany) were placed in the maxilla ($n = 24$) and in the mandible ($n = 24$) and loaded 6 weeks after surgery with implant-supported metal-ceramic FDPs. In two cases advanced surgical procedures (bimaxillary sinus lifting, grafting) were also performed. Resonance fequency analysis (RFA) evaluations were recorded at surgery, at fifth week. Calculations of marginal bone loss (MBL) were performed in radiographs taken at placement and sixth week and 6 months of loading.

Results: The mean RFA values at surgery and fifth week were 64 ± 1.8, and 78 ± 1.4, respectively. MBL (mm) for advanced surgery applied implants were higher (0.8 ± 0.1) than implants placed without advanced surgery (1.1 ± 0.4) during the follow-up.

Conclusions and clinical implications: Early loading of implants placed with advanced surgical techniques and fixed dental prostheses demonstrated a good short-term clinical outcome, however, long-term studies should be conducted.

265 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implant-supported CAD–CAM bridges in patients with atrophied dental arch

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Background: Loss of teeth causes esthetic and functional problems. In some cases, loss of teeth accompanied with alveolar bone defects. Bone graft and prosthetic gingival restorations could be considered as a treatment of choice, and prosthetic reconstruction with mimicked gingival structure has several advantages, such as no need of a complex surgical procedure, relatively short treatment time, and stable clinical result. However, conventional metal ceramic prosthesis had problems like distortion with bulky structure and repeated firing.

Aim: This case report describes patients restored with CAD–CAM Implant Bridges with zirconia and/or titanium with a mimicked gingiva to achieve aesthetic and functional rehabilitation.

Methods: Case 1: A 58-year-old female patient with an edentulous and atrophied maxilla treated with implant-supported-fixed bridge with titanium CAD–CAM made framework and resin facing (synphony®). Anterior teeth were restored zirconia all ceramic crowns.

Case 2: A 60-year-old male patient treated with fibular graft after mandibulectomy required prosthetic restoration. For this patient CAD–CAM made titanium implant bridge was designed and collapsed buccal space could be regained with artificial gum structure.

Case 3: A 34-year-old male patient who was traumatized with a traffic accident suffered from loss of anterior teeth and resorbed alveolar bone. An implant-supported zirconia bridge with a mimicked gingiva was designed, and Procera® Implant Bridge (Nobel Biocare AB, Göteborg, Sweden) system was applied. Zirconia substructure with gingival and individual all ceramic zirconia crowns were fabricated.

Results: All patients have satisfied and maintained good oral health condition. CAD–CAM made zirconia and titanium implant-supported bridges showed a high precision and good tissue response. There has been minor abrasion and chipping of the prosthesis, but no major failure in the framework and implant was observed.

Conclusions and clinical implications: CAD–CAM process enabled the implant-supported fixed bridge could be used for restoring larger defect area. With artificial gingival structure this prosthesis provides more esthetic and functional restoration,

higher satisfaction to the patient and easier treatment to the clinician.

266 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Immediate implant loading in single-tooth replacement: case series

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Background: Immediate loading has been defined as implants subjected to occlusal functional load immediately after implant placement. Immediate loading with fixed implant prostheses in single-tooth replacement is preferred to maintain the esthetic appearance and speech.
Aim: The aim of this clinical case series is to present the preliminary clinical outcome of immediately loaded implant-supported single crowns in maxilla and mandible.
Methods: Partially edentulous three patients (age range: 41–58) received four sand-blasted, large-grit, acid-etched dental implants (Bego, Germany, Straumann, Switzerland, Astra, Sweden) in the maxilla ($n = 2$) and in the mandible ($n = 2$) and implant-supported fixed provisional crowns within 48 h after surgery. After 16 weeks of healing time, definitive, screw-retained, implant-supported ceramometal crowns were fabricated. Resonance frequency analysis (RFA) evaluations were recorded at surgery, after 1 month of loading with the provisional implant-supported crowns as well as 24 months after definitive crowns. Marginal bone loss (MBL-mm) measurements were made in radiographs taken at placement, 6, and 12 months of loading.
Results: The mean RFA values at surgery, and first month were 64 ± 1.3, and 73 ± 1.8, respectively, while the mean values at 12 months follow-up were 81 ± 2.2. Mean MBL at 6 months and 12 months follow-up were 0.9 ± 0.4 and 0.6 ± 0.3, respectively.
Conclusions and clinical implications: Immediate loading of single implants demonstrated a good short-term clinical outcome, however, long-term studies should be performed.

267 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Three years clinical outcomes of early loaded implants placed using autogenous bone grafts: a case series

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Background: The reconstruction of dentoalveolar defects has been a challenge for surgeons. Extensive loss of bone and teeth presents a complex problem for reconstruction.
Aim: The aim of this study was to evaluate the treatment outcome of early loaded implants placed with autogenous bone grafts.
Methods: A total of 30 Astra Tech Osseospeed implants (Astratech AB, Molndal, Sweden) in 14 patients were installed and the success rates of implants placed in the reconstructed areas were evaluated. After 8 weeks, patients were treated with implant-supported-fixed partial dentures. The patients were recalled at baseline, 6 months, 1, 2, 3 years.
Results: The implants were in function and clinically stable when tested individually; the peri-implant soft tissues were clinically healthy. Peri-implant marginal bone loss was in clinically acceptable levels, with an average of 0.23 mm at 3 years. Mean probing depth was 1.9 mm. The patients were satisfied with the prosthetic outcome. The clinical results reported here have shown several procedures may be necessary for the rehabilitation of the patients with extensive bone loss.
Conclusions and clinical implications: Augmentation of the alveolar bone with an onlay bone graft often provides the desired gain of bone, allows for the ideal placement of dental implants, and improves any discrepancy between the upper and lower arches. As a result early loading of Astra Tech implants in augmented bone reveals satisfactory results.

268 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Long-term 10-year follow-up of implant overdentures use telescopic crown designs

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Background: Telescopic crowns designs applied in nature dentition overdentures had more than over 50 years and had outstanding outcomes. According to Eithner etal. (2008) studied that all the clinical parameters evaluated, no significant difference between the stabilization of full dentures via conus and telescopic crowns and bar-anchored dentures could be found. Within the telescopic crown implant overdentures groups found that there were more healthy peri-implant mucosa over the telescopic crown groups. The advantages of the telescopic crown attachment are the easily cleaning, rigid support and secondary splinting.
Aim: The purpose of this clinical report is to evaluate the long-term 10 years follow-up of implant telescopic crown overdentures outcomes and to report the novel technology to provide passive fit for the implant telescopic overdentures.
Methods: Six patients (4 males, 2 females), total 27 implants were included in this report. The implant overdentures were recieved since from 1998. The inner crowns were milled 6° and rigidity connects with outer crown. One patient uses the cutting edge technology CAD/CAM to fabricate the inner crown, and with the intermediate coping design to achieve the passive fit. The other patients used conventional casting method to fabricate the inner crown and not use the immediate coping.
Results: The implant overdentures had good stability during the 10 years follow-up. No implants failed and the peri-implant mucosa maintenance health. The X-ray revealed good bone maintenance.
Conclusions and clinical implications: The implant ovdentures anchorages use the telescopic crown design can be good another

options. To overcome the passive fit of the design, the CAD/CAM with intermediate coping design can be an easily and efficiency method.

269 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Implant overdentures for non-reconstructed hemimandibulectomy patients: a clinical report

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Background: Recently, hemimandibulectomy patients by oral neoplasm have been rehabilitated with bone reconstruction and implant retained prosthesis. Although non-reconstructed hemimandibulectomy patients have never been reported.
Aim: The implant removable prostheses were delivered to two hemimandibulectomy patients without reconstruction. For *in vivo* evaluation, occlusal force and contact area were measured using these prostheses and they were asked a questionnaire to assess their oral health.
Methods: Two hemimandibulectomy patients were not reconstructed after mandibular resection with condyle. The implant-retained and supported prostheses were fabricated using magnet attachment and Konus telescopic systems, respectively. After delivery and adjustments, the occlusal force and contact area were measured using pressure-sensitive sheets (Dental Prescale, GC, Japan). The patients completed a questionnaire about functional limitation, physical pain, psychological discomfort, etc. (Oral Health Impact profile-Japanese edition [OHIP-J]).
Results: Both implant prostheses exhibited appropriate occlusal force and balanced contact area. Total OHIP scores were decreased after rehabilitation, while patients' satisfaction was dramatically increased. The post-rehabilitation median score of the questionnaire indicated a positive judgment of the treatment.
Conclusions and clinical implications: Without reconstruction, two hemimandibulectomy patients were well rehabilitated by implant prostheses. With the use of magnet attachment and Konus telescopic systems, the implant overdentures were successfully, and the patients express satisfaction regarding their masticatory function.

270 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Immediate and early loading of Straumann® SLActive Implants: A 5 years follow-up

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Background: During the past 40 years, prosthetic rehabilitation of the edentolous patient has developed into a viable and predictable treatment option. High clinical success rates with the original implant protocols (Bränemark) have given clinicians and researchers confidence to further develop and refine the osseointegrated technique and, consequently, implants are used in increasing more challenging situations. Currently, Loading at 6–8 weeks has been standard for Straumann® SLA implants in good bone quality. The more recent SLActive surface has been shown to osseointegrate more rapidly, and loading at 4 weeks is now considered to be sufficient for an early loading method. However, more long-term clinical studies are necessary to verify this, especially in regions of poor bone quality like the posterior maxilla and mandible.
Aim: The objective of this presentation is to show the 5 years results (survival rates and mean bone level changes), of a prospective randomized controlled study of the chemically modified SLActive surface in immediate and early loading in the posterior region.
Methods: Patients of both genders 18 years of age with one or more missing teeth in the posterior maxilla or mandible were enrolled in this study. Following implant placement, patients either received a temporary restoration on the day of surgery (immediate loading) or 28–34 days after surgery (early loading); restorations with a single crown or 2–4 unit bridges; loading was done in all four bone type qualities if primary stability was achieved. Permanent restorations (PR) were placed 20–23 weeks following surgery. Standardized radiographs were taken at baseline, at PR and at 12, 24, 36 and 60 months.
Results: At 5 years: 38 out of the 42 initial patients were still enrolled in this study (16 males and 22 females), and a total of 64 implants were placed, 57 implants could be evaluated for bone level changes between surgery and 5 years post-surgery, 29 immediate and 28 early. Mean patient age was 42 years and Implant survival rate was 96.8%. Besides these preliminary results we will report on the descriptive 5 years data and mean bone level changes.
Conclusions and clinical implications: Results of this long-term study show good implant survival and clinical outcomes at 5 years follow-up.

271 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Clinical evaluation of single-tooth implant treatment of the anterior maxillary area – a 15 years follow-up

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Background: Implant-supported oral rehabilitation in the partially edentulous patient has changed towards achieving predictable esthetic success. Restoration of implants in the anterior maxilla while maintaining acceptable interdental papillae presents a major restorative challenge. Preserving papilla in the

gengival embrasure of the esthetic zone is a key consideration in rehabilitation of the maxillary anterior area.

Aim: The purpose of this study was to evaluate the long-term clinical behaviour of single-tooth implants placed in the esthetic maxillary zone.

Methods: The study sample was composed of 25 dental implants placed in the anterior maxillary area. All implants were evaluated with radiographic exam and with an esthetic evaluation protocol PES (pink esthetic score). The radiographic exam was taken after 1, 5, 10 and 15 years in function. Radiographic examination was carried out by the parallel periapical technique, measuring the distance between the bone crest and the implant in the mesial and distal aspect. All measurements were taken three times and the mean of these measurements was used for statistical analysis. Digital radiographs were analyzed by a single examiner. Pink esthetic score was carried out also by a single examiner at the age of 15 years in function.

Results: The mean bone level lost after 15 years in function was 2.9 mm. The pink esthetic score result was 12. Increased marginal bone loss was related with poor pink esthetic score result.

Conclusions and clinical implications: The loss of interdental papilla in the anterior maxillary region, as a result of periodontal disease or previous therapy, produces serious functional and cosmetic deformities. Esthetic results in a long-term perspective are closely related with the amount of marginal bone around dental implants.

272 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Immediate loading procedure for full arch restoration: a systematic protocol

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Background: The immediate loading of four, five or six implants has been described as a successful and predictable way to treat the edentuluous upper or lower maxillary. If teeth have to be removed at the same time of the surgery, a computerised assisted surgery, using for example Nobelguide software, is not yet available. Thus, it is sometimes difficult to have a proper and easy connection of the new temporary screwed bridge.

Aim: The aim is to show how to connect properly a fixed immediate screwed bridge in the same way for all clinical cases with a high level of success and predictability.

Methods: The complete procedure is described, from the early fabrication of the bridge, the impression technic, using rubber dam, the temporary cylinders connection, the casting of the impression and also the fabrication of the final temporary bridge by the lab technician. The preparation of the temporary cylinders is discussed, using a silane application.

Results: The results are showed for the upper and lower maxillary, and the failures are analysed.

Conclusions and clinical implications: This technic allows to place a temporary fixed screwed bridge in a same way for all the clinical cases. It is reproducible by every prosthodontist and every lab technician.

273 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Bone-level implants, when and where?

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Background: Implant dentistry has become a vital part of prosthodontics for partially and completely edentulous patients. The good news is that dental implant restorations have the highest survival rate compared with any other type of prosthesis to replace missing teeth. The bad news is that the treatment plan, the fabrication of restoration, the occlusion, the maintenance, and the treatment of complications, such as creastal bone loss, prosthesis fracture, or esthetics, are most often unique to implant dentistry.

The ideal goal of modern dentistry is to restore the patient to normal countour, function, comfort, esthetics, speech, and health. A dentist should try to provide all of them. As a result of continued research, diagnostic tools, treatment planning, implant designs, materials, and techniques, predictable success is now a reality for the rehabilitation of many challenging clinical situations.

The increased need and use of implant-related treatments result from the combined effect of a number of factors. One factor for success is the maintenance of crestal bone. It has been shown that different implant designs and different vertical implant positions have an influence on crestal bone levels and on soft tissue levels. Bone level implants have been produced as an alternative tissue level implants to fulfill these conditions and they have been often used.

The highly esthetic zone often requires hard (bone and teeth) and soft tissue restoration. The soft tissue drape is often the most difficult aspect of treatment.

Aim: The purpose of this study was to evaluate clinical cases including bone level and tissue level implants in terms of esthetics and biomechanics.

Methods: After clinical and radiographical examination, implant surgeries were planned for eight patients. Bone level and tissue level implants were inserted in maxillary or mandibular ridge of eight patients. All implants were successfully placed. Fixed partially prosthetic restorations supported by implants were performed for mandibular and maxillary prosthodontic rehabilitation. Six months following prosthodontics rehabilitation, patients were recalled for clinical and radiographical examination.

Results: Bone level implants were observed to be superior in both esthetic and biomechanic properties compared with tissue level implants.

Conclusions and clinical implications: Bone level implants display favorable esthetic and biomechanic properties for implant-supported prosthesis.

274 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

The effect of implant therapy on quality of life

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Background: In the general population, the use of dental implants has become a management strategy for replacing missing teeth. In most people, oral health changes, such as tooth loss, affect quality of life. The alterations of oral health impair of the patients' life quality in a period of time. Oral diseases, such as periodontitis, decayed tooth, tooth loss prevalance increases, effect the quality of life. The life quality is the patients' feeling about themselves according to their gratifications. Nowadays in dental routine, the osseointegreted implants take place in treatment of total or partial tooth loss cases and become significant alternative of prosthetic rehabilitation in modern dentistry.
Aim: The aim of this study is to compare implant assisted prosthetic rehabilitations of endentulous posterior maxilla and conventional partial prosthesis, and analyse their effects over the oral health and quality of life.
Methods: Analyse their effects over the oral health and quality of life by conducting OIDP and OHIP questionary.
Results: In our study, it is seen that the patients' treated with implant assisted prosthesis satisfaction rates and the life quality questionnary results are significantly high.
Conclusions and clinical implications: The implant assisted prosthesis are increased the quality of life more than conventional prosthesis.

275 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Extraoral application of osseointegrated implants, case report

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Background: Facial defects can result from trauma treatment of neoplasms, or congenital malformations, and their restoration is still a challenge for both surgeon and prosthodontists. Craniofacial implants can provide many benefits for prosthetic rehabilitation of facial defects; however, accurate placement of extraoral implants is vital for clinical success.
Aim: The aim of this report is to describe the patient underwent orbital emptying due to cancer pathology.
Methods: The patient underwent orbital emptying at the Department of Plastic and Reconstructive Surgery of the University of İstanbul, Turkey. Our final purpose being positioning of titanium implants on the orbital borders, necessary to anchor the silicone epithesis. Four implants were placed in previously irradiated areas. Two months after implant surgery silicone epithesis finished.
Results: Two years after the end of prosthetic treatment patient still happy from silicone epithesis and there is no complication due to extraoral implants.
Conclusions and clinical implications: Satisfactory aesthetic and functional results were obtained by the use of this technique.

276 | Topic – Implant Therapy Outcomes, Prosthetic Aspects

Treatment planning and esthetic results for patients with congenitally anodontia

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Background: Patients with congentially missing teeth often present malocclusion, intermaxillary discrepancy and bone defect. All these factors place emphasis on ancillary treatment with orthodontics and oral surgery. A thorough diagnostic workup should include an interdisciplinary approach to ensure optimal treatment. Implant restorations have been proved to be a successful alternative to treat this unique patient population.
Aim: This study illustrates the problems, treatment planning and esthetic results in patients with congenitally missing teeth.
Methods: From November 2000 to February 2009, 53 patients with congenitally missing teeth underwent thorough diagnostic workup, treatment planning and an interdisciplinary approach mainly including orthodontic treatment, orthognathic surgery to ensure optimal treatment in Department of Implant Dentistry, Peking University, School and Hospital of Stomatology. A standard follow-up protocol was conducted for all the patients.
Results: One hundred and thirty-three implants were placed and restored in 53 patients with the mean follow-up 30.9 months (6–110 months) after prosthetic functioning. Two implants lost after functioned 6 months and the remaining implants functioned well until the last review. In this study 21 patients had 30 single missing anterior teeth as well 31 premolars in 21 cases. Seven cases had multiple missing teeth and accepted 38 implants, while four patients with edentulous arch or nearly so accepted 34 implants. Bone augmentation procedures including guided bone regeneration, onlay graft, sinus graft and vertical distraction.
Conclusions and clinical implications: An interdisciplinary approach ensures optimal treatment for patients with congenitally missing teeth as well implant restorations provide an alternative way with predictable and esthetic results.

Esthetic implant restoration using customized zirconia abutment on maxillary anterior area: a case report

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Background: Recently, as the esthetic demands of dental implant restorations are increased, interesting of implant abutment materials is also increased. Titanium abutments for implant restoration are often chosen because of their high mechanical strength. However, on maxillary anterior area, esthetic is demanded and titanium abutments can be contraindicated. Thin buccal mucosa may discolor from the underlying titanium and compromise the final esthetic result. Zirconia abutments complement these disadvantages and improve esthetics. These abutments have non-metallic color, good biocompatibility, high strength and toughness. Therefore, they can be considered as useful implant restoration materials on anterior teeth. Especially, NobelProcera™ abutment has favorable fit with implant fixture and is customized. The advantage of this system is that it is possible to design the abutment to meet specific situations in terms of shape, emergence profile and soft tissue support.

Aim: The aim of this clinical report was to present of the esthetic result of an all-ceramic crown on a customized zirconia abutment replacing the maxillary left lateral incisor.

Methods: In this case, a 28-years-old male patient complained of dental trauma due to a traffic accident. Treatment procedure included the placement of single implants and laminate veneer. The implant was placed with expansion of the alveolar ridge to compensate for the narrow ridge. After the second-stage surgery, provisional restoration was fabricated and inserted. The gingival tissue was contoured. And then, final impression was made with impression copping. NobelProcera™ abutment was connected to implant fixture and final restoration was fabricated.

Results: NobelProcera™ abutment allowed the correction of implant angulation, development of transitional contours of gingival tissues to create an anatomically oriented restoration with a natural emergence profile, placement of the abutment crown margin at an acceptable level in a sulcus apical to the gingival crest of tissue, and achievement of harmonization with adjacent laminate veneer and natural teeth.

Conclusions and clinical implications: This clinical report describes a treatment in which a lost anterior tooth was replaced with a dental implant that was restored using customized zirconia abutment. We report esthetically and functionally favorable clinical result of this patient after final prosthetic restoration.

Posters: Topic – Tissue Augmentation and Engineering (Abstracts 278–338)

278 | Topic – Tissue Augmentation and Engineering

Bone remodeling after guided bone regeneration using a cellular dermal matrix. Fluorescence study in dogs

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Background: A variety of biocompatible materials, non-absorbable or absorbable, have been used as membranes in guided bone regeneration (GBR). The acellular dermal matrix, material obtained from human skin, has also been used as a membrane for GBR in edentulous ridges and in association with immediate implants, suggesting that this material may be able to act as a barrier.

Aim: The purpose of this study was to evaluate, through fluorescence analysis, the bone remodeling after guided bone regeneration when acellular dermal matrix or a bioabsorbable membrane are used as barrier.

Methods: In seven dogs, the mandibular premolars were extracted. After 8 weeks, one bone defect was surgically created bilaterally and the GBR was performed. Defect dimensions were 10 mm bucco-lingually, 12 mm mesio-distally and 8 mm apico-coronally, measurements that comprise a critical defect. Each side was randomly assigned to the control group (bioabsorbable membrane made of glycolide and lactide copolymer) or test group (acellular dermal matrix as a membrane). During the healing period, fluorescent bone markers were injected to study bone formation. The dyes were injected in the following sequence: alizarin at 2 weeks after surgery, calcein blue 4 weeks after surgery, tetracycline 8 weeks after surgery, and calcein green 12 weeks after surgery. One animal was excluded from the study due to complications in the test group during wound healing, remaining six dogs in the sample. After 16 weeks of GBR the dogs were euthanized and histomorphometic analysis was made to evaluate the remodeled bone on the different postoperative periods. Area and percentage of bone formation were measured.

Results: Fluorescence microscopy showed a similar sequence of bone remodeling (Wilcoxon signed rank test, $P > 0.05$) for both groups: test group, 14.81% bone formation at 2 weeks (2.85 mm^2 of area), 10.94% at 4 weeks (2.1 mm^2 of area), 10.19% at 8 weeks (1.96 mm^2 of area), and 7.85% at 12 weeks (1.51 mm^2 of area); control group, 14.41% at 2 weeks (2.77 mm^2 of area), 9.25% at 4 weeks (1.78 mm^2 of area), 9.45% at 8 weeks (1.82 mm^2 of area), and 8.5% at 12 weeks (1.63 mm^2 of area).

Conclusions and clinical implications: The results of this study indicate that the acellular dermal matrix and bioabsorbable membrane made of glycolide and lactide copolymer act as barriers in GBR and does not interfere in the dynamics of bone formation.

279 | Topic – Tissue Augmentation and Engineering

Translation of embryonic signaling into bone regeneration – impact of Msx1 on critical size defect regeneration

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Background: The homeobox protein Msx1 induces proliferation of osteobasts. Expression of Msx1 is restricted to craniofacial bone in the mature skeleton. Msx1 has been demonstrated to act in part antagonistically to BMP-2/4 by mediating cellular proliferation and preventing terminal osseous differentiation. It is not known if overexpression of Msx1 could contribute to increased bone bone formation in guided bone regeneration approaches.

Aim: The aim of the experimental study was to evaluate the influence of local BMP-2/4 gene transfer on the expression of Msx1 during guided bone regeneration in domestic pig's calvarian bone critical size defect regeneration.

Methods: Twenty adult domestic pigs received nine cylindric CSD (1 × 1 cm) in the calvarial bone. Defects were allowed to regenerate by either filling with: autologous bone; BSM (HA/TCP) + BMP-2/4 transfected osteoblasts + PEG membrane; BSM (HA/TCP) + rhPDGF + PEG-membrane. PEG membranes were used with either 10 or 120 days degradation kinetics. BMP-2/4 gene transfer was realised by a fusion protein (liposomal *in vitro* transfection with the artificial tag V5. Quantitative histomorphometry was perfomed (Toluidin-blue staining) after 2, 4 and 12 weeks. Immunohistochemistry assessed the expression of Msx1, Sox9 and Kollagen X.

Results: Induced BMP-2/4-expression was traced until 2 weeks following cell transfer. Four weeks after surgery in BMP-2/4 transfected defects covered by the membrane, the significantly lowest bone formation ($P < 0.05$) was detected associated with the lowest expression of Msx1. After 12 weeks the group of PDGF treated non-covered defects showed the significantly lowest bone formation ($P < 0.03$) within the study, associated

with the highest expression of Msx1. Msx1 expression presented strict correlation with Sox9 and Kollagen X.

Conclusions and clinical implications: Msx1 resembles proliferation of osteogenic progenitor cells in cranial neural crest derived bone. It antagonizes the action of BMP-2/4 by enhancing proliferation and suppression of terminal differentiation. Sustained expression of Msx1 is associated with prevention of osseous terminal differentiation, resembled by increased expression of Sox9 and Kollagen X. Stimulation of Msx1 during early stages of guided bone regeneration could contribute to increased proliferation of osteoblast progenitors.

280 | Topic – Tissue Augmentation and Engineering

Histomorphometric comparison of anorganic bovine bone (Bio-Oss) and mineralized human bone allograft (Puros) for sinus augmentation

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Background: The present blinded, randomized, controlled investigation compared the histologic and histomorphometric results of sinus augmentation with two different materials; anorganic bovine bone (ABB) Bio-Oss (Geistlich Pharma AG) and Mineralized Human Bone Allograft (MHBA) Puros cortical (Tutogen Medical GmbH).

Aim: The hypothesis to be tested was that the histomorphometrical appearance of the material was comparable after 6 months of healing.

Methods: Patients could be included in the study if the residual alveolar crest height was >3 mm and <7 mm. Fifty-one maxillary sinuses were treated in 38 patients (31–67 years of age). According to the randomization list, lateral sinus augmentation was performed either ABB (control group: 24 sinuses) or MHBA (test group: 27 sinuses). After 180–220 days of healing (the same time frame was used for each individual patient), core biopsies were retrieved from implant sites and processed for histologic and histomorphometric evaluation. Both the calcified and the non-decalcified tissue processing were performed. In the non-decalcified method, core biopsies were fixed in paraformaldehyde, and embedded in a hydrophobic acrylic resin followed by hard section microtomy. Non-decalcified (60 μ thick) and decalcified (5 μ thick) sections were prepared and, respectively, stained with Hematoxylin-eosin and Giemsa-Paragon. Statistical analysis used the student *t*-test and Pearson correlation analysis.

Results: Histomorphometric analysis revealed a close contact between new bone and graft particles for both groups (ABB and MHBA), but we noted a statistical difference in the amount of novel vital bone with a mean percentage of 16.44% and 29.61%, respectively, and a mean percentage of 27.13% and 7.6%, respectively, for residual particles.

Conclusions and clinical implications: Both materials are suitable for sinus augmentation, and were surrounded by new bone, osteoid, and osteoblasts. However, a higher mean percentage of new vital bone that was completely integrated with preexisting bone was observed around the MHBA particles when compared with ABB; subsequently a lower mean percentage of residual particles was revealed within MHBA grafted sinuses. The analysed biomaterials seem to be a safe and effective for maxillary sinus floor augmentation by accelerating bone regeneration and thus reducing the healing time. Mineralized Human Bone Allograft (MHBA) Puros cortical is a suitable grafting material permitting optimal osseointegration of dental implant in the deficient posterior maxilla.

281 | Topic – Tissue Augmentation and Engineering

Biologic activity of stem cells isolated from human alveolar bone

Presenter: Kim Y-T

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Background: Many studies reported that oral cavity could be an easily accessible resource for several kinds of mesenchymal stem cells such as stem cells from human exfoliated deciduous teeth (SHED), stem cells from apical papilla (SCAP), dental pulp stem cell (DPSC) and periodontal ligament stem cell (PDLSC), which could induce appropriate tissues for dental implant surgery and periodontal regeneration.

Aim: We investigated that mesenchymal stem cells could be isolated from alveolar bone tissue obtained during the dental implant drilling, which could be used for bone tissue engineering.

Methods: Alveolar bone fragments were harvested from patients ($n=5$) during dental implant drilling procedures. Cells were isolated from bone marrow of the obtained tissues. Cell cultures were conducted under the defined condition. Colony-forming unit (CFU) test, immunohistochemical staining, Real-time polymerase chain reaction (RT-PCR), fluorescence activated cell sorter (FACS) and western analysis were used to identify characteristics of stem cells and to evaluate adipogenic and osteogenic differentiation. Human alveolar bone stem cells (hABSCs) were transplanted into immunocompromised mice ($n=4$) to assess the potential for new bone formation. Histologic

and immunohistochemical studies were conducted after 8 weeks.

Results: hABSCs had mesenchymal stem cell makers such as STRO-1, CD-146, CD-44 and CD-90. Under defined culture conditions, hABSCs were differentiated to osteoblasts. hABSCs, when transplanted into immunocompromised mice using a hydroxyapatite/tricalcium phosphate (HA/TCP) carrier, showed the potential to induce new bone formation.

Conclusions and clinical implications: This study showed that alveolar bone tissues obtained during dental implant surgery contained stem cells, and these cells had the potential to induce bone tissue *in vivo* study. Tissue engineering using these cells, which could be achieved from a routine implant surgery without ethical issues, might be alternative for clinical approach for reconstruction of bone tissue.

282 | Topic – Tissue Augmentation and Engineering

Promising dental pulp stem cell-based therapy for dental implants

Presenter: Yamada Y
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Background: Tissue engineering is to be essential technology for tissue regeneration. However, it remains unclear whether cells used in bone regeneration applications produce a material that mimics the structure of native bone. And no experimental studies have examined the potential of stem cell based bone regeneration or the correlation with dental implants.

Aim: This study investigated the effect on bone regeneration with dental pulp stem cells (DPSCs), deciduous tooth stem cells (DTSCs), or bone marrow-derived mesenchymal stem cells (BMMSCs) for clinical application in osseointegrated dental implants using tissue engineering technology.

Methods: The expression of surface epitopes of stem cell markers (STRO-1, CD13, CD29, CD 44, CD73) were investigated by using flow cytometry analysis, and the expression of osteogenic marker, alkaline phosphatase, RUNX 2, osteocalcin, was analyzed by using real time RT-PCR in human DPSCs, DTSCs and BMMSCs *in vitro*. And bone formation efficiency was also investigated using canine bone defect model *in vivo*. Graft materials were implanted by as follows: platelet rich plasma (PRP), PRP and canine BMMSCs (cBMMSCs), PRP and canine DPSCs (cDPSCs), PRP and puppy DTSCs (pDTSCs), and control (defect only). After 8 weeks, the dental implants were installed, and 16 weeks later the sections were also evaluated histologically and histometrically. The differences of bone implant contact (BIC) were analyzed using the Tukey–Kramer test following one-way analysis of variance (ANOVA).

Results: The cBMMSCs/PRP, cDPSCs/PRP, and pDTSCs/PRP had well-formed mature bone and neovascularization. Histometrically, newly formed bone areas (NFBE) and BIC were 19 ± 2.9, 49.8 ± 8.8% (control), 19.7 ± 6, 59.1 ± 4.3% (PRP), 52.8 ± 3.5, 73.6 ± 6.5% (cBMMSCs/PRP), 61.6 ± 1.3, 74.7 ± 5.8% (cDPSCs/PRP) and 54.7 ± 2.2, 76 ± 4.1% (pDTSCs/PRP), respectively. The NFBE and BIC of the cBMMSCs/PRP, cDPSCs/PRP, and cDTSCs/PRP showed a significant increase in the implant surface compared with the control and PRP ($P < 0.01$), but there were no significant differences among the three cell types.

Conclusions and clinical implications: These results demonstrated that these stem cells with PRP have the ability to form bone, and this bone formation activity might be useful for osseointegrated dental implants. It is important to note that DPSCs and DTSCs have several advantages over BMMSCs derived from other sources; the method for their isolation is not invasive and they can be expanded rapidly *in vitro*. DPSCs and DTSCs would be a potential source of stem cells for bone regeneration in dental implants as an alternative to BMMSCs, and might be promising approach in terms of stem-cell bone therapy as part of the stem-cell banking system.

283 | Topic – Tissue Augmentation and Engineering

The effect of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) on bone defects of rabbit calvaria

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Background: Platelet-rich plasma (PRP) is a volume of autogenous plasma that has a platelet concentration above baseline. They release multiple wound-healing growth factors and cytokines. These growth factors are thought to contribute to bone regeneration and increased vascularity, vital features of a healing. Platelet-rich fibrin (PRF) that is a fibrin clot charged with serum and platelets, belongs to a new generation of platelet concentrates geared to simplified preparation without biochemical blood handling.

Aim: To evaluate the effect of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) on bone defects. Molecular biologic, radiomorphometric and histomorphometrical analysis was performed in the same rabbit calvaria defect model. And to develop an animal model that can be used to evaluate the bone healing.

Methods: Sixteen healthy rabbits, weighing 2.5–3 kg, were used in this prospective study. In each rabbit, four equal 8 mm diameter cranial bone defects were made with trephine drill and it was immediately grafted with PRP, PRF, autogenous bone and one defect was remained with no treatment (control). The defects were evaluated by cone beam CT at 2, 4, 6 and 8 weeks. At 8 weeks, rabbits were sacrificed. Soft X-ray with step-wedge calibration and histologic process were taken with sacrificed rabbits for radiomorphometric and histomorphometric analysis. RT-PCR was measured for mRNA expression of BMP-2, type I collagen, and osteopontin as a bone morphogenic factor.

Results: As mRNA expression, PRP and PRF were more effective on the early stage of bone formation. Radiomorphometrically and histomorphometrically, the results showed a significant increase in bone formation on autogenous bone graft group.

Both PRP and PRF groups showed significant increase as compared with the control group. There was no significant difference between PRP group and PRF group. Significant improved bone formation was seen with the addition of PRP or PRF on non-critical sized defects in the rabbit cranial model. And PRF group showed more uniform and similar result compared with PRP group.

Conclusions and clinical implications: It is reasonable to think that PRP and PRF can promote bone regeneration. Also, PRF can replace PRP according to good uniform result and simple manipulation.

284 | Topic – Tissue Augmentation and Engineering

Mesenchymal stem cells for sinus augmentation in the sheep model

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Background: New reconstructive and less invasive methods have been searched in order to optimize bone formation and osseointegration of dental implants in maxillary sinus augmentation.

Aim: The aim of the presented ovine split-mouth study was to compare autogenous bone, bovine bone mineral (BBM) alone and in combination with mesenchymal stem cells (MSCs) regarding their potential in sinus augmentation.

Methods: Bilateral sinus floor augmentations were performed in 12 adult sheep. BBM and MSCs were placed into the test side and only BBM in the contra-lateral control side of 6 sheep. In the other 6 sheep BBM and MSCs were mixed and placed into one side and autogenous bone in the other side. Three animals of each group were sacrificed after 8 and 16 weeks. Augmentation sites were analysed by computed tomography, histology and histomorphometry. Statistically analyses was performed according to the mixed model by Pinero and Bates (function lme in package nlme under R)(Pinheiro 2000; R Foundation for Statistical Computing 2009).

Results: The initial volumes of both sides were similar and did not change significantly with time. A tight connection between the particles of BBM and the new bone was observed histologically. Bone formation was significantly ($P = 0.027$) faster by 49% in the test sides and comparable to autogenous bone.

Conclusions and clinical implications: The combination of BBM and MSCs accelerated new bone formation in this model of maxillary sinus augmentation. This could allow early placement of implants (Gutwald et al. 2009; Sauerbier et al. 2010).

References

1. Gutwald, R., Haberstroh, J., Kuschnierz, J., Kister, C., Lysek, D. A., Maglione, M., Xavier, S. P., Oshima, T., Schmelzeisen, R., Sauerbier, S. (2009) Mesenchymal stem cells and inorganic bovine bone mineral in sinus augmentation: Comparison with augmentation by autologous bone in adult sheep. *British Journal of Oral Maxillofac Surg*. (Epub ahead of print).

2. Pinheiro, J. C. B., D.M. (2000) *Mixed-Effects Models in s and S-Plus*. Springer.

3. R Foundation for Statistical Computing. (2009) R: A language and environment for statistical computing. In: Bates, D., Chambers, J., eds. Vienna, Austria.

4. Sauerbier, S., Stubbe, K., Maglione, M., Haberstroh, J., Kuschnierz, J., Oshima, T., Xavier, S. P., Brunnberg, L., Schmelzeisen, R., Gutwald, R. (2010) Mesenchymal stem cells and bovine bone mineral in sinus lift procedures – an experimental study in sheep. *Tissue Eng Part C Methods* (Epub ahead of print).

285 | Topic – Tissue Augmentation and Engineering

The biologic effect of fibrin-binding oligopeptides derived from fibronectin on osteoblast-like cell

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Background: During the periodontal wound healing, complex interactions between cells and components of extracellular matrix (ECM) in gingival connective tissue are important. Fibronectin (FN), one of the major components in ECM, is known to mediate cell adhesion, migration, proliferation and differentiation through the cellular interaction. Within the structure of FN, specified sequences like RGD and PHSRN are well known sites for cell adhesion with integrin. The FN molecule also has many other adhesive sites for various substances, including fibrin, heparin and collagen.

Aim: The purpose of this study was to elucidate the biologic effect of fibrin-binding synthetic oligopeptide derived from fibronectin using osteoblast-like cells.

Methods: Nine to 20 mer oligopeptides, designated FF1, FF3 and FF5, were synthesized by solid-phase peptide synthesizing system. These oligopeptides were coated on the 4, 24, 96 well chamber slide and HOS cells were plated at 3×10^4 cells/well. After 12 h of incubation, adherent HOS cells were fixed and stained to be observed using confocal laser scanning microscope. MTT solutions were added on the cells cultured in 96 well, optical density reflected the level of attached cell to synthetic peptides. For comparison of the mineralization activity, the HOS cells were cultured for 10 days in osteogenic induction medium. 3×10^3 cells were put for a well in media. Mineralization was evaluated by confocal microscopy for calcium deposition and also by Alizarin Red S staining. Each experiment was carried out in quintuplicate. Data were performed by one-way analysis of variance (ANOVA) of 95% confidence interval.

Results: FF3 and FF5 peptides increased the number of attached HOS cells and FF3 showed prominent cell spreading.

Mineralization was also increased in FF3 and FF5 than FF1 and untreated control.

Conclusions and clinical implications: It is concluded that fibrin-binding oligopeptide denoted FF3 and FF5 enhanced the cell attachment and mineralization on osteoblast-like cell. These results indicate that FF3 and FF5 have potential to increase the osteoblast-like cell activity and these peptides can be applied to surface modification over biomaterials to enhance osteogenesis and thus improve the regeneration of destroyed alveolar bone.

286 | Topic – Tissue Augmentation and Engineering

Minimally invasive vertical ridge augmentation using xenogenous bone blocks: a prospective clinical study

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Background: Current procedures for treatment of the atrophic alveolar ridge often require intraoral or extraoral bone harvesting, inferior alveolar nerve transposition, or distraction osteogenesis. These procedures have increased morbidity and discomfort for the patient.

Aim: The purpose of this study was to investigate the results of a surgical technique in which xenogenous bone blocks are inserted in atrophic mandibles using a subperiosteal tunneling procedure for vertical ridge augmentation.

Methods: Nine patients were included in this study. All patients underwent a subperiosteal tunneling procedure with Bio-Oss® block onlay grafting in an atrophic area of the mandible. The newly formed bone in the atrophic areas was evaluated 6 months after augmentation using computerized tomography (CT) and trephine core biopsies.

Results: All atrophic areas were covered with bone tissue. The average height of new bone formed in the areas was 5 ± 0.5 mm (range: 4.3–5.5 mm). New bone formation was consistently observed upon histological evaluation.

Conclusions and clinical implications: Our findings support the clinical use of vertical ridge augmentation, using a subperiosteal tunneling procedure with Bio-Oss® bone blocks for bone augmentation in atrophic alveolar ridges.

287 | Topic – Tissue Augmentation and Engineering

Bone response of porcine bone xenograft vs. the bovine xenograft

Presenter: Maria Piedad RF

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Background: The substitution of bone tissue constitutes an unsolved problem that requires new research into diverse materials capable of repairing defects and stimulating host bone growth in order to achieve repair.

Aim: The aim of this study was a radiological and histomorphometrical evaluation to the response of bone at xenografts proceeding from two different species, 4 months after their insertion in tibiae rabbits.

Methods: Twenty New Zealand rabbits weighing 3900–4500 g were used. Twenty porcine bone implants made up of 90% bone granules of 600–1000 μm in size and 10% pure type-I collagen were placed in the proximal metaphyseal area of the left tibia. In the right tibia we use a bovine xenograft implant with bone granules of 500–1000 μm in size. Four groups were formed following implantation: Group I (1 month), Group II (2 months), Group III (3 months) and Group IV (4 months). An anteroposterior and lateral radiological study was carried out. Samples were sectioned at 5 μm and stained using Hematoxylin-Eosin, and Masson's trichromic. The entire circumference of the section (containing bone, grafted particles, and connective tissue) was traced manually to create an individual region of interest. All samples were examined under light microscopyusing X10 to X40 objectives for descriptive evaluation and morphometrical measurements. The ANOVA test was used to identify significant the mean differences and standard deviations.

Results: After 4 months of treatment period the bone defects into which the xenografts had been placed displayed the radiological image the complete repair of the osseous defect. No healed or residual bone alterations attributable to the presence of the implant were observed. Histomorphometric showed that a higher density of newly formed bone for the porcine xenograft was present showed the mean values groups of 25.4 ± 1.8%, the porcine bone residual 36.3 ± 3% and non-mineralized conective tissue of 38.2 ± 2.5% vs. the mean values of the new bone bovine was 10.5 ± 1.5%, residual bovine bone 50.4 ± 2.3% and non-mineralized tissue 39.1 ± 2.5%, respectively, at 4 months. There was a significative difference between both xenograft.

Conclusions and clinical implications: The collagenized porcine xenograft has proven to be biocompatible, bioreabsorbable and osteoconductive and more resorptive than bovine bone. Both can be used as a possible bone substitute without interfering with the normal reparative bone processes.

288 | Topic – Tissue Augmentation and Engineering

Computed tomography analysis of Schneiderian membrane after lateraly sinus augmentation procedure

Presenter: Anduze G
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Background: Bone substitute graftings is nowadays a well-established procedure for maxillary sinus floor augmentation before implant placement. So far, the impact of these procedures on the sinus membrane has not been explored. Therefore, it is of interest to evaluate the modifications of the Scheinderian membrane following grafting procedures.

Aim: The aim of is study was to measure with computed tomography the Schneiderian membrane's changes following laterally sinus augmentation procedure.

Methods: Thirty laterally sinus augmentation procedures were performed on 26 healthy patients (22 females). Bovine xenograft (Bio-Oss®) was used as bone substitute, and the lateral window was closed with a resorbable membrane (Bio-Gide®). Computed tomographies (CT scan) were analyzed with an image analysis system (ImageJ®). The thickness of the sinus membrane, the alveolar bone height, and the sinus filling were measured pre and postoperatively.

Results: Ten months postoperatively (± 5.64 months), a significant decrease of the mean sinus membrane thickness was observed ($P = 0.017$). The correlation between pre- and post-membrane thickness was low ($r = 0.15$). Alveolar bone crest showed a decrease of 0.11 ± 0.66 mm, and the bone fill into the sinus was 13.19 ± 3.11 mm, with an available total bone height of 16.94 ± 3.33 mm. Multivariate analysis pointed out the influence of postoperatively healing time.

Conclusions and clinical implications: The Schneiderian membrane may be subjected to modification following sinus augmentation procedures. This modification may be interpreted as an adaptation of the membrane over time. In healthy sinuses, the preoperative thickness of the membrane is not a prognosis factor for the postoperative thickness of the membrane following lateral augmentation.

289 | Topic – Tissue Augmentation and Engineering

Quantitative assessment of bone quality following sinus lift using intraoral radiography

Presenter: Kim C
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Background: In previous studies it was shown that the image analysis of the bony structure on dental radiographs was valid to assess bone quality. The imaging parameters of the trabecular pattern on intraoral radiographs show correlations with the bone mineral density (BMD) as measured by quantitative computerized tomography (QCT).

Aim: The aim of this prospective study was to quantitate bone graft quality using the image analysis of intraoral radiographs. The reliability of the imaging parameters following sinus lift was assessed to examine whether the tested analysis could be used to quantitate graft incorporation.

Methods: Twenty-two patients were treated with sinus lift before implant placement. A total of twenty-four sinuses were grafted with bovine hydroxyapatite and recombinant human platelet-derived growth factor. Implant installation was performed after a mean healing period of 4.3 months. Intraoral radiographs of grafted sites were obtained peroperatively and at predetermined periods thereafter. The regions of interest were selected for each radiograph stored on hard disk and binarized. A total of 32 parameters were measured using binary images to assess bone graft quality morphometrically. The reliability of the parameters at each phase was examined by means of Cronbach's α.

Results: More than 53% of the values of Cronbach's α for the parameters were less than 0.6 during the first 2 months. A significant increase in the values of α was measured 2 months postoperatively. Seventy-four percent of the values was at least 0.85 thereafter and 99% was at least 0.85 at 4 months and thereafter. The increases in the values of α leveled 4 months postoperatively and little further changes were measured.

Conclusions and clinical implications: The internal consistency of the imaging parameters was established at least 4 months postoperatively. This study indicates that a healing period of 4 months after bone grafting has already been sufficient for graft incorporation. The image analysis of intraoral radiographs potentially offers an alternative diagnostic tool to identify the optimal graft healing period and the timing of implant placement after grafting. These results need to be confirmed in the measurements of the parameters on a larger collection of radiographs of grafted sites.

290 | Topic – Tissue Augmentation and Engineering

Modified sinus elevation in severely resorbed alveolar ridges

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Background: Various techniques for sinus elevation are suitable in cases of severe atrophy of the crestal bone. The osteotome technique described by Summers and numerous surgical protocols based on this technique have been published, indicating that the search for the optimal method is ongoing. The crestal approach is considered to the lateral window technique as less traumatic. Until know the osteotome technique is recommended for single implants with residual bon height of at least 5 mm. The presented procedure allows the insertion of implants assuring primary stability and less postoperative complications in residual bone of 1–4 mm.

Aim: Present a modified technique for sinus elevation in severely resorbed alveolar ridge.

Methods: After exposure of the alveolar crest a cortical bone block was mobilised. The sinus elevation was than performed by using osteotomes in diverting directions to split the cancellous bone avoiding a direct contact to the Schneiderian membrane. Panoramic radiographs and cone beam CT were done before, after surgery and at implant exposure. Success was defined as survival of the implants. Statistical analysis was used to identify the influence of age, residual bone, augmentation height, and implant shape on implant success.

Results: One hundred and twenty-four modified sinus elevation was performed in 105 patients with 181 inserted implants. The average residual bone height was 3.9 (1–8 mm), the average augmentation height was 7.2 mm (2–14 mm). The first follow up was performed at implant exposure on average of 3.4 months (1–14). The overall success rate was 93%. Success rate in cases with residual bone <4 mm was 75%, by residual bone >4 mm was 99%. By an augmentation height ≥ 9 mm the success rate decreased significantly compared with the augmentation height ≤ 9 mm (81% vs. 98%; $P=0.01$). The risk of implant failure increased by an age over 50 years and residual bone ≤ 4 mm, where a conical implant shape decreased it.

Conclusions and clinical implications: Based on the results of the present study an immediate implant insertion in alveolar ridges with a residual bone of less than 5 mm is successfully possible using the described method. The technique is a minimally invasive procedure with reliable outcomes regarding integrity of the sinus membrane, primary stability and implant success rate.

291 | Topic – Tissue Augmentation and Engineering

Chitosan-collagen composites may induce new bone formation around pure titanium implants

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Background: The enhancing effects of chitosan on activation of platelets and differentiation of osteoprogenitor cells have been demonstrated *in vitro*.

Aim: The purpose of this study was to evaluate the *in vivo* effects of chitosan-collagen composites on ectopic new bone formation around pure titanium implant surfaces in experimental rats. In addition, histomorphometric analysis was used to test if molecular weight of chitosan within the composites affects the amount of new bone formation.

Methods: Chitosan-collagen composites containing chitosan of different molecular weights (450,000 and 750,000 Da) were used to wrap onto titanium implants and embedded into the subperiosteum area on the back of fifteen Sprague Dawley rats. The negative consisted of implants wrapped with plain collagen type I membranes. Implants and surrounding tissues were retrieved 6 weeks after surgery and identified by Alizarin red and Alcian blue whole mount staining. The newly formed structures in the test groups were further analyzed by Toluidine blue, Masson–Goldner Trichrome staining, and immunohistochemical staining with osteopontin and alkaline phosphotase. The bone formation parameters of the new bone in the two test groups were measured and compared.

Results: New bone formed ectopically in both chitosan-collagen groups, whereas no bone induction occurred in the negative control group. These newly formed bone-like structures were further confirmed by immunohistochemical staining. Comparison of bone parameters of the newly induced bone revealed no statistically significant differences between 450,000 and 750,000 Da chitosan-collagen groups.

Conclusions and clinical implications: Our results demonstrated that chitosan-collagen composites might induce *in vivo* new bone formation around pure titanium implant surfaces in experimental rats. Molecular weight of chitosan did not show significantly different effect on the osteoinductive potential of the materials. The chitosan-collagen composites may provide beneficial effects in the application of bone augmentation.

292 | Topic – Tissue Augmentation and Engineering

Application of hydroxyapatite fiber for bone augmentation

Presenter: Kimura J

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Background: Autogenous bone is widely recognized as the gold standard for bone augmentation.

However, harvesting autogenous bone sometimes associates morbidity to intra or extra oral host site.

Moreover, reduction of bone volume after augmentation often prevent proper placement of dental implant.

To resolve these problems, the use of synthetic bone substitute combined with autogenous bone has been applied.

However, it is difficult for bone substitute particles to fill the gap between harvested bones completely.

In our department, the fiber-formed Hydroxyapatite (HF) was reported to have enough effect to socket preservation.

HF is able to adapt complicated various forms and has a possibility to be applied for filling the gap.

However, the most effective bone/HF ratio has not been known.

Aim: The aim of this study was to examine the effect of combined use of HF for filling bone gap and to determine the most effective bone/HF ratio.

Methods: Thirty Japanese male white rabbit (3.1–3.8 kg) were used.

For each rabbit, two Polytetrafluoroethylene chambers (hollow cylinders; diameter: 5 mm h: 3 mm) were fixed with stainless screw in calvaria.

The chambers were filled with HF only or combined with harvested bone from tibia (bone/HF ratio: 3/1, 3/2, 1/1).

Animals were sacrificed after 4 and 8 weeks.

The samples were embedded in polyester resin and non-decalcified specimens were processed for histological and histomorphometrical analysis.

Results: The total bone volume of 3/1 and 1/1 ratio group at 8 weeks was lower than that of 4 weeks, and that of 3/2 ratio and HF only group at 8 weeks was higher than 4 weeks.

The total bone volume of 3/2 ratio group is higher than other groups at 8 weeks.

Newly formed bone between host bone and harvested bone showed a net-like structure that included HF.

Multinuclear cells and mononuclear cells were observed around HF.

Conclusions and clinical implications: Present study suggested that combination of HF and autogenous bone is applicable for bone augmentation and the most effective bone/HF ratio was 3/2 to maintain the total bone volume.

293 | Topic – Tissue Augmentation and Engineering

Post-extraction site management by a novel nanoporous polytetrafluoroethylene barrier

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Background: Several methods of alveolar ridge preservation (ARP) utilize space-maintaining barriers to preclude undesirable cells and bacteria, thus enabling osteoprogenitor cells to repopulate the extraction socket. Lack of primary flap closure above the membrane or premature exposure may result in compromised quality of the underlying tissues. However, forced primary flap approximation following periosteal releasing incisions often lead to unwelcome bruising and coronal shift of the mucogingival junction thus reduction of the width of keratinized mucosa. To overcome these drawbacks a cell-occlusive barrier, without the necessity of primary closure, would be favourable. A novel nanoporous polytetrafluoroethylene membrane (nPTFE) (Cytoplast GBR-200, Osteogenics, TX, US), manufactured with 300 nm porosity, enables diffusion of oxygen and nutrition, but disables the passage of bacteria.

Aim: To investigate the healing of human extraction sockets treated with nPTFE.

Methods: Five healthy individuals (two males, three females; age: 36–64 years) entered the present pilot. Each subject presented with one or more teeth scheduled for extraction due to trauma, endodontic or periodontal reasons. Ten extraction sites represented the front, premolar and molar regions. Following atraumatic extraction, socket was thoroughly debrided. Subsequently nPTFE was trimmed and tucked under the periosteum, overlaying the socket. Flaps were not reflected. Soft tissue margins were approximated by 6/0 monofilament sutures, although primary closure was not intended. Patients were then instructed to avoid mechanical cleansing of the area, but rinse with 0.2% chlorhexidine for 4 weeks instead. Sites were observed once a week.

Results: Healing was uneventful in nine out of ten sockets. At one site a minor increase of mucosal dehiscence occurred, presumably due to the mechanical irritation of the insufficiently extended membrane fringe. The exposed barriers were well tolerated without clinical signs of inflammation at all the other sites. Juvenile, highly vascularized newly formed tissue filled in the sockets at crestal level after 4 weeks upon membrane removal; dislike the single compromised site, where granulation tissue was identified. Sockets were covered by epithelium in 2–3 weeks thereafter. The width of the keratinized mucosa was maintained. Variable amount of hard tissue was found at re-entry, presumably influenced by the post-extraction site morphology and individual healing capacity. Dental implants were then successfully inserted in prosthetically driven positions with sufficient primary stability, however, minor to medium augmentations were carried out simultaneously.

Conclusions and clinical implications: Within their limits, the present findings indicate that nPTFE barrier might be a suitable candidate for ARP. Randomised controlled trials have to be conducted before clinical decision making.

294 | Topic – Tissue Augmentation and Engineering

Biomimetic calcium phosphate bone filler with coordinated delivery of multiple-drugs

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Background: Treatment of voluminous bone defect remains a challenge in implantology and orthopedics. Apart from osteogenic agents, additional bioactive drugs are also needed for the defects with different etiologies. For example, defects resulted from infection need antibiotics in the short term and defects resulted from tumor need anti-neoplastic drugsin the long term. Ideal bone filler should be accommodative to store and deliver on demand the osteogenic agents together with bioactive drugs locally. However, none of the current products meet this criterion.

Aim: The aim of this study is to develop a novel bone filling material that would be not only biodegradable and biocompatible, but also capable of coordinately delivering multiple bioactive agents as a goal to heal voluminous bone defects.

Methods: Biomimetic Calcium Phosphate (BioCP), a novel bone-filling material, was made from fivefold supersaturated calcium phosphate solution (CPS) at 37°C and pH 7.4 using biomimetic principles. Fluorescein-isothiocyanate labelled bovine serum albumin (FITC-BSA) was incorporated into BioCP

during the preparation. BioCP was characterized using scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDX). The *in vitro* degradation rate of BioCP was monitored by measuring released calcium ions using atomic adsorption spectrometry. The rate and pattern as well as the *in vitro* release kinetics of BioCP and -incorporated proteins were monitored.

Results: BioCP showed an amorphous morphology and a ratio of calcium and phosphorus at 1.48. The BSA was successfully incorporated into BioCP with an incorporation rate of 89.1 ± 1.9% when the BSA concentration was 10 mg/L in the 5 × CPS. The degradation rate of BioCP was correlated with the protein release, and the later showed a slower release kinetic.

Conclusions and clinical implications: Biodegradable BioCP bone filling materials are not only useful for bone repair, but also can act as a drug delivery system; The flexibility of BioCP in structure and its capacity of coordinately delivering bioactive agents conferred the novel bone filling material a promising application potential in healing voluminous bone defects with different etiologies.

295 | Topic – Tissue Augmentation and Engineering

Split-mouth, tomographic and histological comparison between autogenous and fresh-frozen allogenous grafts

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Background: The use of fresh-frozen allogenous bone (FFAB) blocks as substitutes for autogenous bone (Ab) blocks in implant surgery have gained enormous clinical interest. However, the data on incorporation and volume maintenance of FFAB are still incipient to date.

Aim: The objectives of this study were (1) to examine the histological pattern of FFAB graft in comparison with Ab graft and (2) to assess grafts volume through computerized tomography (CT).

Methods: Twelve patients needing bilateral bone augmentation for implant placement in the anterior maxillae were selected for the study. In a random order, one side was treated with Ab harvested from the mandibular ramus, while on the other side the FFAB (Marilia University, Brazil) was used. The volume of bone blocks measured 1997.8 mm^3 and 1173.3 mm^3 in average, respectively, for FFAB and Ab. After 6 months the patients underwent implant surgery and biopsies from the grafted areas were performed using a 3-mm diameter trephine bur and paraffin histological sections were prepared. At 12 postoperative months the patients were rehabilitated with prosthesis. The CT scanning was carried out at bone grafting surgery (day 0), at implant placement (6 months) and at 12 months prosthesis installation. The difference between groups was evaluated through ANOVA and *t*-test and the level of significance was set at a *P*-value of 0.05.

Results: The histological findings revealed that FFAB was encased in fibrous tissue, healed through creeping callus, characterized by dead cortical bone with absent osteocytes and abundant bone marrow area contrasting with mineralized bone. When intra-group bone was assessed, the FFAB grafts decreased in volume from the baseline to 6 months ($P = 0.003$) and 12 months ($P = 0.02$) while no difference could be found in the Ba group. The comparison between groups showed that FFAB grafts were related with significant volume loss from baseline to 6 months ($P = 0.03$) and to 12 months ($P = 0.002$) compared with Ba group.

Conclusions and clinical implications: The graft remodeling process was more evident in the FFAB group compared with Ba group. However, the graft resorption did not hinder implant installation. The implant installation at 6 months might explain the reduced bone loss in the FFAB group until 12 months postoperative.

This study was supported by the Sao Paulo Research Foundation (Fapesp)

296 | Topic – Tissue Augmentation and Engineering

Acceleration of extraction socket healing using bone repair cells (BRCs)

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Background: Bone repair cells (BRCs) are autologous bone marrow-derived cells expanded in a closed and automated single pass perfusion (SPP) system to concentrations not achievable in a simple bone marrow aspiration.

Aim: In this study, we investigated safety and efficacy of this novel cell therapy approach to treatment of orofacial bone defects.

Methods: This was a controlled randomized proof-of-concept clinical trial in which, 24 patients were randomly assigned to test or control group. The expanded cells adsorbed in a gelatin foam were implanted in the sockets after tooth extraction while the carrier alone was used in the control group. A collagen membrane was used to isolate the grafted defects. Bone core biopsies were harvested at the time of implant placement after either 6 or 12 weeks of healing. A clinical evaluation of the quality of the regenerated bone was performed using the Misch density scale. In order to analyze quality and quantity of the regenerated bone linear measures were taken on standardized digital radiographies (SDR) and bone volume fraction (BVF) and bone mineral density (BMD) were calculated on the micro-CT reconstructions of the bone core biopsies. Histological examination was also performed. All restored implants are being followed for 1 year after completion of the grafting procedure.

Results: Baseline clinical measures of the extraction sockets showed no significant differences between groups. Using the Misch scale measure a tendency for higher values in test vs.

control groups was noted. SDR measurements showed significantly ($\rho < 0.05$) more bone regenerated in the BRC group at 6 weeks as compared with the control group at the same time point. BVF and BMD measures also showed a trend for higher values in the treatment groups. Histological evaluation revealed formation of highly cellular and vascular mature bone as early as 6 weeks after implantation of BRCs. All patients exhibited regeneration of new bone enabling stable placement of dental implants. No serious study-related adverse event was reported.

Conclusions and clinical implications: The application of BRCs as a regenerative graft is safe for use in the correction of orofacial bony defects. The observations of this study demonstrate that BRCs accelerate the early stages of osteogenesis. Future research will examine the application of this innovative technology to enable predictable implant placement in more challenging oral and craniofacial osseous defects.

Study supported by NIH/NCRR UL1RR024986 and Burroughs Welcome Fund. NIH clinical trials database: NCT00755911.

297 | Topic – Tissue Augmentation and Engineering

Maxillary sinus augmentation with corticocancellous pig bone: histologic and histomorphometric analysis

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Background: Implant placement in the posterior maxilla may often be contraindicated because of insufficient bone volume and the presence of the maxillary sinus. In these situations, sinus floor lifting ang grafting frequently have been proposed as the best treatment. Corticocancellous pib bone (MP3 Osteobiol, Tecnoss, Torino) has been suggested to be used in maxillary sinus floor augmentation procedures before or in conjunction with implant placement.

Aim: The aim of his study was to analyze histologically the use a combination of autogenous bone and corticocancellous pig bone for maxillary sinus augmentation.

Methods: Biopsies were taken from a group of 16 consecutive patients 6 and 12 months after maxillary sinus floor augmentation with a mixture of MP3 (80%) and autogenous bone (20%) and prepared for histologic analysis.

Results: Light microscopy and morphometry from biopsies taken after 6 months showed various amounts of mineralized bone tissue. The specimen area was occupied by 54.1 ± 12.6% nonmineralized tissue, followed by 21.2 ± 24.5% lamellar bone, 14.5 ± 10.3% MP3 particles, and 10.2 ± 13.4% woven bone. The nonmineralized tissue seen in bone-forming areas consisted of a loose connective tissue, rich with vessels and cells. There were no signs of resorption of the MP3 particles. The lamellar bone appeared to have originated from the recipient site and was seldom in contact with the MP3 particles. After 12 months, the nonmineralized tissue area had decreased to 36 ± 10% ($P < 0.05$) and consisted mainly of bone marrow tissue. The surface area of lamellar bone had increased to 50.7 ± 22.8% ($P < 0.05$), and there was almost no immature bone. The mean specimen area occupied by MP3 particles was 12.4 ± 8.7% and had not changed from 6 months (not significant). Moreover, the sizes of the particles were similar after 6 and 12 months. The degree of MP3 particle-bone contact had increased from 28.8% ± 19.9% after 6 months to 54.5 ± 28.8% after 12 months ($P < 0.05$).

Conclusions and clinical implications: Histology of specimens from maxillary sinuses augmented with 80% MP3 particles and 20% autogenous bone showed a positive bone tissue response after 6 and 12 months after augmentation of the maxillary sinus floor before implant placement in a group of 16 patients. The bone surrounding and in contact with the MP3 particles after 6 months was mainly immature woven bone, which with time was replaced by mature lamellar bone filling the interparticle space as observed in the 12 months specimens. Moreover, bone-integrated MP3 particles seem to be resistant to resoption. The results indicate that the procedure may be considered when only small amounts of intraoral autogenous bone graft are available.

298 | Topic – Tissue Augmentation and Engineering

Clinical study of new bone substitute: α-TCP containing simvastatin

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Background: We have reported that α-TCP is biodegradable bone substitute exchanging to bone after being applied to bone defects. Although this material is osteoconductive and acts as a scaffold for bone regeneration, it does not stimulate bone formation. On the other hand, simvastatin, a therapeutical drug for hypercholesterolemia, stimulates BMP-2 expression in osteoblasts. In animal experiments we have already reported that combination with α-TCP and simvastatin is biodegradable bone substitute stimulating bone formation.

Aim: The purpose of the present study is to examine clinically efficacy of this combined material as bone substitute.

Methods: The present clinical study was approved by the institutional ethical committee. α-TCP particles of 0.5–0.7 mm diameters with micro-porous structure were used and the particles, which contained 4 mg simvastatin per 1 g particles were prepared. These particles were applied in the bone defects of 12 patients: two defects after implant removal, three fresh sockets after tooth extraction, six unhealed-defects, which were filled with connective tissues and one sinus for sinus floor elevation. The applied areas were periodically examined visually and radiographically. In one patient who received the material in his sinus, the tissue was harvested from the applied area 6 months after the application and histologically examined.

Results: In all cases there was neither local nor systemic adverse effect and the soft tissues of the applied areas healed normally. In radiographical images, the borders between the material and surrounding bone became indistinguishable gradually, which suggests degradation and exchange of the material to bone. The histological images obtained from the sinus, where

the material was applied, demonstrate the resorption of the material as well as new bone formation. In seven cases the dental implants were installed to the sites, where the material had been applied. In these cases hard cortical bone covered the previous bone defect, which enabled to stabilize the implants. During the 2 years follow-up after delivering the final prostheses, we did not observe any clinical problem.

Conclusions and clinical implications: The results of the present clinical study indicate that bone substitute of α-TCP containing simvastatin is an effective bone substitute especially for implant installation site. Combination of a bone substitute with a compound, which stimulates bone formation, would be a bone substitute of the next generation and our product is a potential candidate.

299 | Topic – Tissue Augmentation and Engineering

Regulation of Wnt signaling pathways during cell culture of hMSCs for efficient bone regeneration

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Background: Tissue engineering and bone regeneration techniques using mesenchymal stem cells (MSCs) have started to be applied to the field of oral and maxillofacial surgery including the dental implant surgery. Clinically, a shortened treatment time and improved efficiency are necessary because of the patients' needs and the running cost of cell culture. On the other hands, it has been revealed that Wnt signals play an important role in the proliferation and differentiation of human MSCs (hMSCs), but their effects to the conventional cultivation process of hMSCs have not been studied well until now.

Aim: In the present study, the cultivation process for human MSCs (hMSCs) was examined by regulating the Wnt signaling pathway.

Methods: Commercially available hMSCs were used in this study. We activated Wnt signaling with LiCl and inhibited Wnt signaling with sFRP-3 (secreted Frizzled-Related Protein-3). The proliferation of LiCl-treated hMSCs was examined by studying the cell growth rate and performing BrdU assays. Osteogenic differentiation of sFRP-3–treated hMSCs was examined by alizarin red staining, and osteogenic gene expression on days 7 and 14 after induction was examined by reverse-transcription polymerase chain reaction (RT-PCR) analysis and quantitative real-time RT-PCR analysis.

Results: LiCl-treated hMSCs showed increased cell numbers and BrdU-positive cells as compared with the untreated cells. Alizarin red staining showed early mineralization of hMSCs on day 7 of the sFRP-3 treatment. A high expression level of the alkaline phosphatase gene on days 7 and 14 of sFRP-3 treatment was also demonstrated.

Conclusions and clinical implications: These results suggest that the regulation of the Wnt signaling pathway contributes to the increased cell numbers and the early osteogenic differentiation of hMSCs. This study supports the possibility that the regulation of the Wnt signaling pathway during the cell culture of hMSCs contributes to the development of effective and efficient bone regeneration techniques.

300 | Topic – Tissue Augmentation and Engineering

Ridge preservation with bovine bone mineral coated with synthetic peptide corresponding to collagen binding domain of osteopontin

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Background: Following tooth extraction, alveolar ridge dimension reduce their original volume. The ridge preservation technique has been tested in many clinical studies with membrane alone or membrane plus graft, achieving positive results compared with extraction only.

Aim: The aim of the present clinical study was to compare the post-extraction dimensional changes following ridge preservation with deproteinized bovine bone mineral coated with synthetic oligopeptide plus collagen membrane or deproteinized bovine bone mineral plus collagen membrane.

Methods: Ridge preservation was performed in 44 extraction sites. In the test group, deproteinized bovine bone mineral coated with synthetic oligopeptide; Ossgen-X15® was packed into the socket. In the control group, deproteinized bovine bone mineral; Bio-Oss® was implanted into the socket. A collagen membrane; Bio-Gide® was trimmed to cover the socket completely and applied to the entrance of the socket in both groups. Four clinical parameters were compared between baseline and 6 months. In addition, histologic observation was done.

Results: At the re-entry, newly formed hard tissue was observed at the ridge preservation site. The grafted socket sites were well preserved in their volume dimension. In both groups, horizontal ridge width was reduced and vertical height was increased. There were no statistically significant differences in horizontal and vertical ridge change between two groups. From the histologic standpoint, newly formed bone and contact ratio between bone graft and new bone in the test group were higher than those in the control group.

Conclusions and clinical implications: In conclusion, the ridge preservation approach using bone mineral coated with synthetic oligopeptide corresponding to collagen binding domain of osteopontin in combination with collagen membrane effectively prevented resorption of hard tissue ridge after tooth extraction. Furthermore, the histologic analysis showed evidently new bone and mineralized tissue integrated with graft particles in ridge preservation sites.

Bone regeneration through a collagen carrier of melatonin. Histomorphometric and radiographic study in rabbits

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Background: The bone regeneration process constitutes one of the bases of research in the field of surgery. The application of melatonin allows qualitative and quantitative improvements, being the main drawback the bioavailability of it in the area. This point is fixed using a carrier of collagen. The basis of this research is to optimize properties of melatonin, extending its actuation time with the carrier.

Aim: Quantify the improvement of regenerative properties of melatonin in the bone when is increased the bioavailability trough its combination with a carrier of collagen.

Methods: Two tibiae of 20 New Zealand male rabbits were used. Premedication with atropine sulphate (0.3 mg/k, im), hidroclorure chlorpromazine (10 mg/k, im) and antibiotic prophylaxis: amoxicillin (0.1 mg/kg, im). Anaesthetic procedure with Ketamine hydrochloride (50 mg/kg, im). Infiltrative local anesthesia with articaine 1 : 100,000. Two holes in each tibia were prepared with 4 mm diameter trephine. The first defect was filled with collagen (R1), the second was cover by a collagen membrane (R2). In the other tibia, the first defect was filled with membrane and melatonin inside (L1) and a hole was used as control (L2). Randomly samples at 15, 30, 45 and 60 days where was collected: histomorphometric analysis of the new bone, length of covered defect, and radiological analysis by micro-TC. ANOVA test for independent variables and Bonferroni test were applied. $P < 0.005$ was taken as significative.

Results: L1 group showed higher values for all parameters examined. Of the histological analysis we had an evident increase of new bone, higher content of new bone for L1 in relation to the group without melatonin ($P < 0.005$). In the histomorphometric analysis the values for the closure of the created defect (%) were higher for L1 group ($P < 0.005$). For new bone, L1 showed better values in the group treated with melatonin and collagen at every times of this study ($P < 0.005$). With the micro-CT scan we obtain values for the volume of the graft location is 3.7 mm × 6.9 mm × 3.5 mm (0.089 cm^3) at beginning of work, and confirmation of the closure of the defect.

Conclusions and clinical implications: Melatonin application achieves an enabling effect of bone regenerative activity limited by their preservation time in the bone. The combination with a carrier of collagen gets these effects to be longer, and improve the bone regenerative process while membrane resorption time.

Primary interactions between enthothelial cells and titanium surfaces coated with linear and cyclic RGD-pepides

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Grant application: YES

Background: Interactions of endothelial cells (ECs) and osteoblasts are pivotal for bony healing.

Aim: The objective of this *in vitro* study was to evaluate the influence of structure (linear vs. cyclic) of cell adhesive peptides on short time EC adhesion and proliferation.

Methods: Gly-Arg-Gly-Asp (l-RGD and c-RGD) was chemically immobilized with wet chemistry to the surface of titanium. EC adhesion and proliferation on differently pretreated titanium surfaces (oxidized, silanized, linear and cyclic RGD peptide [each $n = 3$]) were evaluated after 24 h and 3 days via quantification of surface coverage of attached cells and Alamar blue assay.

Results:

	24 h	3 Days	Standard deviation (SD)
Cell adhesion measured in percentage of total surface			
Oxidized Ti	7	9	1.4
Silanized Ti	13	5	0.4
l-RGD Ti	26	10	0.2
c-RGD-Ti	16	20	1.7
Proliferation measured in fluorescence units (FU)			
Oxidized Ti	7	48	4.7
Silanized Ti	25	21	4.8
l-RGD Ti	22	72	21.5
c-RGD-Ti	37	119	23.6

Conclusions and clinical implications: The novel biomimetic coating of two forms of the RGD peptide on conventional titanium surfaces showed a positive effect on EC adhesion. L-RGD surfaces had a strong initial effect on EC adhesion but, after 3 days, c-RGD surfaces were leading in promoting EC growth. Within the limits of this study, modifications of titanium surfaces with c-RGD have been shown to be a promising approach in promoting endothelial growth.

303 | Topic – Tissue Augmentation and Engineering

The use of fresh-frozen allogeneic bone for sinus lift

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Background: Maxillary sinus floor augmentation have proven to be a treatment option for the placement of endosseous implants and consequent prosthetic rehabilitation of partial and total edentulous atrophic maxilla. At the present time, autogenous bone and xenografts are the most widely used graft materials alone or in combination whenever this type of procedure is indicated. The use of allogenous fresh-frozen bone (FFB) is not widely accepted by the dental community as a graft material for sinus floor augmentation. However, allogenous FFB presents several advantages such as availability, reduction of surgery time, decreased blood loss, and less morbidity.
Aim: The purpose of this study was to evaluate histologically and clinically the use of particulate FFB graft in maxillary sinus floor augmentation.
Methods: In a period of 24 months, 13 consecutive patients (median age of 42.5 years) were subjected to sinus membrane elevation using the lateral-wall technique followed by sinus floor augmentation with Muscle-skeleton Tissue Bank particulate FFB. After a 6-months healing period, a two-stage approach was used wherein 30 implants were placed into 18 FFB grafted sinuses, followed by prosthetic rehabilitation.
Results: In a period of 6 months, histological findings revealed that the particulate allograft was almost completely incorporated in viable bone allowing, thereafter, implant-supported rehabilitation.
Conclusions and clinical implications: This study indicates that allogenous FFB is a valid alternative for sinus floor augmentation. This type of grafting material lessens tissue morbidity as well as inherent risks of the autogenous graft procedures. The FFB graft presents good bone quality and showed to be adequate to support endosseous implants undergoing prosthetic functional loading.

304 | Topic – Tissue Augmentation and Engineering

Histomorphometry of human sinus floor augmentation using demineralized freeze-dried bone and deproteinated bovine bone powder

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Background: Bovine-derived bone xenograft and human demineralized freeze-dried bone (DFDB) have been well-accepted material for sinus floor augmentations, but few clinical studies in humans have been reported.
Aim: The purpose of this study was to evaluate the bone formation when sinus was augmented with Biocera® (Oscotec. Seoul, Korea) and DFDB mixture.
Methods: Eight patients were treated with sinus floor augmentation using Biocera® and DFDB with one to one mixture. After 9 months, grafted bone segments were taken through implant drilling site with 3 mm trephine drill. In the augmented area, bone formation was evident in all biopsies. Decalcified histologic samples were made from nine biopsy samples of six patients. Histomorphometric measurements were carried out in order to quantify bone augmentation. To get better information of graft particles into bone, five biopsy samples from two patients were immunohistochemically stained.
Results: The average bone volume formed in augmented sinus was 24.3% (± 5.6). Average soft tissue volume was 66.6% (± 9.5), and average graft material volume was 8.9% (± 6.7). There was no statistic difference between middle area (25.1 ± 8.7%) and apical area (23.6 ± 8.6%) in bone formation. ALP positive connective tissue cells were found in abundance around the graft particles, at a close distance from maxillary bony surface.
Conclusions and clinical implications: These histologic results indicate that the mixture of Biocera® and DFDB is an acceptable bone substitute material for augmentation of maxillary sinus. The bone formation seems to be active near crestal area compare with apical area.

305 | Topic – Tissue Augmentation and Engineering

The use of a connective tissue graft in interdental papilla reconstruction

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Background: The interdental papilla augmentation is one of the most demanding, but still least predictable procedures in periodontal plastic surgery. The loss of interdental papilla is associated with both esthetic and functional problems. Several soft tissue augmentation procedures have been proposed for papilla reconstruction, but no long-term data on their predictability and efficacy are still available.
Aim: The main objective of this study was to assess the predictability and the stability of the connective tissue graft (CTG) placed under a papillary-advanced flap for interdental papilla augmentation.
Methods: Seven consecutive systemically healthy non-smoking patients, 23–61 old (average 42), presenting the interdental papilla loss in the esthetic zone were enrolled in this study. After the initial therapy, the minimally invasive papillary flap was elevated and the CTG was placed underneath. The surgical area was sutured with 6–0 suture. Papilla presence index (PPI) was used in order to evaluate the papilla loss and the soft tissue

contour before surgery, as well as 3 months postop. The distance between the bone crest and the contact point was assessed at the baseline, as well as 3 months following the surgery.

Results: The mean PPI at the baseline was 3.7 ± 0.51. It decreased to 2.13 ± 0.45, 3 months following the surgery. The mean value for bone crest to contact point distance was 7.39 ± 0.56at the baseline.

Conclusions and clinical implications: The described procedure showed the satisfying interdental papilla increase 3 months following the surgery. It has to be mentioned that the procedure proved to be successful, due to the high baseline value of the bone crest to contact point distance. However, more long-term follow-ups and studies on this topic need to be done. PPI proved to be efficient and easy to perform papilla classification end evaluation method.

306 | Topic – Tissue Augmentation and Engineering

Randomized-controlled study of implants placed simultaneously into maxillary sinus grafts: Interim report

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Background: Augmentation of the maxillary sinus with a lateral approach and several months of healing before implant placement have proven to be an effective technique for restoration of sites in significantly resorbed maxillae. Simultaneous implant placement with sinus grafting surgery offers benefits to both the clinician and the patient by eliminating a surgical intervention leading to more timely prosthetic function. The approach, however, is challenging and few contemporaneous randomized-controlled studies are available with a wide range of success rates having been reported. It is plausible that the procedure is technique-sensitive and baseline variables may impact implant outcomes.

Aim: This prospective, multicenter, randomized-controlled study was designed to determine if implants placed simultaneously with maxillary graft augmentation have equivalent outcomes compared with implants placed after 4 months of graft healing.

Methods: Seven European centers have been involved in this study. Patients requiring either uni- or bilateral-sinus grafts with ≤ 5 mm of residual vertical bone height qualified for inclusion. Cases were randomly assigned to: simultaneous (test) cases in which implants are placed during sinus augmentation or delayed (control) cases in which grafts are allowed to heal for 4 months before implant placement surgery. All implants are the NanoTite Certain Prevail system and placed in a two-stage procedure with 4 months of submerged healing. Implant performance is assessed annually for 3 years.

Results: Ninety-six patients were enrolled having 144 cases treated with a total 311 study implants under evaluation of which 170 are test and 141 control implants. Following 12 months of observation, 23 implants were declared failures (92.6% survival) with a 94.3% survival rate in the control group and 91.2% survival rate in the test group.

Conclusions and clinical implications: Being that this is a randomized-controlled study, at the time of this interim report, the difference in success rates might reflect inherent technical challenges and clinical experience associated with the simultaneous approach, although the benefits are yet to be demonstrated pending a longer follow-up period. Furthermore, analysis of baseline variables, including initial and post-augmentation maxillary ridge dimensions, implant dimensions, and implant positions in the grafts may provide insight as to the conditions associated with treatment success.

307 | Topic – Tissue Augmentation and Engineering

Intraoperative cell-settlement (ICS) in clinical schedules for complex augmentations of the jaw (CAJ)

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Background: Osteogenic induction is regarded as an indispensable step for complex augmentations of the jaws (CAJs). The traditional methods by harvesting large corticocancellous bone grafts (CCBGs) often meet clinical needs but is attended by painful load for the patient in postoperative healing process and donor site morbidity.

Aim: For *in situ* regeneration, integration of cell seedings and bioactive factors by ICS in the CAJs may promote tissue regeneration and restoration of function in the maxillary and mandibule jaw.

Methods: Patients undergoing CAJs by harvesting large CCBGs from anterior or posterior iliac crest were treated by integrated cell harvest and concentration of bone marrow cells. Harvest of cells and concentration took place as ICS in accordance with the national transplantation law (Transplantationsgesetz, 1.12.1997, rev. 4.9.2007). Bone marrow was harvested by intraoperative aspiration of cells of the iliac crest donor site from 20 to 60 mL. Concentration took place under sterile conditions with a closed sterile or open sterile bench technique.

Samples of cells were counted before and after concentration by *in vitro* expansion in human mesenchymal stem cell (hMSC) medium by an adherence expansion technique. HMSCs were identified by clinical routine of FACS-analysis, proof of cell surface

positivity for CD-105,-29,-90,-73 and negative results for CD-45,-14,-34,-19, 7-AAD und HLA-DR.

Clinical results were compared with controls (patients treated without ICS). Considering homogeneity of variances by Levene statistics, one-way analyses of variance (ANOVA) and Scheffe tests or Tamhane tests, where appropriate, were performed in order to reveal significant influence.

Results: The clinical routine of harvesting CCBGs for CAJs may supplemented by intraoperative cell harvest, concentration and ICS of bone marrow cells without additional donor site morbidity. The harvested cells are detectable with typical surface characteristics of quiescent hMSCs. Cell concentration techniques allow a higher density of cells in the range of factor 2–10. Clinical experiences with this ICS techniques showed, that CCBGs have less post-transplantation loss by bone resorption and a higher quality of bone while preparation of dental implant adit ($P = 0.02$).

Conclusions and clinical implications: Although ICS with concentrated hMSCs integrated in CAJs with CCBGs is large-scaled and a procedure with high additional costs, it may provide a technique for *in situ* regeneration of the jaw by an osteogenic inductive approach. The proof of less resorption in the post-transplantation-phase before dental implant insertion may allow harvesting minor sized CCBGs to reduce donor site morbidity in the near future.

308 | Topic – Tissue Augmentation and Engineering

Ridge preservation following tooth extraction using an autologus bone graft

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Background: Healing process following tooth extraction usually occurs with substantial reduction of the original height and width of the alveolar bone, which in some cases may aesthetically compromise an implant, supporting prosthetics. Several studies have proposed various ridge preservation techniques following tooth extractions, including placement of different graft materials and/or use different techniques to cover the extraction socket entrance.

Aim: To evaluate dimensional alterations of the alveolar ridge that occurred following autologus bone graft placement in fresh extraction sockets.

Methods: Sixteen patients who required extraction of maxillary frontal teeth or premolars and implant replacement were enrolled in the study.

Sulcular incision and two vertical incisions were performed in selected area and full thickness mucoperiostal flap was elevated. The tooth was carefully extracted.

Standardized clinical measurements of the alveolar socket depth and width were performed using UNC periodontal probe.

Following clinical measurements were taken:

1. Internal vertical dimension (IVD, alveolar socket depth) – the distance from the bottom of the socket to the alveolar crest. After taking this measurement, titanium pin was placed in the most apical part of the bucal wall of the extraction socket to serve as fixed reference points for following clinical measurement.
2. External vertical dimension (EVD) – the distance from the titanium pin to the alveolar crest.
3. Horizontal dimension (HD) – the distance from the vestibular to oral alveolar crest.

Sockets were filled with the grafting material (autologus bone graft). VIP CT Flap (Vascular Interpositioned Periosteal Connective Tissue Flap) was used to achieve soft tissue closure.

Reentry surgeries were performed at 4 months. After obtaining clinical measurements (IVD, EVD, HD) pins were removed and endoosseus implants were placed.

Results: The differences between the values recorded at the baseline examination and at 4 months later were found to be statistically significant in all observed parameters The measurements were expressed using mean values and standard deviations (paired t-test, P-value < 0.05, statistically significant). The mean changes of EVD showed that there was a resorption of the alveolar crest of 1.86 ± 1.49 mm ($P = 0$), the mean changes of IVD were 7.21 ± 1.39 mm ($P = 0.001$). Furthermore, treated sites had lost 2.53 ± 1.34 mm bone width in average ($P = 0$).

Conclusions and clinical implications: This study suggests that treatment of extraction sockets with autologus bone graft combined with VIP CT graft is beneficial in preserving alveolar ridge dimensions following tooth extraction.

309 | Topic – Tissue Augmentation and Engineering

Supra-implant bone augmentation: the buried implant. Options in terms of the tissuecare concept

Presenter: Hanser T
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Background: Recent clinical studies indicate that implants with a reduced prosthetic table for platform-switching in combination with a tapered, conical implant-abutment connection may prevent peri-implant bone loss and improve long-term clinical appearance. Furthermore this implant design allows subcrestal implant placement making bone apposition on a microstructured implant shoulder possible.

Aim: The presentation reports the preliminary results of a study evaluating the clinical performance of implants, which were placed subcrestally and additionally completely covered with bone, to gain additional vertical bone volume and to actively create bone apposition on the complete implant shoulder.

Methods: One hundred and five Ankylos® (Dentsply Friadent, Mannheim, Germany) were consecutively placed between 2007 and 2008 in the maxilla and mandible either in local bone, with concomitant or following bone grafting procedures. Sixty-two implants were placed in the maxilla and 43 in the mandible. All

implants were placed 1–1.5 mm subcrestally and completely covered with bone. The bone to cover the implants was generally harvested with a trephine drill (Dentsply Friadent, Mannheim, Germany) during the implant site preparation. Irrespective of the implant localization second-stage surgery occurred after 3 months and implant restorations were functionally loaded. Standardized radiographic assessment was made after implant-prosthetic incorporation and consecutively every 6 months.

Results: After a follow-up of 12–18 months (average 15.3 months) no implant failed. To remove the cover screw during the second-stage surgery, 3 months after implant placement, the center of the implant was sounded with a dental probe, penetrating the bone, which was covering the implant. The cover screw was then pulled out with the Ankylos® cover screw remover (Dentsply Friadent, Mannheim, Germany). Because of the tapered, conical implant-abutment connection, the sulcus former could be placed without removing the bone covering the implant shoulder and surplus bone could simply be pushed aside by screwing down the sulcus former. After 1 year of implant loading standardized radiographs demonstrated more than two-thirds of the implants showing continuous bone apposition on the implant shoulder to the abutment.

Conclusions and clinical implications: The data and the experience described of this 18 months preliminary analysis indicate that covering implants with bone after subcrestal placement in combination with platform-switching and a bacteria-proof connection enables a predictable, stable and active bone apposition on the implant shoulder to the abutment. The technique is easy to perform as the bone to cover the implant is harvested during the implant site preparation. The supra-implant bone augmentation seems to enhance the bone growth on the implant shoulder, thus improving peri-implant vertical bone volume, bone retention and tissue stability.

310 | Topic – Tissue Augmentation and Engineering

Socket preservation with beta-tricalcium phosphate and type I collagen

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Background: The bone healing at the extraction sites proceeds with external resorption and remodeling of the original socket walls with varying degrees of dimensional changes in both height and width of alveolar ridge. Therefore, preservation of extraction socket dimensions has been attempted immediately following tooth extraction. Beta-tricalcium phosphate (β-TCP) has been shown to be resorbable and simultaneously capable of supporting new bone formation. Furthermore, bony regeneration has been reported with β-TCP without the use of a barrier membrane in patients undergoing sinus floor elevation and mandibular cyst removal.

Aim: The aim of this study was to investigate the healing of human extraction sockets filled with beta-tricalcium phosphate and type I collagen (β-TCP/Clg) cones with or without a barrier membrane and flap surgery.

Methods: Twenty patients were divided in two groups: A) β-TCP/Clg treated sockets not covered with a barrier membrane and with a mucoperiosteal flap; the β-TCP/Clg and socket opening were left to heal spontaneously; and B) β-TCP/Clg covered with a barrier membrane and a mucoperiosteal flap. All patients were examined at days 3, 5, and 7, then at 4 and 9 months postoperatively. Clinical characteristics of the grafted area, as well as biopsies from the grafted sites were collected 9 months later. Bone samples were analyzed using histomorphometry. A paired Student t-test was used for the analysis of the alveolar ridge changes and histomorphometry. ANOVA was used for the analysis of the clinical characteristics at the grafted sites. Comparisons were considered significant at $P = 0.05$.

Results: All extraction sites healed uneventfully with the complete epithelial socket closure of non-membrane group in 3 weeks. The horizontal dimension of the alveolar ridge was significantly reduced 9 months after the socket preservation in the non-membrane group in comparison with the horizontal dimension before treatment. There was a solid bone formation without significant difference between the groups in the area occupied by new bone (A = 42.4%; B = 45.3%), marrow (A = 42.7%; B = 35.7%) or residual graft (A = 9.7%; B = 12.5%).

Conclusions and clinical implications: Both membrane and non-membrane groups exhibited similar potential for bone healing and demonstrated sufficient amount of the vital bone to support dental implant placement after 9-months healing period. Further investigations of β-TCP/Clg for the socket preservation to evaluate the alveolar dimensions and a quality of a new bone for the healing period less than 9-months would be of interest.

311 | Topic – Tissue Augmentation and Engineering

Balloon-assisted sinus floor elevation (BASFE) – preliminary results

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Background: Sinus floor elevation is since 1985 a major part in the treatment of the atrophic posterior maxilla. Common techniques like the direct (DSFE) and the indirect sinus floor elevation (ISFE) show a very high success rate of approx 90% within their limits. A possible reason for failure is violation of the schneiderian membrane. This anatomical structure can

reliably be preserved by the use of a fluid filled balloon as shown in cadaver studies. Furthermore, the augmentation volume can more precicely be predicted using the balloon technique.

Aim: The aim of this preliminary study was to proof the concept clinically.

Methods: Eight patients were treated with the BASFE. The vertical bone height as well as the mesio-distal dimension in the posterior maxilla was measured pre- and postoperatively. The balloon volume and the operation time were recorded. Membrane perforation was controlled by valsava maneuver and saline rinsing test. Clinical examination was performed 1, 5 and 10 days postoperatively.

Results: The average preoperative bone height was 3 mm (SD ± 1.39 mm), postoperatively 14 mm (SD ± 3.72) and the mesio-distal bone dimension was 12.5 mm (SD ± 2.12 mm). The average balloon volume was 13.5 cc (SD ± 3.27 cc). The average operation time was 12.5 minutes (SD ± 0.49 minutes). No rupture of the membrane was detected. Seven of eight patients had no pain, no swelling or signs of an inflammation at any time of the examination. One patient showed signs of an infection like swelling and pain after 5 days, which was successfully managed by antibiotic treatment.

Conclusions and clinical implications: This preliminary study demonstrated a reliable clinical use the BASFE. A sufficient and predictable bone dimension was created for an implant treatment without perforation the schneiderian membrane. Although the BASFE as a minimally invasive and fast technique with a predictable bone dimension and the postoperative comfort for the patients, the system is not a replacement for the common techniques. The BASFE is an additional procedure to the DSFE end ISFE. Although the technique is easy a high level of surgical skills and a special training is recommended. Further long-term studies are necessary.

312 | Topic – Tissue Augmentation and Engineering

Success rate of dental implants inserted in GBR or ONLAY graft regenerated areas: a systematic review

Presenter: Clementini M
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Background: Many different techniques have been developed to reconstruct deficient alveolar jaws where otherwise the placement of dental implants would not be possible.

Aim: The present systematic review was carried out to assess the success rate of implants placed in atrophic ridges, augmented either by means of guided bone regeneration technique or by means of block bone grafts.

Methods: A systematic review of all prospective and retrospective studies analyzing the success rate of implants inserted in GBR or ONLAY graft regenerated areas, compared with implants placed in pristine bone, was performed. To be included, studies had to involve at least five consecutively treated patients and to report clearly specified success criteria. It was also necessary a minimum follow-up period of 6 months, to allow the observation of potential biological complications during function, rather than early implant failures. In order to assess the success rate of implants in terms of health of periimplant tissues, implant stability, osteointegration and bone resorption, studies reporting only the survival rate of implants were excluded.

Results: From 323 potentially relevant studies, 97 full-text publications were screened and 16 were identified as fulfilling the inclusion criteria. The success rate of implants placed in GBR augmented ridges ranged from 61.5% to 100%, with all the studies but two, reporting a success rate higher than 90%. The success rate of implants placed in onlay graft regenerated ridges ranged from 72.8% to 97% after follow-up periods ranging from 6 months to 10 years, with all the studies but two, reporting a success rate higher than 84%.

Conclusions and clinical implications: The obtained data demonstrated that the success rate of implants placed in regenerated areas are very similar to those obtained in case of implants placed in pristine bone, and suggested that guided bone regeneration and onlay graft augmentation represent quite predictable techniques to allow the placement of implants in atrophic areas. Despite that, the current review revealed that there are not many studies providing data on the success rate of dental implants placed in augmented ridges and demonstrated, on average, a poor methodological quality. So randomized controlled studies adopting standardized criteria to define success and failure of implants are required and data from this review must be considered indicative.

313 | Topic – Tissue Augmentation and Engineering

Increased peri-implant osteogenesis by injectable hydrogel coupled with rhBMP-2 and mesenchymal stromal cells

Presenter: Pan H
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Background: Coupling with growth factor or stem cells recently becomes an alternative to enhance peri-implant bone formation. Among delivery systems of these factors, hydrogel is increasingly considered as an efficient scaffold for tissue regeneration, especially, its swelling property may act advantageously in implant dentistry for enhancement of peri-implant poor bone quality.

Aim: The purpose of present study is to verify whether injectable, *in situ*-forming hyaluronic acid-based hydrogel (HA-Hy) can infiltrate and disperse recombinant human bone morphogenic protein-2 (rhBMP-2) and/or human mesenchymal stromal cells (hMSCs) into neighboring tissue, resulting in increased-peri-implant bone quality.

Methods: Titanium implants was placed after injection of *in situ*-forming (1) HA-Hy alone, (2) HA-Hy + BMP-2, (3) HA-Hy + hMSCs, (4) HA-Hy mixed with rhBMP-2andhMSCs, (5)

implant alone (control group) in rabbit tibia and canine mandible model. New bone formation was histomorphometrically determined by bone area in whole bone marrow area (BA1) and in inter-screw area (BA2) and bone-implant contact (BIC) along implant surfaces at 2 weeks after implantation.

Results: HA-Hy + rhBMP-2 + hMSCs mixture group showed a highest increase in BA1 (27.4%, 69.4%), BA2 (38.5%, 58.2%) and BIC (32%, 43.8%) compared with other experimental groups (both $P < 0.0001$) in rabbit and canine model. HA-Hy alone (9.2%, 55.3%) could increase in BA1 compared with the control group (2.7%, 43.7%) (both $P < 0.05$)The addition of rhBMP-2 alone resulted in significantly increased BA1 (15.7%, 59.1%) (both $P < 0.05$) and BA2 (21.7%, 47.2%) ($P < 0.05, < 0.01$) compared with the control group (BA1: 2.7%, 43.7%, BA2: 5.4%, 29.8%), while HA-Hy + hMSCs could increase only in BA2.

Conclusions and clinical implications: These results suggest that injectable, *in situ*-forming HA-Hy can stimulate stem cells in bone marrow by its swelling property, and it can be an effective delivery system for rhBMP-2 and/or hMSCs, leading to enhanced peri-implant new bone formation.

314 | Topic – Tissue Augmentation and Engineering

Evaluation of vertical bone formation using recombinant human BMP-2 and rapid prototype titanium cap in rabbit calvaria

Presenter: Kook M-S
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Background: In atrophic maxilla and mandible, the augmentation of the alveolar ridge is standard treatment procedure for dental implant installation. This ridge augmentation procedure includes autogenous block bone graft, guided bone regeneration and alveolar distraction osteogenesis. BMP as bone additive material were previously reported. The various study of bone formatin by BMP in vertical guided bone regeneration is needed.

Aim: This study was aimed to assess the effect of rhBMP-2 and β-TCP on new bone formation in the rabbit calvarium using rapid prototype (RP) titanium cap.

Methods: In eight New Zealand white rabbits, calvaria was exposed to make round groove to fit the hemispherical RP titanium cap (1 cm in diameter). Control group was filled with β-tricalcium phosphate (β-TCP), and experimental group was filled with rhBMP-2 soaked β-TCP. The rabbits were sacrificed after 2 weeks and 4 weeks of healing. The percentage of new bone formation was calculated from the micro-CT images.

Results: 1. In control group, relatively small amount of new bone formation were observed at 2 week (6.56 ± 1.6%). The control group showed increased new bone formation in 4-week group (7.17 ± 1.54%) than 2-week group, but there are not statistically different.

2. In experimental group, more amount of new bone formation was observed at 4-week group (14.1 ± 1.76%) than 2-week group (8.55 ± 1.42%), and there is statistically difference ($P < 0.05$).

3. In experimental group, amount of new bone was more than the control groups at 2- and 4-week group, respectively. In 4-week group, there are statistically difference between the experimental group and the control group ($P < 0.05$), but in 2-week group, there are no statistically difference between the experimental group and the control group.

4. Micro-CT images showed that new bone was formed from the calvaria to the top of the titanium cap in β-TCP and BMP treated group, following along the surface of the titanium cap. The trabecular pattern was observed in newly formed bone.

Conclusions and clinical implications: These results suggest that RP titanium cap can guide new bone formation of β-TCP and rhBMP-2 effectively.

315 | Topic – Tissue Augmentation and Engineering

A comparison of two techniques to relapse in alveolar distraction osteogenesis for dental implant of mandible: the time of implant placement

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Background: Vertical alveolar distraction osteogenesis is an efficient method for augmentation before inserting dental implants. But a relapse of the transport segment and decrease in bone height before implant placement is common.

Aim: In this study, we evaluated this alveolar distraction osteogenesis before implant placement, investigated the relapse in bone height. And we determined the overcorrection in alveolar distraction osteogenesis, period of implant placement.

Methods: The subjects were 32 patients, ranged in age from 27 to 55 years with the defect of the mandible (11 males and 21 females). In all cases we treated by vertical alveolar distraction osteogenesis. Active distraction was started after a latency period of 3 days with a rate of 0.5 mm twice daily. After the end of alveolar distraction osteogenesis, length of consolidation was 3 months, and distractors were removed. Bone height was and measured on digital orthopantomographic radiographs, after distraction, before implant placement and 1 month after implant placement.

Results: Mean alveolar distraction was 13.5 mm 1 month before distractor removal, 10 patients were performed implant placement (Group A). The mean relapse was 15% (6% to 21%) at implant placement. On the other hand, 22 patients were performed distractor removal and implant placement at the same time (Group B). The mean relapse was 26% (17% to 34%) after the end of consolidation, at implant placement. About both group, the relapse was a little 1 month after implant placement, the mean relapse was 1%.

Conclusions and clinical implications: The vertical alveolar distraction osteogenesis before dental implant placement is very useful but a considerable relapse must be confronted. This study indicated that implant placement performed before distractor removal if possible.

316 | Topic – Tissue Augmentation and Engineering

Bone regenerative capacity of hyaluronic acid applied PLGA membranes

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Background: Various types of membranes have been clinically used in guided bone regeneration, and the use of HA has been suggested.

Aim: The objective of the present study was to evaluate biocompatibility, absorption period, and bone regeneration capacity and investigate the clinical usefulness of hybrid typed new membrane, produced by applying hyaluronic acid on PLGA.

Methods: On calvarias of 12 rabbits, four penetrative bone defects of 6 mm in diameter were created and on each of the defects, a selected membrane from no-membrane (NM), collagen membrane (Ossix™)(C), PLGA (P), HA-coated-PLGA (HCP), HA-PLGA/PLGA (HPP) was applied, and bone formation capacity (BV/TV) and bone density (gray scale) were compared and analyzed. Demineralized specimens were prepared and histologically analyzed to comparing the effect of the membrane developed in this study and that of the existing membranes.

Results: In histological findings, no inflammatory reaction was shown regarding absorption in all the membranes used in this study, and the membranes were maintained until the 12th week in-group C. The membranes were completely absorbed after 8 weeks in-group P, and after 12 weeks in-group HCP and HPP. At the 12th week, the cortical bone plates were formed above the bone defected area in-group HCP, and above and below the bone defects in-group P and group HPP.

In micro-CT examination, bone formation capacity of group HCP was increased by 6.83% compared with group C and by 2.3% than group P after 4 weeks. It was increased by 6.27% compared with group C and by 2.9% than group P after 8 weeks, and by 12.27% compared with group C and by 4.77% than group P after 12 weeks. Gray scale was increased by 3.11% compared with group C after 4 weeks, by 63.26% than group C and by 66.53% compared with group P after 8 weeks, and by 87.48% compared with group C and by 44.64% than group P after 12 weeks.

Conclusions and clinical implications: From the results above, it was thought that HA applied PLGA membrane could be used effectively as a barrier film in guided bone regeneration.

317 | Topic – Tissue Augmentation and Engineering

Anatomic research of the Arteria genus descendens for microvascular transplants of the distal femor for augmentation

Presenter: Virnik S
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Background: One of the basic aims of Oral and Maxillofacial Surgery is functional reconstruction of the stomatognathic system. The reestablishment of swallowing, chewing, articulation, and aesthetics after tumour surgery, in case of traumatic defects or highly atrophic jaw are crucial. Autologous, allogenic or alloplastic materials can be used depending on the defect size and morphology. Also free, pediculated or microvascular reanastomosed transplants are used in common. It is not just the degree of the defect that determines the choice of the transplant for reconstruction or augmentation. Even a minor affected defect site that has been damaged by radiotherapy and chemotherapy, multiple surgical treatments or severe trauma, requires microvascular transplants. Surgeons can choose from a wide range of transplants but adjusting the transplant precisely to the according defect, especially to minor defects. Therefore in many cases the main idea is to keep the transplants vascularised and to prefer over dimension first avoiding pedicle damage.

Aim: The main aim of this cadaver study is a systematic examination of the vascular anatomy of the femur transplant. Arterial vascularization of the transplant is made by the descending genicular artery, which is a branch off the femoral artery running out of the adductor channel.

Methods: This study 50 cadavers have been investigated

Results: In 80% of all cases, the descending genicular artery has two further branches.

One of them is the articular ramus (which emitters muscular and periosteal branches and is responsible for vascularisation of the distal medial femur – together with patellar rate). The second branch is the saphenus ramus, which provides the skin in the medial knee region.

It means that a combined osteo-musculo-cutaneous or osteo-cutaneous transplant with one common pedicle can be harvested. Therefore only one arterial and venous anastomosis has to be done for this compound flap.

The length of the descending genicular artery results in an average of 3.2 cm, the saphenus ramus in 7.18 cm and the articular ramus in an average of 6.72 cm. That means that the pedicle of the medial osteoperiosteal femur flap is about 10 cm. Therefore anastomosation and subsequently sufficient blood supply should be achieved without anatomical problems.

In 20% the saphenus ramus branches off from the femoral artery itself as an independent vessel. In these cases the length the saphenus ramus results in an average of 7.18 cm and the descending genicular artery in an average of 10.2 cm.

Conclusions and clinical implications: In conclusion it can be stated that the femur transplant meets all demands for a flap to

cover medium or minor defects. The flap is suited for clinical examination and use in reconstructive Oral and Maxillofacial Surgery.

318 | Topic – Tissue Augmentation and Engineering

The UCLA esthetic analysis: a new tool for the esthetic assessment of the anterior maxilla

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Background: The phenomenon of osseointegration discovered by Professor Brånemark in 1965 has revolutionized the world of implant dentistry. A variety of indications for dental implants were developed to support removable and fixed prosthetic reconstructions. Initially, the goal was to rehabilitate deficiencies of the oral cavity and restore function, but as the use of dental implants in esthetic areas increased, the patient's esthetic demands also increased. Several objective analyses have been proposed in an attempt to quantify ideal esthetics for the anterior maxilla. These include: PES (Pink Esthetic Score), PES/WES (PES/White Esthetic Score), Complex Esthetic Index (CEI), and several studies on gingival contours and gingival zenith positions.

Aim: The aim of this study is to present a new analysis for the esthetic assessment of the anterior maxilla.

Methods: Utilizing an intra-oral photograph in maximum intercuspation (MIP), the UCLA Esthetic Analysis uses the *maxillary canines* as reference points and draws 3 horizontal lines: (1) Gingival Margin Line, (2) Mesial Papilla Line and (3) Cusp-Incisal Line. Utilizing the PowerPoint® software available in any desktop computer, the lines are drawn and the cusp tips of the canines are connected. Discrepancies with hard and soft tissues, proportions and tooth positions become easily apparent. The image can be printed and utilized at the time of consultation.

Results: The UCLA Esthetic Analysis is a simple, reproducible and cost-effective tool that allows us to pin-point four key points:

1. Balance and Harmony of hard and soft tissues
2. Tooth positions and shapes/contours
3. Deficiencies in crown ratios
4. Deficiencies in soft tissue contours, papillae volume/height.

Conclusions and clinical implications: The UCLA Esthetic Analysis is a new tool for the esthetic assessment of the anterior maxilla. It is a reproducible, simplified analysis that can be carried out by a single operator. It is user-friendly and does not require any additional software programs or instrumentation. It can be used as a diagnostic, educational and documentation tool to assist in determining proper treatment protocols and sequencing.

319 | Topic – Tissue Augmentation and Engineering

Onlay alveolar bone grafting with simultaneous implant placement: case report

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Background: Strategies to increase alveolar vertical dimension include, onlay block grafting, interposition alveolar bone grafting, sinus lifting, and alveolar distraction osteogenesis.

It is well known that maintaining alveolar vertical augmentation is difficult as relapse and resorption are common.

Aim: This poster presentation aims to present a treatment strategy that allows simultaneous vertical ridge augmentation and dental implant placement in selected cases.

Methods: A 22-year-old man presented with a missing upper right canine that had been surgically removed 1 year ago. The resulting defect had been augmented with a right ramus buccal shelf block as the patient had opted for dental implant placement.

Clinical and radiographic examinations showed a remaining vertical ridge defect of about 7 mm. An informed consent was taken for ridge augmentation and if possible simultaneous dental implant placement. Under local anaesthesia the alveolar bone in the upper right canine area was exposed. Measurements of the buccopalatal width of the bony ridge and the vertical bone loss were done. Initially an osteomy for a 4 mm Astra Tech implant to a depth of 10 mm was prepared in the receiving site that was type 1 quality bone. Later the mandibular symphisis was exposed via a conventional vestibular incision. A fissure bur was used for the osteotomy and before mobilization of the block an implant site was prepared in the middle. The symphisis block graft was mobilised, trimmed as appropriate and rigidly fixed to the receiving site by a 4 15 mm Astra Tech implant. The alveolar ridge was grafted horizontally with Straumann bone caramic, no membranes were used. A posteriorly based palatal flap was rotated for primary healing.

Results: Healing was uneventful. Clinical and radiographic examinations 6 months post-operatively, confirmed healing. The thick keratinized gingiva at the receiving site required a gingivoplasty during the placement of the healing screw. Restoration was completed and the patient was satisfied with the end result.

Conclusions and clinical implications: This strategy can be safely utilised providing the receiving site is type 1 or type 2 quality bone, to achieve a rigid fixation of the graft and a good primary stability of the implant. Using trephine burs to harvest bone blocks will allow improved positioning of the implants.

This technique saves an extra operation and allows 2–6 months of early delivery of the restoration compared with a two-stage procedure.

320 | Topic – Tissue Augmentation and Engineering

Autogenous block bone grafts and platelet-rich fibrin (PRF) for the augmentation of the anterior atrophic maxilla

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Background: Patients with excessive bone loss in the anterior maxilla often need vertical and horizontal bone augmentation before dental implant installation. A variety of materials and surgical techniques are available for bone augmentation. Autologous block bone grafts are one of the well-documented options. Autologous block grafts can be covered with a resorbable membrane to avoid undesired cell migration. Platelet rich fibrin (PRF) is a biomaterial that is part of a new generation of platelet concentrates. It was a specific technique for oral and maxillofacial surgery.

Aim: The aim of this case presentation is to evaluate the use of autologous block bone grafts in conjunction with PRF in the treatment of vertical and horizontal augmentation in the anterior maxilla.

Methods: A 47-year-old patient was referred to the Istanbul University Faculty of Dentistry Department of Oral Implantology for implant placement in the left first incisor site. After clinical and radiological examination, horizontal and vertical deficiency of the alveolar crest was seen because of the traumatic tooth extraction. The PRF membrane was prepared with the directions of the manufacturer by blood taken from the antecubital vein of the patient. Firstly, the recipient side was prepared by using full thickness periostal flap, than the block graft was taken from the ramus region. After shaping properly the graft was fixed to the recipient side. The PRF membrane was placed over the graft. The site was primarily closed using three silk sutures. After 4 months the grafted area was exposed and the microscrews removed. 3.3 mm in width and 12 mm in height dental implant (Straumann Bone Level, Switzerland) was placed.

Results: No complications were observed during healing period. Three months later from the dental implant surgery, the healing abutment was placed. After shaping peri-implant soft tissues with using temporary abutment, the permanent crown was placed.

Conclusions and clinical implications: The result suggests that block autograft in conjunction with PRF can be used in treatment of maxillary alveolar ridge deficiencies to allow subsequent implant placement in ideal position. Histological evaluation may be helpful to verifying this outcome.

321 | Topic – Tissue Augmentation and Engineering

Comparison between different autogenous intra – oral bone graft techniques

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Background: As many authors refers (Clavero J, Lundgren et al.), the placement of endosseous implants in edentulous areas is frequently limited by inadequate bone volume of the residual ridge. Local bone graft from the mandible is a convenient source of autogenous bone for alveolar reconstruction before implant placement.

Aim: This randomized, clinical study want to compare the efficacy of bone autograft harvested by means of different techniques.

Methods: This study was conducted with histological investigations on five preparations from five different patients. Grafts procedures were performed in the Department of Oral and Implant Rehabilitation, University of Milan. The different techniques used were: Bone Scraper (Safescraper; Meta, Reggio Emilia, Italia); Rosette bur (Astra Tech Molndal, Svezia), made with stainless steal, with 1.8 mm of diameter on handpiece (1000 round/min); Implant Spiral bur (Astra Tech Molndal, Svezia), made with stainless steal, coated with titanium nitrate, with 2 mm of diameter on handpiece (800 round/min); Piezoelectric system (Esacrom Surgysonic, Imola, Italia); Trephine bur (TRE 02; 3i, Palm Beach Gardends, FL) on handpiece (1000 round/min). The samples were observed to the optical microscope. With an istomorphological analysis on the microscope photographs it was possible to determinate the best graft procedures in terms of quantity (dimensions of the individuals fragments) and quality (vitality of the individuals fragments).

Results: The best results, in terms of quantity and quality of the graft bone, were obtained by Trephine bur and Safescraper.

Conclusions and clinical implications: Authors consider all the techniques appropriate for the autogenous intra – oral bone graft. Only with the continuation of this study and the improve of the samples this results will be significant from a statistical point of view.

Effect of rhBMP-2 incorporated in porous hydroxyapatite on bone quality and bone volume in canine jawbone defect model

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Background: Even though recombinant humanBMP-2 (rhBMP-2) induces relevant bone formation, an adequate carrier with slow releasing is needed for its effective osteogenesis. And it is well known that rhBMP-2 can stimulate new bone formation in bone defect area, its effect on bone quality and quantity is not yet well known. Moreover, it is not clear whether rhBMP-2 can increase bone mineral density (BMD) of neighboring natural bone.

Aim: Hydroxyapatite is one of most frequently used grafting materials. The aim study is to evaluate hydroxyapatite as a carrier for rhBMP-2, and to investigate the effect of rhBMP-2 on increasing bone quality and volume (BV) at osseous defect area and adjacent natural bone.

Methods: Three alveolar bone defects with half-cylinder form (8 mm in diameter, 5 mm in depth) on both side of mandible and maxillary sinus elevation model were used in canine ($n = 7$). Alloplastic, particulated HA incorporated with rhBMP-2 (5, 20, 80 μg for mandible, 80 μg for maxilla) was filled into bone defects and maxillary sinus cavity on the left side, while HA without rhBMP-2 was filled on the right side. Four weeks after bone grafting, animals were sacrificed, and micro CT and histological analysis was performed in all specimens.

Results: In micro-CT analysis, the total volume and new BV was increased for 22% and 29% in 5 μg (both $P > 0.05$), 62% and 64% in 20 μg (both $P < 0.05$), and 93% and 96% in 80 μg rhBMP-2 (both $P < 0.05$) in mandible, and for 97% and 130% in 80 μg rhBMP-2 (both $P < 0.05$) in maxilla, compared with the control group, while BMD all groups showed no differences compared with the control group. BV and BMD in neighboring natural bone were not increased in all rhBMP-2 groups. In the histomorphometry, new BVs in all rhBMP-2 groups were significantly greater ($P < 0.01$) than the control, while BV showed no difference between rhBMP-2 groups.

Conclusions and clinical implications: HA incorporated with rhBMP-2 could effectively increase new bone formation, and it can be used for a carrier of rhBMP-2, thus, an osteoinductive alloplastic material in jawbone defect. However, rhBMP-2 could not increase in BV and BMD in non-osteoporotic natural bone.

Use of autogenous and alloplastics bone substitutes for repair of bone defects. Histometric and immunohistochemical analysis

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Background: The bone presents high regeneration capacity could restore his structure and function completely. However, in some situations, due to the size of the defect, the bone tissue is not repaired for complete. In the attempt of minimizing those limitations mainly in cases of bone tissue of low quality, the autogenous bone grafts, heterogenous, homogenous and synthetic bone substitutes are used.

Aim: The aim of this study was to analyze through analysis histometric and immunohistochemistry the repair process in defects surgery created bone in cranium of rabbits filled out with clot, autogenous bone and cement of carbonate-phosphate of calcium (Norian®).

Methods: Ten adult male rabbits (*Oryctolagus cunilicus*) received three ostectomies in the parietal area through drill of 8 mm of diameter. The bone defects were filled out in agreement with the following ones groups: Group I - defect filled out with sanguine clot; Group II - bone defect filled out with autogenous bone; Group III - bone defect filled out with cement of carbonate-phosphate of calcium (Norian). The animals were submitted to the euthanasia to the 40 and 90 postoperative days. The obtained cuts were stained with hematoxiline eosin for analysis histometric of the formed bone area in the defect of the cranium and also submitted to the processing immunohistochemistry for the expression of the proteins osteopontine, osteocalcin and tartrate-resistant acid phosphates. For statistical analysis, the obtained medium values of the formed bone area were transformed in arch sine and submitted to the statistical analysis of variance and powders test of Tukey.

Results: The group II presented difference statistically significant ($P = 0.0385$) when compared with the other groups to the 40 days in relation to the neoformation bone. To the 90 days there was not difference among the groups. All of the groups expressed the three proteins. The group II showed prevalence of the osteocalcin and osteopontine and smaller expression of tartrate-resistant acid phosphatase.

Conclusions and clinical implications: Based on the present methodology, it may be concluded that the cement of phosphate of calcium used in the study did not accelerate the proteins dynamism of the bone repair and did not stimulate the largest formation of bone tissue compared with the other groups, however, is biocompatibility.

A comparative study of 456 implants placed in grafted posterior maxilla with up to 9 years follow-up

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Background: Grafting the floor of the maxillary sinus has become the most common surgical intervention for increasing alveolar bone height before the placement of endosseous dental implants in the posterior maxilla. In an era where alternative techniques for rehabilitation of the severely atrophic posterior maxilla are proposed without the support of long-term clinical studies, we present a comparative study of three different implant designs (456 implants) placed in the grafted posterior maxilla with up to 9 years follow-up.

Aim: To compare the survival rates of three different implant designs: 3i® (Biomet 3i) cylindrical implants, 3i NT® (Biomet 3i tapered implants and Ankylos® (Dentsply, Friadent) when placed in the grafted posterior maxilla.

Methods: One hundred and forty-four consecutive patients previously treated with at least one implant in the grafted maxillary sinus region of the maxilla were included in this retrospective analysis. A total of 456 fixtures: 314 3i® (Biomet 3i) cilindrical implants, 23 3i NT® (Biomet 3i) tapered implants and 120 Ankylos® (Dentsply, Friadent) had been surgically placed to support fixed dental bridges. All implants were placed at the Instituto de Implantologia, Lisbon, by the same surgeon. The patients were followed in a standardized clinical and radiographic method for up to 9 years.

Results: An overall survival rate of 94.1% was verified. Of the implants (21) that failed: 6% of the 3i cylindrical implants failed; 8.7% of the 3iNT implants failed and 4.2% of the Ankylos implants failed. After a statistical analysis we verified a significant difference between tapered and cylindrical implants. No statistical difference was found between internal and external connection cilindrical implants.

Conclusions and clinical implications: Sinus floor elevation is well documented and presents high implant survival rates, which make it a predictable technique for implant rehabilitation of the severely atrophic posterior maxilla. However, the implant placed in such situations may affect the survival rates of the fixtures placed under these conditions.

Histological aspects of transalveolar sinus augmentation with bioglass + autogenous bone

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Background: Transalveolar sinus lift augmentation by means of osteotomes, including implantation of bone biomaterials in combination with autogenous bone, with the aim to generate bone inside the sinus cavity is an established treatment approach. Information about the treatment outcome on the histological level is, however, relatively sparse.

Aim: To evaluate histologically the outcome of a bioglass + autogenous bone composite implantation for transalveolar sinus augmentation.

Methods: In 31 patients, transalveoral sinus lift augmentation including implantation of a bioglass + autogenous bone composite (at 1 : 1 ratio) was performed. During implant surgery, after ca. 4 months, the sites were re-entered and 8 mm deep osteotomies were made through the transalveolar channel by means of a trephine bur with 3 mm external diameter. From the harvested biopsies, non-decalcified 10 µ sections through the long axis of the cylinder were produced. A strict selection process was used, taking into account the presurgical residual bone height and biopsy length, so that at least 2 mm² of the newly formed tissue inside the sinus cavity was represented in the sections. Finally, three central sections from each of eight qualifying biopsies representing a portion of the new tissues formed inside the sinus and of 15 qualifying biopsies representing a portion of the tissues formed inside the transalveolar channel were selected for analysis. Histomorphometrical analysis included evaluation of the tissue fraction occupied by newly formed bone (mineralized tissue + bone marrow), soft connective tissue, residual biomaterial + empty spaces, and debris inside the sinus cavity or the transalveolar channel. Histological analysis included an evaluation of extend of inflammation (if present) and of quality and maturity of the formed bone.

Results: Bone and connective tissue fraction in the newly formed tissues inside the sinus cavity averaged 23.4 ± 13.2% and 54.1 ± 23.5, respectively. Residual biomaterial + empty spaces averaged 12.4 ± 5.9% and debris was 8.4 ± 14.5%. In the transalveolar channel, bone and connective tissue fraction averaged 41.6 ± 14.3% and 46.1 ± 13%, respectively, while the amount of residual biomaterial + empty spaces amounted to 7.5 ± 6.2% and the amount of debris was 3.2 ± 2.6%. Minimal

amounts of inflammation were generally observed, and the new bone was mostly characterized by slender mature trabeculae and narrow osteoid zones. New bone in contact with the surface of the biomaterial particles but also within cracks in the particles was observed.

Conclusions and clinical implications: Inside the transalveolar channel, new bone fraction was almost twice as much as in the sinus cavity, and the residual biomaterial occupied a much smaller fraction than that inside the sinus.

326 | Topic – Tissue Augmentation and Engineering

The BOP graft: a novel method for alveolar ridge preservation in the esthetic zone

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Background: Healing of extraction socket includes a series of events including the formation and maturation of the coagulum that subsequently will be replaced by a provisional matrix and woven bone. As following the removal of the tooth, marked hard and soft tissue alternation will take place within the affected region of the alveolar ridge. Further, more pronounced bone loss is accrued in the buccal wall than in other portion of the ridge. Therefore, the preservation of bone volume immediately after tooth removal might be necessary to optimize the success of implant placement in terms of esthetic and function especially in the esthetic zone. Socket seal surgery was introduced as a tool for optimizing the preservation of the hard and soft tissue components of the alveolar ridge immediately following tooth extraction. Using the above technique encounter some problems and not appropriate for implant placement. Other technique using restorable membranes and biomaterial grafts may not solve the lack of soft tissue and my cause an unsatisfactory result.

Aim: To introduce a novel soft tissue graft in order to deal with the diminution of hard and soft tissue volume in the buccal aspect of the esthetic zone.

Materials and Methods: Immediately following tooth extraction, the socket bony walls are debrided and the soft tissue walls are deepithelialized. The alveolar defect was filled with particles of a slowly resorption bone substitute material according to GBR principals. A soft tissue graft which included epithelium and connective tissue in the middle of the graft with two extensions of subepithelium connective tissue (one for the buccal aspect and the other for the palatal wall) was harvested from the masticatory mucosa of the palate. The extensions of the graft were inserted between the resorbed bone and buccal flap and between the palatal flap and the ridge. The tissue graft was stabilized with simple interrupted 6–0 monofilament achieved under magnification.

Results: The surgical protocol, which combined modified free gingival graft with two extensions of subepithelial connective tissue, bone graft particles proceeded smoothly. The postsurgical healing phase was uneventful for the patients. All the patients were followed weekly during the first month and monthly during the 6 months later. The dimension of the bucco-palatal aspect was preserved and the esthetic result was satisfactory.

Conclusion: The novel BOP (Buccal-Occlusal-Palatal) soft tissue graft combined with GBR technique is an efficacious procedure for ridge preservation in the esthetic zone and is effective in providing the necessary conditions for preserving both the soft and the hard tissue before and during implant insertion.

327 | Topic – Tissue Augmentation and Engineering

Augmentation of implant installment site using autogenous teeth

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Background: A variety of bio-materials have been introduced for dental surgery and these are widely used in practice such as OMF surgery, periodontal surgery, and implant surgery. Of all these, autogenous bone is an ideal graft material because it has osteoregenerativity, osteoinductivity and osteoconductivity, and there is a clear consensus about it. However, the available amount is limited and secondary defect is necessary for using autogenous material. As a result, allogenic bone, xenogenic bone and alloplast were developed and constant research has been done for more ideal material as well.

Recently, in Chosun University, a graft material made of autogenous teeth had been successfully developed by professor S.G. Kim and his colleagues. It could easily be obtained from teeth and made up of hydroxy apatite. In addition, once autogenous teeth is mixed with plaster of paris properly, which makes the graft stable and promotes bone healing, it is proved in many study to possibly be used for restorations of hard tissue in oral and maxillofacial region and GBR. It could be used as a membrane itself as well.

Aim: This study is to find out if the augmentation of an implant installation site using autogenous teeth was successful both clinically and histologically.

Methods: Two cases were sampled for the study. In the first case, an implant fixture was placed in a site with bone defect and augmentation using autogenous teeth was done at the same time. In the other case, sinus lift was performed using the material and an implant was installed later at the site. The result of both cases was analysed clinically and histologically.

Results: In both cases, augmentation was successful clinically and histologically.

Conclusions and clinical implications: For an implant installation at a site with lack of bone, augmentation using autogenous teeth was appeared to be successful clinically and histologically. However, more study would still be necessary because the number of case is limited so far.

328 | Topic – Tissue Augmentation and Engineering

Clinical and radiographical evaluation of guided bone regeneration for peri-implantitis

Presenter: Yoon H-M
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Background: Results from recent publications indicate that peri-implantitis are common disorders. The history of chronic periodontitis may pre-dispose to the development of peri-implantitis. Therapies proposed for the management of peri-implant diseases appear to be based on the evidence available for treatment of periodontitis. From the reports available, it can be concluded that treatment of peri-implantitis lesions with guided bone regeneration may lead to fill of the defects and improved soft tissue conditions.
Aim: Evaluate clinical and radiographical results of guided bone regeneration for peri-implantitis.
Methods: In peri-implantitis patients, guided bone regeneration therapy was done. After incision and flap elevation, granulation tissue was removed thoroughly. Saline soaked gauze swabbing and then saline and chlorhexidine irrigation was done. In one case, regenerative therapy was done after detoxification using tetracycline solution. FDBA and anorganic bovine bone mixture or anorganic bovine bone alone was grafted on defect site. Then, resorbable collagen membrane was applied on the grafts. Suture was done. Oral hygiene instruction and periodic supportive periodontal therapy was done. During follow-up period, clinical and radiographic evaluation was done up to 1–2 years.
Results: In all cases, the radiograph indicate increased radiopacity and bone fill from the initial pre-operation radiograph to the 1–2 years postsurgical radiograph. Probing depth was reduced, bleeding on probing was negative.
Conclusions and clinical implications: From the cases, it can be concluded that treatment of peri-implantitis lesions with the combination of grafts and resorbable membranes may lead to bone fill and improved soft tissue conditions.

329 | Topic – Tissue Augmentation and Engineering

Maxillary sinus floor augmentation with anorganic bovine bone: histologic evaluation

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Background: Sinus augmentation is routine procedure for implant surgury of maxillary posterior area. Many grafts materials were used for maxillary sinus augmentation. Among the grafts materials, xenograft (especially anorganic bovine bone) is used in many cases. Osteoconductive properties is expected in xenograft materials for maxillary sinus augmentation.
Aim: The aim of this report is to investigate the efficacy of anorganic bovine bone xenograft at maxillary sinus floor augmentation in humans.
Methods: Two male patients who missed maxillary posterior teeth were included. They were performed maxillary sinus floor augmentation using anorganic bovine bone xenograft. After 10 or 13 months, the regenerated tissues were harvested using trephine drills with 2 or 4 mm diameter and non-decalcified specimens were made. The specimens were examined histologically and histomorphometrically to investigate graft resorption and new bone formation.
Results: Newly formed bone was in contact with anorganic bovine bone xenograft particles directly without any gap between the bone and the particles. The proportions of newly formed bone were 23.4–25.3% in patient 1 (Pt.1) and 28.8% in patient 2 (Pt.2). And the proportions of remained anorganic bovine bone xenograft were 29.7–30.2% in Pt.1 and 29.2% in Pt.2. The fixtures installed at augmented area showed good stability and the augmented bone height was maintained well.
Conclusions and clinical implications: Anorganic bovine bone xenograft has high osteoconductivity and helps new bone formation, so that it can be used in maxillary sinus floor augmentation.

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Sinus floor elevation with platelet-rich fibrin

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Background: Sinus grafting with delayed implant placement is indicated when the maxilla is severely atrophied and/or when no period without denture is requested. Many grafting materials are used to gain bone volume for implant placement. Autogenous bone grafting has been widely used despite increased morbidity. Bone substitutes avoid problems related to bone harvesting at secondary surgical sites but are reported to undergo a slow regeneration process. Until now, platelet-rich fibrin (PRF) has been proposed as substitution grafting material with simultaneous implantation (Diss et al. 2008, Mazor et al. 2009).
Aim: A patient asked for maxillary implant placement to support a full prosthesis with the least invasive shortest treatment; he requested no period without denture during the treatment. Sinus grafting was performed with only PRF through a crestal approach and implant placement was delayed. The 1-year clinical performance of implants was assessed.
Methods: A 69-year-old woman presented for maxillary full rehabilitation. Posterior to the maxillary bicuspids, the residual bone height was $\leq$ 5 mm. PRF grafting was prepared from the patient's centrifuged blood (Choukroun et al. 2001). Through crestal sinus floor elevation, osteotomy sites were enlarged and

the membrane integrity was controlled. PRF pieces were introduced, and flaps sutured. Twelve weeks later, Bone Level® (sites #13, 14, 23 and 24; Ø4.1 mm, length 10 mm, Straumann AG) and TE® implants (sites #16 and 26; Ø4.8–6.5 mm, length 10 mm, Straumann AG) were placed without tapping in a submerged manner. The 4-month healing period was uneventful. After exposure, implants were restored with an overdenture relying on six implants connected with two bars. Computed tomography scans and radiographs were performed before surgery and during the 1 year follow-up after loading.

Results: All implants achieved primary stability although bone density was poor. They were successfully loaded. After 1 year, they were clinically stable with a functional load. In the sinuses, newly formed mineralized tissue was visible but regenerated bone volumes were limited. Implants #26 and #16 showed a residual protrusion into the sinus of 2 and 4 mm, respectively.

Conclusions and clinical implications: This case report has shown that sinus grafting via a crestal approach can be managed within duration of 3 months using PRF. The introduction of PRF has contributed to maintain space for bone regeneration; however, bone density was poor and peri-implant bone formation was low.

331 | Topic – Tissue Augmentation and Engineering

Autologous wedge-shape ramus graft prior dental implant treatment. Case report

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Background: There are some implant treatment requirements that must be achieved in order to get a successful complete case. They are both, appropriate functional and aesthetic pattern. However, most patients have distinct residual bone conditions, not only vertical but also horizontal dimensions show resorption result of trauma, periodontal disease, traumatic extractions, etc. These factors sometimes make impossible the immediate implant placement, so we use techniques to recover lost bone dimensions for a long term.

Aim: This case reports a treatment of autologous wedge-shape ramus graft in the alveolus of 2.2 with the aim of increasing the residual alveolar ridge vertical and horizontally, in order to achieve a suitable bone support for the implant, that comply with the appropriate biomechanical functions and satisfy the aesthetic that patient requires.

Methods: A partially edentulous 25-year-old patient without any systemic compromise had a recent extraction socket at 2.2 sites because of several crown destruction. There were a 6 mm and 4 mm-deep defects in the bucal and palatal bone, respectively, that did not allow the placement of the implant and the restoration in a proper position. After expose the affected area a mucosal incision and a total thickness flap elevation was performed in the left retro-molar area, and the autologous wedge-shape ramus graft was harvested by using a 5 mm-diameter round trephine bur. It was necessary to reshape the graft according to the vertical and horizontal dimensions of the defect. Then, fixed the bone graft in the socket with an osteosynthesis microscrews. When 6 months had passed, we reopened the site and notice a ridge totally consolidated, it means with qualities and dimensions proper to an implant treatment. Finally, we were able to place the implant in the correct position and restore it.

Results: We achieved a significant increase in the height and width of the residual alveolar ridge, approximately 5 mm vertically and 4 mm horizontally, which allowed implant placement 2.2 without any complications.

Conclusions and clinical implications: The use of autologous wedge-shape ramus graft is a predictable choice to regenerate recent extraction sockets with small and moderate plate defects. The regenerated bone has good quality and brings acceptable biomechanical properties to the future implant.

332 | Topic – Tissue Augmentation and Engineering

Osteogenesis distraction, block grafts and periodontal plastic surgery, powerful tools combined

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Background: Regenerative techniques has become in such powerful tools in implant dentistry that it makes possible to place implants at almost any site in the dental arch. Osteogenesis distraction, onlay and inlay grafts, and GBR provide help to recover lost dimensions, either hard or soft tissues. However, for a correct practice we must focus in so important issues, biomechanics and aesthetics.

Aim: The aim of this case is to show a combination of osteogenesis distraction, block graft for horizontal increasing, blocks graft for vertical increasing and periodontal plastic surgery at 2.1 and 2.2 sites in order to improve the shape, contours and the aesthetics of the residual alveolar ridge.

Methods: A 46-year-old patient with absence of 2.1 and 2.2 with a severe resorption of residual alveolar ridge (Seibert 3) was undergone to an osteogenesis distraction using KLS Martins distractor to increase vertically. After 12 weeks that was the consolidation period, we removed the device and put on an onlay J-shape block graft harvested from the chin with GBR to increase vertical an horizontally. Six months later reopened the site and realized that it was not enough, consequently another chin block graft obtained with a trephine bur with GBR was performed for vertical increasing al 2.1 and 2.2. Once the ridge got the optimal dimensions, we were able to place two implants at those sites. Finally, to improve the contour and aesthetics it was made a connective tissue grafts from the palate and then the individual ceramic restorations.

Results: It was found a significant and progressive gain in height and width with all of the techniques. Osteogenesis distraction improved 4 mm vertically approximately. J-shape block graft improved 4 mm horizontally and 3 mm vertically. The second chin block grafts showed an improvement of 3 mm

vertically. The connective tissue grafts allowed a filling of 2.5 mm horizontally and 1 mm vertically. The two implants integrated in the regenerated bone without any complications.

Conclusions and clinical implications: All of these regenerative techniques are predictable for proposes themselves. The quality of newly formed bone is extremely good, so it is possible to be grafted on it. In the surgical stage, we have an arsenal of techniques that allow us to face every situation.

333 | Topic – Tissue Augmentation and Engineering

The behaviour of ceramic scaffolds for bone regeneration

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Background: Tissue engineering is emerging as a multidisciplinary field combining the principles of biology and engineering to develop viable substitutes to restore, maintain or improve the function of tissues or organs.

The general principle of tissue engineering comprises the combination of cells with a natural or synthetic support scaffold to produce a three dimensional tissue.

The strategies based on the use of scaffolds depend on two key aspects: materials and processes.

Aim: In this study, we explore the effect of different materials to produce three-dimensional scaffolds for bone regeneration, using a sintering technique.

Methods: Two bioceramic materials are considered: hydroxyapatite and calcium triphosphate. Scaffolds with different material composition (case 1: 100% hydroxyapatite; case 2: 25% hydroxyapatite and 75% calcium triphosphate; case 3: 60% hydroxyapatite and 40% calcium triphosphate with magnesium; case 4: 60% hydroxyapatite and 40% calcium triphosphate without magnesium) and different porosities (60% and 70%) were used. We also investigate the effect of adding small amounts of magnesium.

Bone regeneration analyses were performed using a Kodak *in vivo* system FX.

Results: Hydroxyapatite scaffolds enable the formation of more regular and organised bone formation with a ''lamellar'' structure, but have small degradation rates. Hydroxyapatite and calcium triphosphate scaffolds are associated with less organised bone formation and the formation of conjunctive tissue inside the pores, on top of having a higher degradation rate.

Conclusions and clinical implications: Preliminary results suggest that the considered scaffolds have different biological and mechanical behaviours.

Hydroxyapatite scaffolds with small amounts of calcium triphosphate (to control the degradation rate) are appropriated for bone regeneration. The use of additive biomanufacturing to produce these scaffolds in a customised way will enable to develop a clinical strategy adapted to the specific characteristics of the patient.

334 | Topic – Tissue Augmentation and Engineering

Successful reconstruction of large mandible defects by bone marrow stem cells in oral and maxillofacial area

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Background: Mesenchymal stem cells derived from adult bone marrow are multipotent cells capable of differentiating along several lineage pathways. Cell-driven approaches, especially the biophysical stimulation of the host cell population surrounded by the bone defect, are common treatment methods in maxillofacial surgery. Others, such as autogenous cell implantation, have now gained acceptance for clinical trials. All of the cell-driven repair strategies are under intensive investigation in an effort to provide surgeons with a limitless supply of tissue for bone repair and reconstruction in future procedures. An overview of the basic biological aspects as well as the inherent constraints of different cell-based approaches are given in this paper.

Aim: The aim of this study was to evaluate the bone formation effects of mesenchymal stem cells & autogenous scaffolds in oral and maxillofacial area.

Methods: The success of transplanting marrow stem cells for repairing various defects and severe atrophy in maxilla and mandible is encouraging. We treated all 50 caces; sinus lifting, tumor, GBR, etc.

Results: All 50 cases were treated by stem cells and then implanted, so we present our cases and discuss about tissue engineering of bone regeneration.

Conclusions and clinical implications: Bone marrow stem cells showed in bone defects for implant.

335 | Topic – Tissue Augmentation and Engineering

Management of anteroposterior bone defects in aesthetic restoration of the front teeth

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Background: Bone loss is a problem that makes it difficult or impossible to place implants. We report the management of bone defects in aesthetic reconstruction for the placement of osseointegrated implants. The final outcome has to be an implant-supported restoration surrounded by good quality bone and soft tissues that harmonize with the existing dentition.

Aim: Development of a clinical protocol for the management of anteroposterior bone defects in the front teeth followed by later rehabilitation with osseointegrated implants.

Methods: The anatomic concepts that characterize the front teeth and the placement and three-dimensional relations of

implants were reviewed. Recent literature on bone and soft-tissue reconstruction techniques for the front teeth was reviewed. We present our 8-year experience over more than 100 patients in managing these defects with different types of grafts.

Results: A protocol for the treatment of bone defects for rehabilitation of the front teeth with osseointegrated implants is described that depends on the magnitude of the bone defect (small defects that do not jeopardize implant placement, single-wall defects that jeopardize implant placement, or two or three-wall defects) and the patient's periodontal biotype.

Conclusions and clinical implications: In aesthetic restoration, maximum precautions must be taken in placing any implant. These precautions must be even greater when bone grafts are required. Proper bone graft management makes it possible to correctly place the implants three dimensionally to achieve acceptable aesthetic results for restorations.

336 | Topic – Tissue Augmentation and Engineering

Micro-3D bone reconstruction – case report

Presenter: Moura J
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Background: An intraoral bone graft from the maxillary tuberosity can serve as a good predictable treatment modality for horizontal augmentation. The use of the 3D technique, described by Khoury and colleagues, allows for the minimal amount of bone collection, cortical plates are used to create a scaffold in which medullar particulate tissue is then packed, this creates a regenerative pattern similar to a cortico-medullar graft.

Aim: The regeneration of the bone destruction caused by root failure, as to maintain soft tissue contour and allow for the rehabilitation of the area with implant-supported restoration.

Methods: Forty-five-year-old female patient presented with root failure and peridental bone reabsorptionaround teeth 14 and 15 (FDI). Her chief concerns were to restore function and maintain a natural looking dentition in that area. Surgical treatment consisted in extraction of teeth 14 and 15, implant placement in site of teeth 14 and 16 and bone reconstruction of site of tooth 15, from the donor site both cortical and medullar bone chips were collected. The cortical plates were used to create a scaffold, placed at 90 degree angles and fixated with osteossintesis screws, in which medullar bone chips were then packed, this created a regenerative pattern similar to that of a cortico-medullar graft.

Results: At 1 year of follow-up the implants and the grafts were classified as a success. The bony and soft tissue volume is maintained and the rehabilitation fulfils a functional and aesthetical role.

Conclusions and clinical implications: An intraoral bone graft from the maxillary tuberosity can serve as a good predictable treatment modality for horizontal bone augmentation. In the repair of alveolar defects, bone graft from maxillary tuberosity offer several benefits when comparing with other donor places like calvarium, tibia and the iliac crest because reduce operative and anesthesia time, there's no cutaneous scar and patients report minimal discomfort and less morbility.

337 | Topic – Tissue Augmentation and Engineering

Five years with maxillary fresh-frozen bone allograft

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Background: In the last decade several studies have been performed to evaluate clinical outcome of implants inserted in auologous bone, but there are a few available on maxillary grafted with fresh-frozen bone.

Aim: The aim of this communication is to present our results with the use of fresh-frozen bone in the reconstruction of maxillary alveolar ridges as a bone fill and support for the placement of dental implants.

Methods: From February 2005 to February of 2010 our surgical team has treated 20 patients with augmentation procedures using fresh-frozen bone as a bone graft material.

In six cases calvarium allograft was used to reconstruct the bone platform. The other 14 tricortical iliac crest was cosen as allograft material.

Average age was 38.5 years old. 13 women and 7 men.

All the surgical procedures were performed under conscious sedation and local anesthesia.

In 15 patients allografts were used for horizontal augmentation. The other patients, allografts promoted both horizontal and vertical new bone apposition.

Results: Forty-one blocks were placed, and the number of blocks each patient received ranged from 1 to 4. Twenty blocks were located in the maxilla and 21 in the lower jaw.

Only in one block (lower jaw) was a fracture of the upper half.

Three gingival fenestrations appeared during the follow-up controls but did not affect the implant insertion.

Conclusions and clinical implications: Bone allograft is a reliable technique for bone augmentation.

No need of donor area surgery decreasing morbidity.

Adequate gingival biotype before bone graft surgery is required. Gingival fenestrations may appear including after 1 year postop.

Allograft has low degree of bone resorption in the maxillary areas. Do not overbuilt the bone defect during graft surgery.

Both allograft and autograft have similar resorption degree in the anterior area of the lower jaw.

Allogenic bone, highly concentrated PRP, stem cells and hrBMP-2 application in jaw-bone defect treatment: DVT, mathematical analysis

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Background: In the last period several bioengineering methodology were used for induction of osteogenesis in jawbone defects treatment. From the clinical point of view this methodology called GBR, described, very well known and newest hrGF, growth factor application. The active growth factors used for the clinical reasons are: PDGF BB (GEM21S), Emdogaine (amelogenin), hr BMP2. The source of PDGF is PRP, the source of BMP2 is allogenic bone, but in very limited and low concentration.

Aim: The aim of the study was CT-DVT qualitative and quantitative evaluation of newly formed bone after different type of used grafts. The observation concerned 30 cases, male patients (age 30–75) 6 months after insertion of the above-mentioned transplants in different jawbone defects. Bio-Oss was used as a carrier for the PRP and CD34 + human stem cells.

Methods: Four advanced technique based on tissue engineering were present and compared the effects of stimulation of osteogenesis of alveolar bone by transplants of (1) allogenic bone matrix, processed in tissue bank (Central Tissue Bank, Warsaw Medical University), (2) highly concentrated, pure PRP (Cobe Spectra system), (3) bone marrow autologous population of stem cells CD34 + (Haematopoietic Stem Cells, Warsaw University), (4) human recombinant BMP2 on collagen spongy scaffold (gUIDE-UCLA).

Results: Newly formed bone augmented under influence of BMP2 and highly concentrated PRP shows the closest similarity to the control; most mature bone of hrBMP2. Less effective was the treatment of allogenic bone, which is a source of BMPs slow releasing during transplant remodeling. The efficacy of non-processed CD34 + stem cells used for bone augmentation on bovine bone mineral carrier is less effective than other transplants.

Conclusions and clinical implications: It seems that application of growth factors (GF, BMP2) is more effective than guided bone regeneration (GBR) of jawbone. It really probably, that hrBMP2 is fast release from the collagen sponge, other grafts had a lower biological activity, slower releasing after surgery.

Posters: Topic – Technical and Biological Complications (Abstracts 339–358)

339 | Topic – Technical and Biological Complications

Detoxification of implant surfaces using different laser/LED irradiation

Presenter: Giannelli M
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Background: Bacterial lipopolysaccharide (LPS) represents a key pathogenic factor of peri-implantitis being able to adhere tenaciously to dental titanium (Ti) implants. However, the current therapeutic approach is based mainly on bacterial decontamination, rather than neutralization of bioactive bacterial products.
Aim: To compare the ability of different dental laser/LED devices used in photoablative mode (PA) or photodynamic mode (PD) in combination with the photoactivated dye methylene blue (MB) to inactivate LPS preadsorbed to Ti dental implants.
Methods: RAW 264.7 macrophages were seeded on Ti discs cut from commercial dental implants (Bicon, Boston, MA, USA), uncoated or coated with P. gingivalis LPS. The LPS-coated discs were then subjected to different irradiation treatments. The parameters were chosen on the basis of the accepted laser parameters for titanium dental implant surfaces:

– Nd:YAG laser (1064 nm, 20 mJ/70 Hz or 15 mJ/100 Hz pulse energy/frequency × 60 s).

– Erbium laser (2940 nm, 100 mJ/10 Hz pulse energy/frequency × 60 s).

– CO_2 laser (10,600 nm; 2 W pulse power, 0.5 mJ/2 kHz pulse energy/frequency 60 s).

– Diode laser (810 nm; 1 W continuous wave × 60 s).

– Diode laser (630 nm; 0.15 W in continuous wave × 60 s) + MB.

– LED light source (630 nm; 0.15 W in continuous wave × 60 s) + MB.

Others were treated with 0.3% chlorhexidine. LPS bioactivity was assessed by measurement of the generation of nitric oxide (NO) by the stimulated macrophages. Macrophage activation and viability were assayed by ultrastructural analysis and MTS assay, respectively.
Results: LPS coating caused a significant increase in the amount of nitrites (assumed as indicators of NO generation) in the RAW 264.7 cell supernatant and the appearance of ultrastructural signs of cell activation. Both parameters were significantly attenuated by pretreatment with the tested light sources, the most effective ones being Nd:YAG laser at 20 mJ/70 Hz and 15 mJ/100 Hz and diode laser at 810 nm wavelength in PA mode, and diode laser and LED light at λ 630 nm + MB in PD mode. Chlorhexidine also caused a marked nitrite reduction, but this effect was mainly related to its cytotoxic action on the macrophagic cells. In fact, normalization of the values of the actual NO production by the number of viable cells showed that the laser or LED light PD treatment was the most effective LPS debridement treatment, whereas chlorhexidine had no significant effects.
Conclusions and clinical implications: The present findings provide strong experimental evidence for the efficacy of diodo laser 630 nm operating in PD mode to remove harmful LPS from dental implants and successfully treat peri-implantitis.

340 | Topic – Technical and Biological Complications

CBCT evaluation of orthodontic miniplate anchoring screws in the posterior maxilla

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Background: While numerous installations of miniplates have been considered successful based on clinical stability, the actual position of inserted miniplate performed by clinicians has not been evaluated using three-dimensional (3D) imaging techniques, and therefore currently there are no scientific analysis on the frequency of root proximity, root penetration, or maxillary sinus involvement after miniplate insertion. There is no literature on the position of cortical bone penetration or effects on the surrounding structures using 4-mm length miniscrews in the human patients.
Aim: To evaluate the actual postplacement positions of orthodontic miniplate anchoring screws (MPAS).
Methods: 3D-CBCT images were generated to examine 31 miniplates and their MPAS (1.5 mm × 4 mm), which showed good stability 6 months after placement in the posterior maxilla of 18 patients. The CBCT data were analyzed with ANOVA and Fisher exact test to evaluate the difference of placement depth and to determine differences in MPAS position, root proximity, and sinus penetration.
Results: The mean placement depth was 2.48 mm with no significant difference relative to their position. Nine showed root proximity, and 7 had root penetration, all of which were placed in the central position of the plate. Thirty-nine penetrated the sinus, indicating a low interrelationship between placement depth and bone thickness of the sinus.
Conclusions and clinical implications: Root proximity of MPAS seems to have minimal effects on the successful stabilization of miniplate. Pertinent guidelines should be followed during MPAS placement to minimize the risk of damage to adjacent roots.

341 | Topic – Technical and Biological Complications

Patient satisfaction regarding dental implant treatment

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Background: Evaluation of dental implant outcome may be performed based on the professional clinician's assessment or based on the outcome as perceived by the patient. There might be a discrepancy between the outcome reported by the clinician and the patient.

Aim: To analyse the patients' satisfaction regarding implant therapy performed at a university clinic and to compare quality of life and treatment satisfaction among subjects having or having had complications with subjects without such experiences.

Methods: A total of 164 subjects having had implants inserted and suprastructures made at the Institute of Clinical Dentistry, University of Oslo between 1990 and 2005 were invited to join the project. One hundred and nine subjects were available for examination. Information regarding previous biological and mechanical complications was derived from the patient files. The examinations were conducted in 2007–2008 and comprised radiographic and clinical evaluation. In addition, the subjects were asked to grade their satisfaction on a visual analogue scale (VAS) in which 0 indicated ''total dissatisfaction'' and 10 indicated ''total satisfaction'' according to statements presented in the questionnaire. The questionnaire was answered before the clinical examination was performed. The results were analysed using descriptive statistics and Mann–Whitney test.

Results: Registrations from patient files showed that 9.2% of the participants had experienced implant loss and 46.2% had experienced biological and/or mechanical complications requiring chairside treatment. Peri-implantitis (exceeding 2 mm radiographic bone loss and bleeding on probing at pocket probing depth $\geq$ 4 mm) was registered at one or more implant in 20.4% of the population at the present examination. The question regarding implant restoration in general gave a mean VAS score of 8.4 (standard deviation 2); aesthetics yielded a score of 7.9 (2.6) and chewing function yielded a score of 8.6 (1.9). No statistically significantly differences in patient satisfaction were found between subjects having or having had experience of the complications assessed and subjects without such experiences.

Conclusions and clinical implications: The present study participants were generally satisfied with dental implant treatment. There were no statistically significantly differences regarding patient satisfaction between subjects with or without experience of complications in the present study.

342 | Topic – Technical and Biological Complications

Fluorescence-guided debridement in bisphosphonate-related osteonecrosis of the jaws – preliminary results

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Background: The surgical debridement is the therapy of choice in advanced stages of bisphosphonate-related osteonecrosis of the jaw (BRONJ). However, the therapy is currently only loosely standardized due to the fact that no suitable imaging modalities exist.

Aim: This prospective pilot study aims to redress this by exploring the suitability and reproducibility of applying a fluorescence-guided bone resection to patients suffering from BRONJ.

Methods: This prospective pilot study encompassed 19 patients with 24 BRONJ lesions (only stage II and III) with a history of intravenous bisphosphonate treatment due to metastatic bone diseases. Before surgical treatment, each patient received a 10-day administration of doxycycline. Fluorescence-guided resection of necrotic bone was performed by means of a certified fluorescence lamp. Success of procedure was proclaimed if mucosal closure was observed and symptoms were absent within 4 weeks.

Results: The 4-week post-operative follow-up identified a mucosal closure in 21 of 24 (87.5%) BRONJ lesions. These patients were free of any symptoms. Failure as defined by mucosal dehiscence and exposed bone was observed in 3 of 24 BRONJ lesions (12.5%).

Conclusions and clinical implications: The success rate of this surgical regimen of BRONJ was respectable and thus fuorescence-guided bone resection can be considered to be an effective treatment of stage II and III BRONJ. Furthermore, the reproducibility of the technique offers an opportunity to standardize the surgical therapy. Further studies are called for that compare the fluorescence-guided bone resection with conventional surgical approaches, as well as surgical versus conservative treatment in early stages (stage 0 and I) of BRONJ.

343 | Topic – Technical and Biological Complications

Analysis of morphology of maxillary sinus septa and sinus appearance in dental-computed tomography

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Background: The prevalence of maxillary antral septa in computed tomography scan (CT scan) varies between 13% and 36%.

The septa are varying in shape and size. The presence of maxillary sinus septa, have been reported to increase the risk of sinus membrane perforation during sinus elevation procedures. Surgical interventions in the posterior maxillary region require detailed knowledge of maxillary sinus anatomy and the possible anatomic variations for preventing any complications that may occur.

Aim: The study aimed to analyze the morphology of maxillary sinus septa and other appearance of sinus in patients undergoing oral and maxillofacial surgery by using a dental-computed tomography scan.

Methods: Dental CT data of 63 septa from 242 sinuses in 121 patients were analyzed utilizing Denti-Plan version 1.2 software. The height of each identified septa was measured at three regions selected along its course across the sinus floor; the lateral, the middle, and the medial aspects. Septa measuring more than 2.5 mm in height at any positions were included and categorized as primary septum (located apical to maxillary tooth root) or other septa (located apical to edentulous maxillary ridge). The whole sinus was scanned thoroughly and any presented appearances of sinus pathology were recorded.

Results: Measurements of septal height varied among different areas and the average was 4.6 ± 2.9 mm. The lateral region ranged from 0 to 18.16 mm (3.4 ± 3.12 mm), the middle region ranged from 1.73 to 14.35 mm (4.59 ± 2.43 mm), and the medial region ranged from 2.33 to 14.21 mm (5.8 ± 2.63 mm). The anatomic shape was similar to an inverted gothic arch, with a greater height than width. Both primary and secondary septa were found. Two complete septa were noticed in the maxillary sinus of two patients (1.65%). Upper sinus septa were presented in 77 patients (63.6%). Thickening of sinus lining was found mostly 38.8% among all appearances while 52.08% presented with no any pathology appearance.

Conclusions and clinical implications: Most septa oriented in the medio-lateral direction and increased in height from the lateral to the medial insertions that causes the sinus lift operation difficult and poses the risk of sinus membrane perforation. Complete septa seem to be a very few observation. Reconstructions of dental CT data allow accurate visualization of specific anatomical variations and are reliable in the diagnostic of maxillary septa that are necessitated for implant surgery planning.

Surgical reconstruction of peri-implant bone defects with prehydrated and collagenated porcine bone and collagen barriers

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Background: Surgical reconstruction of peri-implant defects is challenging and unpredictable due to, e.g., the regenerative capacity of the native bone or the osteogenic potential of adjunctive materials used.

Aim: To study the healing capacity of a new bone xenograft material in the treatment of peri-implant defects.

Methods: In four cases with extensive peri-implant defects flap surgery was performed. After thorough debridement including cleaning of the exposed implant surface, prehydrated and collagenated porcine bone (PCPB) particles were placed into the defect. A bioresorbable collagen barrier was adapted and placed over the defect and the flaps were relocated. In one case, this procedure was repeated 6 months postoperatively. After 6 and12 months of healing clinical and radiographic examinations were done including cone beam computer tomography (CBCT). In one case a bone biopsy was harvested after 1 year and analyzed with histology.

Results: All defects healed uneventfully. At 6 months probing depths were reduced on average by 4 mm with no bleeding on probing or pus formation. Intraoral radiographs showed an average gain of the marginal bone level by 3 mm. In the case where surgery was repeated a further clinical and radiographic gain of attachment was found. CBCT after 1 year confirmed these findings showing bone formation up to the marginal threads approximally. Histology showed osteoconductive properties as bone formation with typical osteoblastic seams was observed directly on the surface of the grafted particles.

Conclusions and clinical implications: The presented cases show that PCPB have favourable properties enhancing bone regeneration in peri-implant bone defects.

345 | Topic – Technical and Biological Complications

Porous titanium granules for bone regeneration in peri-implantitis-related defects

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Background: Because of the increasing number of implant insertions, peri-implantitis and related therapies have become important issues of clinical work. Lacking prophylactics, plaque control, oral hygienic instructions, and evaluation of biomechanical factors contribute to serious peri-implantitis-related defects. For regeneration, non-resorbable bone graft materials may offer advantages as compared with resorbable bone graft materials or autogenous bone grafts.

Aim: The purpose of this study is the evaluation of porous titanium granules as bone graft material for treating peri-implantitis-related defects.

Methods: Twenty implants with two- and three-wall intraosseous defects were included in this study. Four suprastructures were removed and the respective implants submerged for the healing period. Sixteen implants could be maintained with suprastructures during peri-implantitis treatment. After crestal incision and debriment with plastic-scalers, intraosseous defects were cleaned with chlorhexidin. Defect walls were perforated with a bur to promote bleeding, titanium granules (Natix, Tigran Technologies AB, Mölndal, Sweden) were inserted into the defects and the operation site was sutured.

Patients were followed-up for 6 month after operation. Clinical parameters such as probing depths, gingival index, and bleeding on probing were recorded. Radiographs were taken to verify the graft position directly after the operation and after 6 months to verify the osseointegration process of the graft material.

Results: Postoperatively, six implants showed signs of infection and were treated with antibiotics and chlorhexidin irrigation. In these cases, graft material was partially lost during healing. Fourteen implants were without clinical or radiological signs of inflammation.

Conclusions and clinical implications: In this study, porous titanium granules offered a feasible method to regenerate bone in two- and three-walled defects caused by peri-implantitis. Because of the limited number of cases, further investigations with longer observation periods will have to follow. Additionally, the osseointegration of surrounding bone and titanium granules has to be confirmed histologically.

346 | Topic – Technical and Biological Complications

Removal of osseointegrated implant without trephine enabling immediate implantation

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Background: The purpose of this study is to demonstrate a new method for removing osseointegrated dental implant without trephine.

Aim: The traditional method for removing osseointegrated implants has been the trephine bur. The disadvantages of the trephine are well known: huge socket, injure to surrounding bone structure or nerves, and the resultant for guide bone regeneration. By utilizing a different technique for removal of osseointegrated implants, we can not only eliminate the negative effects of the trephine, but also reimplant a same size implant during the same surgery.

Methods: Five osseointegrated, functioning implants were removed from three different patients. Three (Ankylos) implants were removed due to abutment fracture, and two (Implantium) implants were removed due to faulty implant position. The tool used for implant removal is a surgical carbide round bur also used for impacted tooth extraction. We drilled in the middle of the implant buccolingually, from top to bottom, effectively splitting the implant into two pieces. An elevator was used to detach the distal half of the split implant. After picking it out, the process was repeated for the mesial half of the implant. The bone wall was intact, and the socket size was almost unchanged.

Results: Three (Ankylos) implants with fractured abutments were removed and same size implants were inserted during the same surgeries. All three implants showed good primary stability. Two malpositioned (Implantium) implants were removed, for the reason of augmentation, we performed guide bone regeneration procedure and sutured.

Conclusions and clinical implications: With this carbide bur technique, we can remove osseointegrated implants without the damaging effects of the trephine. Furthermore, same size implants can be inserted with good primary stability during the same surgery.

347 | Topic – Technical and Biological Complications

Photoelastic stress analysis of fixed prostheses supported by straight and inclined implants in various macro designs

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Background: Biomechanics is one of the main factors for achieving long-term success of implant-supported prostheses.

Long-term failures mostly depend on biomechanical complications. Implant design is a crucial factor in implant biomechanics. In each situation, certain implant types, shapes and sizes and restorative scheme might be more or less advantageous. Therefore, selection of a specific implant system should be made after careful consideration of the specific needs of the patient.

Implants are normally placed in a relatively straight allignment because inclined arrangements of implants have been shown to create forces that cause adverse effects on the supporting implants or the surrounding bone.

Aim: The aim of this study is to evaluate and compare the effects of macro design and straight vs. inclination of the implants on the stress under loading conditions.

Methods: In this study, the photoelastic response of four different types of implants which were inserted with different angulations were comparatively analyzed. The implant types investigated were screw cylinder (ITI, Straumann AG, Basel, Switzerland), stepped cylinder (Frialit2, Friadent GmbH, Manheim, Germany), root form (Camlog Rootline, Alatatec, Wilshelm, Germany), cylindiric implant with micro-threads on implant neck (Astra, AstraTech, Mölndal, Sweden). In the test models, one of the implants was inserted straight while the other one was aligned mesially with 15° angles. Superstructures were prepared as single crowns. A 150 N loading was applied to the restorations throughout the test.

Results: The comparison of implant designs showed that there were no significant differences between straight implants; however, between inclined implants, the most favorable stress distribution was seen with the stepped cylinder implants. The least favorable stress concentration was observed around the root-formed implants. Micro-threads around the implant neck apperared to be effective in homogenous stress distribution. Observations showed that misaligned implants caused less stresses than the straight implants but the stress concentrations were not homogenous.

Conclusions and clinical implications: At the end of the study, none of the systems is far better or worse than the others at stress concentrations and distribution. Each system has different advantages. Because of these, for long-term success, a careful planning, care up and maintenance should be provided along side besides the implant design.

348 | Topic – Technical and Biological Complications

Anorganic bovine bone and collagen membrane in surgical treatment of peri-implantitis: 24 months clinical and radiographic evaluation

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Background: The use of dental implants to replace missing teeth in daily clinical practice has been shown to be a reliable treatment. However, peri-implant infections have been reported.

Aim: This prospective and longitudinal study evaluated the surgical treatment of peri-implant lesions using anorganic bovine bone and collagen membrane.

Methods: Thirteen patients with 19 diseased implants were enrolled in this study. Peri-implantitis was characterized as implants with probing depth (PD) > 4 mm, bleeding on probing and/or suppuration, and vertical bone loss > 4 mm. Follow peri-implant debridment and detoxification of implant surface with citric acid (pH = 1), the bone defects were filled with anorganic bovine bone and covered with collagen membrane. Clinical parameters such as visible plaque, marginal bleeding, bleeding on probing, suppuration, PD, clinical attachment level and radiographic bone gain were recorded at baseline and after 6, 12 and 24 months of submerged healing.

Results: Two patients were discontinued from the treatment due to pus formation. The means of PD and radiographic crestal changes (RCC) presented significant improvements after treatment ($P < 0.0001$). At baseline the PD mean was $5.78 + 1.34$ mm and at 24 months after treatment, this means was decreased to $2.56 + 1.67$ mm. The means of RCC were 5.6 and 3.45 mm at baseline and 24 monhts, respectively.

Conclusions and clinical implications: The surgical regenerative therapy resulted in clinical improvements after 24 months post-therapy.

349 | Topic – Technical and Biological Complications

Bone-level changes around dental implants

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Background: Many clinical and histological studies show that the location of implant–abutment interface, the so-called microgap, influences the level of peri-implant bone. In the other hand, Weng et al. (2003) have demonstrated that the microgap designs may be able to influence the peri-implant bone level.

Aim: The objective of this multicenter study was to analyze the marginal bone loss around dental implants with tapered connection supporting fixed prosthesis.

Methods: Between February 2006 and December 2007, 347 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were inserted in healed sites in 109 partially edentulous patients and in eight patients with edentulous maxilla. Implant length ranged from 8 to 14 mm. The implant diameter distribution was 64.5% of 3.5 mm, 32.25% of 4.5 mm and 3.25% of 5.5 mm. All implants were inserted at least 1 mm below the cortical plate. Marginal bone level using standardized radiographs were evaluated at the implant loading, 6, 12 and 24 month later. Before second stage surgery, soft tissue thickness was clinically measured. Clinical parameters and all complications were noted. All patients were submitted maintenance therapy.

Results: One implants was removed 3 weeks after implantation. After 3–4 months of healing, all other implants were osseointegrated and were loaded with cemented crowns. Ninety-seven implants were loaded with single crowns, 199 with 83 bridgework and 50 to support eight full arch bridges. The total number of units replaced was 455. After a total loading period of 30.4 months (range 20–42), two implants was lost and the cumulative survival rate was 99.14%. Radiographic mean bone loss evaluating both interproximal surfaces was 0.67 mm (range 0.35–1.93). Only 12% of the sites showed a crestal bone loss > 1 mm. The majority of implants presented healthy peri-implant soft tissue conditions showing low values of clinical parameters (mPlI = 1, mSBI > 1). Six patients reported ceramic fractures. No complications related to implant components occurred.Seven patients were not satisfied with aesthetic result.
Conclusions and clinical implications: It is concluded that a correct oral hygiene, the presence of keratinized mucosa and the characteristic design of the connection with a not relevant microgap, significantly influence the peri-implant soft tissue and bone level stability. In case of thin gingival tissue, we can expect crestal bone loss in the process of biologic width formation.

350 | Topic – Technical and Biological Complications

The usnic acid, an alternative for peri-implantitis treatment

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Background: The vegetal extracts are used as an ecological alternative to classical anti-infectious treatments based on antibiotics, exhibiting the advantage of secondary effects low risk. Most of these compounds are secondary metabolites, especially aromatic substances synthesized by plants in a reduced concentration.
Aim: In senior plants there were found many antiseptics that keep down or destroy the activity of microorganisms. One of these substances is the usnic acid, a vegetable extract with germicidal action, similar with the antibiotics. We think that this substance could be used for perimplantitis treatment, too.
Methods: Were ingathered sterile samples from peri-implantitis diseases (10 patients) during 2006–2009. The samples were set beside a suspension of usnic acid for 1, 2, 5 and 15 min. Every sample was put in brain heart infusion in order to determine the decrease curve for total number of germs, developed at different periods of time from incubation: 3, 6, 16 and 24 h. The establishment of total number of germs was realised through the use of microdilution and blood-gelose medium.
Results: The usnic acid selectively inhibits the development of biofilms mould by bacteria from periimplantitis. The multiplication was affected by the connection with usnic acid. The usnic acid could induce the change of the bacteria features through the involvement of the wall cell structure.
Conclusions and clinical implications: The germicidal action of usnic acid prove the possibility of using it for obtaing dental products able to prevent the development of dental plaque, as a new ecologic antiinfectious strategy which could be an alternative for the conventional antibiotic therapy.

351 | Topic – Technical and Biological Complications

Closure of oro-antral fistula resulting from the failing sinus-lift procedure: report of three cases

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Background: The sinus-lift procedure is regarded as the golden standard for implant treatment of the atrophic posterior maxilla. With sound surgical technique, success rate is high and complications are few. Oro-antral fistulas after sinus floor elevation are rare but represent a challenge: bony defects are huge due to lateral access window; infected graft is present in the sinus/subantral space, ridge atrophy is advanced, soft tissue quality is low due to former operation(s).
Aim: By presenting three patients with failures of the sinus-lift and consequent long-standing oro-antral fistulas, we want to emphasize the seriousness of the surgical problem and propose solutions.
Methods: All patients had lateral access sinus-lifts performed. One patient had one-stage procedure with particulate graft, the other two had two-stage procedures, one with autologous and the other with deproteinized bovine bone block. With first two patients, who were refered from other surgeons, fistula was evident after inflammatory episodes a few weeks after implant placement that have never been functionally loaded. Both patients were healthy, but heavy smokers, and both have had at least two unsuccessful former closure surgeries. Third patient was non-smoker but a bruxer that fractured the suprastructure and body of one of the implants 4 years after loading. Fistula was established after removal of the infected remnants of the deproteinized bovine bone block.

Similar surgical technique has been used by all patients. Fistula was exscised and residual grafting material removed. Incisions were extended diagonally vestibular/sublabial at least 15 mm anterior and posterior to the communication, where normal tissue structure could have been identified. Blunt preparation of periosteal layer over the maxillary bone started here and continued toward the center by sharp division of fused external and internal mucoperiosteal layers. Finally, residual sinus mucoperiosteum was undermined and a resorbable collagen membrane (Evolution fine, Osteobiol) placed beneath. The second membrane layer was placed under the external periosteum, which was sutured under the palatal site of the wound. Finally mucosal edges were adapted and meticulously closed tension free by interrupted sutures. Appropriate antibiotic, analgesic and decongestant medication was prescribed.
Results: Closure was successful by all patients. By the technique described, we were able to close fistulas based on bony defects of up to 30 mm.

Conclusions and clinical implications: Oro-antral fistulas after failing sinus-lift procedure should never be underestimated. Surgical technique for their closure should be adapted to the specific situation.

352 | Topic – Technical and Biological Complications

A novel technique to close large perforation of sinus membrane: a case report

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Background: Maxillary sinus floor elevation is a well-documented technique and it is generally accepted as a regenerative procedure to facilitate dental implants placement in the posterior atrophic maxilla. Although the sinus lift procedure is relatively safe, some potential problems could be occur. The most prevalent intraoperative complication is perforation of sinus membrane, which can lead to graft infection and early failure. Attempts at managing sinus membrane perforations are often limited by difficulty of access, as well as by the friability of the soft tissue lining the sinus. Various techniques and materials have been developed for repairing perforated sinus membrane.

Aim: Aim of this work is to present a new technique to repair large perforation of sinus membrane when a collagen membrane is not available.

Methods: This case report is focused on a 7 mm perforation of sinus membrane occurred during preparation of the sinus window, but may be due to trauma during a previously impacted root removal. The perforation was located in the mid superior aspect of the osteotomy, extending mesiodistally for two thirds of the dimension of the total osteotomy site. The obliteration of the perforation was obtained through suturing sinus membrane with a resorbable material to the periosteum directly lateral to the osteotomy site, giving the chance to not abort sinus augmentation procedures althought a collagen membrane was 'not available.

Results: No serious infections have occured and clinical and radiographic findings at 4 months were adequate. This technique results useful to obtain the closure of a large perforation when a collagen membrane is not available, providing the clinician with a containing element for the placement of the planned regenerative materials.

Conclusions and clinical implications: It can be concluded that membrane elevation must be carefully executed to avoid membrane perforation, but if it occurs and there is no available a collagen membrane it is still possible to continue the procedure safely using a resorbable suture for the closure of the perforation.

353 | Topic – Technical and Biological Complications

Implant placement under highly sedation

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Background: A barrier to effective implant placement is a sense of fear, uncertainty, and anxiety. The use of intravenous conscious sedation may alleviate these conditions in a predictable and safe manner, allowing the patient to feel more relaxed, comfortable, and less threatened. Conscious sedation may be defined as a state of relaxation and drowsiness from which the patient can be aroused.

Aim: In this study, the patient satisfaction after sedation and implant palcement was evaluated.

Methods: Seven patients needed more than 8 implants completed the study with average titrated dosages of 5 and 10 mg for midazolam and diazepam, and 150 μg of fentanyl, respectively. Ten days after the surgery in the check up session a questionnaire was given to the patients to evaluate the patient satisfaction.

Results: All the patients reported complete satisfaction and prefer the same procedure to be done in future in case of same surgery needed.

Conclusions and clinical implications: Highly sedation can be a method of choice for the patients need more than 3, 4 implants but more investigations are required.

354 | Topic – Technical and Biological Complications

Therapeutic modalities for peri-implant diseases: a systematic review

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Background: Information on the efficacy of therapeutic modalities for peri-implant diseases in humans is limited.

Aim: The aim of this study was to perform a systematic review of

- randomized and non-randomized controlled (or comparative) trials and
- retrospective case-control studies

published in the dental literature in the English language, up to and including February 2010, concerning the efficacy of all modalities used for the therapy of peri-implant diseases (peri-implant mucositis and peri-implantitis).

Methods:
- *PubMed* and *Cochrane* (CENTRAL) databases were searched electronically and
- sixteen journals were examined manually.
- At the first phase of selection, the titles and abstracts and
- at the second phase, complete papers

were screened independently and in duplicate by two reviewers (Sotirios Kotsovilis, Ioannis Fourmousis).

According to the inclusion/exclusion criteria,

- studies including < 5 patients in at least one study group,
- prospective or retrospective studies without a control (or second) group,
- cross-sectional studies,
- case series/reports,
- animal studies,
- *in vitro* studies,
- reviews,
- consensus reports,
- practice guidelines,
- letters and
- editorials

were excluded.

Results: The search provided 1376 potentially relevant titles and abstracts.

Following the first phase of selection, 29 articles:

1. six articles reporting on six peri-implant mucositis patient cohorts,
2. Twenty-one articles reporting on 15 peri-implantitis cohorts and
3. two articles reporting both on two peri-implant mucositis and two peri-implantitis cohorts

were retrieved for full-text evaluation.

Following the second phase, 21 articles:

1. six articles for peri-implant mucositis and
2. fifteen articles for peri-implantitis

were selected.

Conclusions and clinical implications: • *Non-surgical therapy of peri-implant mucositis and peri-implantitis* may include:

1. Motivation/instruction in oral hygiene,
2. supra- and sub-mucosal mechanical debridement (using carbon fiber curettes/hand plastic instruments or specially designed ultrasonic devices, followed by rubber cup polishing),
3. antiseptic therapy and implant surface detoxification/decontamination (using mouthrinses/irrigants/gels, e.g. chlorhexidine, citric acid, hydrogen peroxide, saline) and
4. chemical cleansing therapy (e.g. 35% phosphoric acid etching gel).

- Non-surgical therapeutic modalities may

1. improve plaque control,
2. reduce the clinical signs of peri-implant inflammation and
3. reduce/eradicate associated putative pathogenic bacteria.

- *For peri-implantitis*, the use (possibly repeated) of

1. local or systemic antibiotics or
2. Er:YAG laser

may result in significant improvement in

1. peri-implant clinical ''attachment'' level and
2. probing pocket depth.

- Further improvement can be achieved by *surgical therapy of peri-implantitis*, which may include:

1. Soft tissue resective surgery and
2. osseous regenerative techniques (osseous grafts and substitutes, alone or combined with resorbable or non-resorbable barrier membranes).

- However, the indications and the relative efficacy of these therapeutic modalities have not been clearly determined and long-term studies are required.

355 | Topic – Technical and Biological Complications

Comparison of the bacterial sealing at two different implant/abutment interface

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Background: An important parameter related to bone loss around dental implants is the implant/abutment interface, where a microgap is present, and there is the possibility of bacterial leakage in this area.

Aim: The aim of this study was to compare, *in vitro*, external hexagon and Morse tapper implant systems, considering bacterial sealing between implant and abutment.

Methods: Twenty-four samples of implants were equally divided into two groups. Group I were composed by external hexagon (Neodent, Curitiba, Brazil) and group II by Morse tapper (Neodent) implant/abutment designs. The implants were apically perforated with a 1 mm bur until it reached its internal chamber. Prosthetic components with the recommended torque (32 and 10 N cm, respectively) were adapted for each group. The implants were attached to the coverage of essay vial, with the abutment end positioned into the tube. Using a sterilized syringe the essay vials were filled with liquid culture medium (BHI). All the specimens were sterilized by γ radiation. After confirming the efficacy of sterilization using control samples, the apical hole was carefully opened and inoculated with *Escherichia coli*.

Results: The control of sample turvation was daily performed and the results pointed that 60% of the samples of Group I were contamined in a 14-day period as well as 30% Group II. After this period there was no contamination in both groups.

Conclusions and clinical implications: Considering the obtained results it was concluded that Morse tapper implants presented better bacterial sealing than external hexagon implants.

356 | Topic – Technical and Biological Complications

Interimplant papilla reconstruction and hard and soft tissues interactions

Presenter: Tizzoni R
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Background: To achieve an aesthetic outcome in an implant-supported rehabilitation, the foundation for the gingival support is the underlying osseous crest. It has been proven that by maintaining or trying to correct the height of bone in the interproximal area, an aesthetic reconstruction of the papilla can be achieved. In the aesthetic area GBR procedures are routinely performed before or during dental implant placement to increase alveolar bone volume.

Aim: The aim of this case report was to verify the role of bone loss in one case of GBR procedure, as a consequence of a

post-surgical complication, on the presence or absence of previously reconstructed interimplant papillae.

Methods: The premaxilla in one patient, requiring adjacent implants and fixed prosthesis, was treated with six scalloped implants from tooth number 1.3 to tooth number 2.3.

The implants were placed in a ridge with flat anatomy and in ideal 3D position 4 months after tooth extraction and simultaneous guided bone regeneration procedure performed by means of particulated autologous bone and reabsorbable membranes. A surgical technique for interimplant papilla reconstruction was also carried out on bone structures at the time of implant placement and on soft tissues at second-stage surgery.

A total of five interimplant papillae were examined.

Four implants rehabilitated posterior areas, too.

Results: All implants were stable and successfully in function at 1 year follow-up, resulting in 100% cumulative survival rate.

Eighty percent of the interimplant spaces analysed showed aesthetically pleasant papilla reconstruction 2 weeks after second-stage surgery and at 1 year follow-up, one interimplant papilla (20%) started to fail to maintain underlying hard tissue support 7 days after implant placement due to a deficiency in wound closure, even if complete spontaneous wound healing was accomplished 20 days after implant placement.

Nevertheless no bone support was achieved for that papilla and the aesthetics was jeopardized.

Conclusions and clinical implications: This case report indicate that for an aesthetic reconstruction of interimplant papillae the following factors need to be considered:

1. bone grafting is applied for good initial implant stability, to prevent resorption of the buccal bone plate and to support the buccal and interproximal gingiva for an optimal aesthetic result of the peri-implant soft tissues

2. the results of the present study seem to confirm that interimplant papillae reconstruction is now achievable, as previously reported.

3. an uneventful soft tissue wound healing is desirable to allow bone graft stability, to prevent extensive bone resorption and reconstructed interimplant papilla maintainance.

357 | Topic – Technical and Biological Complications

Peri-implantitis treatment

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Background: Peri-implantitis is a consequence of the imbalance between the present bacteria and host defenses. It is defined as an inflammatory process, with infeccious origin, that affects the tissues around the osseointegrated implant, resulting in bone loss.

There are two possible treatments: surgical and non-surgical. The first one is indicated when periodontal pockets have 5 mm depth or more and bone loss is present.

Non-surgical treatment refers to mechanical debridement, without flapless surgery.

In addition, it can be used topical antiseptic and/or systemic antibiotic at the same time with both treatments.

Lang and colleagues suggest one systematic approach for preventing and treatment of peri-implantitis. This protocol is called cumulative interceptive supportive therapy (CIST) and has four steps:

A – Mechanical debridement.

B – Antiseptic cleansing.

C – Systemic or local antibiotic therapy.

D – Ressective or regenerative surgery.

This protocol is cumulative. For peri-implantitis treatment it can be used the following protocols A + B + C or A + B + C + D, depending on disease severity.

Aim: To compare which treatment is more effective.

Methods: Research in the Pubmed, since 2004, with the following keywords: *"peri-implantitis treatment"*, *"surgical treatment of peri-implantitis"* and *"non-surgical treatment of peri-implantitis"* wih the following limits:

– Language: English;

– Type: meta-analyses, randomized clinical trials and reviews.

Results: From 46 studies, eight were selected according to the following criteria:

– Must describe surgical and/or non-surgical treatment of peri-implantitis;

– Studies in animals and humans, with 1 year minimum of follow up;

– Mention the following terms: pocket depth, bleeding on probing and radiographic bone level.

Conclusions and clinical implications: Non-surgical mechanical treatment shows limited evidence in the treatment of peri-implantitis. Clorhexidine shows efficiency on microbial and clinical parameters. Surgical mechanical treatment has no scientific evidence solving peri-implantitis, but mechanical debridement, descontamination of the implant surface and administration of local or systemic antibiotics have show to decrease bleeding on probing and pocket depth.

More randomized clinical trials are needed, especially in humans to evaluate the results and advantages of both treatments.

358 | Topic – Technical and Biological Complications

Management of a failed subperiosteal implant case with endooseous implants

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Background: Options for the edentuluous mandible include a conventional denture, a tissue-borne implant supported prosthesis, or an implant supported prosthesis.

In the past, due to inadequate alveolar bone height in certain sites of the jaws, subperiosteal implants were developed. Multiple variations

to the first subperiosteal implant of Dahl''s were fabricated but these devices often resulted in wound dehiscence.

Blade implants were introduced in 1968 by Linkow. These endoosseous implants had numerous configurations for different applications, and the implants were widely used around the world.

Brånemark's root form threaded titanium implants were first used in 1965 and studies showed prolonged survival and bone maintanance. This was a breakthrough in maxillofacial reconstruction.

Aim: This poster presentation aims to present a failed subperiosteal implant that resulted in gross vertical bone loss and a simple treatment strategy involving an implant supported overdenture.

Methods: A 66 years old man presented complaining of his lower dentures poor stability. A clinical examination revealed the unstable posts of a subperiosteal implant in anterior mandible. The patient could not recall the date of the operation and was only able to tell that it was within the last decade. The gingiva around the posts was inflamed. A panaromic radiograph showed the extent of bone loss. Loose screws, the subperiosteal implant and a piece of sequestered alveolar bone were observed within abundant granulation tissue.

An informed consent was taken for sequesterctomy, retrieval of the subperiosteal implant and at a later stage endoosseous implant placement for fabricating an implant supported overdenture. Under local anaesthesia anterior mandible was exposed, the implant and the associated granulation tissue were removed, leaving only basal bone with a vertical height of 8 mm between the mental foramina. Nine months after this operation two dental implants were placed under local anaesthesia. After 3 months, healing screws were placed and a mandibular overdenture with ball attachements were made.

Results: Healing was uneventful. The patient was satisfied with the stability and aesthetics of his new denture.

Conclusions and clinical implications: Subperiosteal implants could lead to extensive alveolar bone loss precluding any easy solutions for retreatment.

8 mm of residual vertical height of anterior mandible is sufficient for fabricating lower implant supported overdentures.

Posters: Topic – Basic Research (Abstracts 359–403)

359 | Topic – Basic Research

A model to study reconstruction methods for the inferior alveolar nerve

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Background: During implant insertions or oral surgery, injuries of the inferior alveolar nerve may occur. These disturbances cause massive reductions in quality of life through difficulties for eating and speech.

Aim: The aim of this study was to evaluate a rabbit model to test reconstruction techniques including growth factors for the inferior alveolar nerve.

Methods: In eight rabbits the inferior alveolar nerve was resected over a distance of 2 cm. In four animals, the defects were reconstructed by using the turned resected nerve as positive control, while the defects remained without further reconstruction in four other animals as negative control. Before surgery and then every month for 6 months, the regeneration was monitored electrophysically by testing the jaw-opening reflex that is only present in rabbits. This reflex opens the mouth after stimulation of the inferior alveolar nerve. After 6 months histologies were harvested.

Results: Electrophysiology revealed that all animals in the positive control groups had a restored jaw-opening reflex after 3–4 months, while all negative controls remained negative until 6 months. These results could be confirmed by histology.

Conclusions and clinical implications: The presented rabbit model allows testing of different reconstruction techniques like stem cell injections for the inferior alveolar nerve by electrophysiological and histological methods. In future experiments even growths factors could be tested and compared in a validated model.

360 | Topic – Basic Research

Biological responses of hmscs cells on ti-implants depending of their roughness

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Background: Interaction between cells and the extracellular matrix (ECM) is critical for the regulation of cellular function such as cell shape, migration, proliferation, and survival. It is widely accepted that the initial interactions between cells and implant surface are crucial for clinical success and the improvement of these processes may lead to faster bone formation. Morphology and roughness is related with this process (Puleo et al. 1991; Damsky 1999; Hood et al. 2002).

Aim: To evaluate the cellular response (adhesion, proliferation and cellular differentiation) of hMCSs on the surface of titanium implants depending on their roughness (smooth and rough surface).

Methods: Titanium rough implants and disks with smooth and rough surface; Human mesenchymal stem cells derived from bone marrow (hMSCs); Cellular distribution (DAPI; Cell tracker); Cellular adhesion (cell number until 24 h); Proliferation (cell number until 28 days); Differentiation (osteogenic markers expression until 28 days by Real Time PCR). A sample size of six was used for each experimental group. Analysis of variance (ANOVA) and pairwise multiple comparison tests (Student's *t*-test) were used to determine differences within a group (SPSS software package).

Results: Adhesion, proliferation and differentiation of hMSC cells were carried out on Ti6Al4 V titanium alloy samples with smooth and rough surface. Surface roughness showed a positive correlation in comparison to proliferation, adhesion and differentiation parameters. Cells distribution was higher on the valley than in the ridge of the Ti-implants. The results show a trend to increment in cellular adhesion on rough surface when compared with smooth surface. It was observed a trend to increment cellular proliferation on rough surface when compared with smooth surface. The osteogenic marker osteopontin increased its expression in cells seeded on rough and smooth surface when compared with plastic surface (control), showing higher expression on rough than on smooth surface.

Conclusions and clinical implications: The surface roughness seems to improve the cellular adhesion and proliferation of hMSCs and it is able to induce osteogenic differentiation in absence of any differentiation factor. This may lead to the suspicion that the concomitant effect of surface roughness has an effect on osteoblastic cell proliferation and adhesion.

361 | Topic – Basic Research

Effect of implant-borne bridgework on supporting tissues of natural teeth

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Background: Statement of the problem: Application of endosseous implants to support prosthesis in the partially dentate jaw

has been documented with great success. However, little is known of the effects these superstructures have on the supporting tissues of the opposing natural teeth.

Aim: To obtain histological evidence that there are no adverse effects on the structure of the supporting tissues of natural teeth opposing implant-borne bridgework.

Methods: Test samples consisted of maxillary second premolar-second molar jaw segments from four healthy adult male monkeys (*Macaca fascicularis*) that had implant-supported three-unit bridge placement in the second premolar-second molar regions of their mandibles – one side for immediate loading and the other side for delayed loading, in a split mouth design. Control samples also consisted of maxillary second premolar-second molar jaw segments from two monkeys but without fixed prosthesis placement in the opposing mandibles. After 3 months of functional loading, the animals from both test and control samples were sacrificed, and the premolar-molar regions of the maxilla were harvested and processed for histological analysis. The histological reactions of bundle bone, periodontal membrane and cementum were evaluated.

Results: The gingiva, bundle bone, periodontal ligament and cementum of the natural teeth were of normal structure. No difference was found in these tissues of natural teeth in test and control samples. However, considerably more remodeling activity was observed in the cementum and bundle bone in the test samples.

Conclusions and clinical implications: Present findings suggest that implant-borne bridgework do not produce adverse effects on the supporting tissues of the opposing natural teeth. This observation has great impact on the clinical application of endosseous implants in the restoration of the partially dentate jaw.

362 | Topic – Basic Research

Evaluation of the bone regeneration process in a rat model of osteoporosis

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Background: Osteoporosis is characterized by a reduction in bone mass and disruption of bone architecture, resulting in increased bone fragility and fracture risk. These fractures are widely recognized as a major health problem in the elderly population. Osteoporosis is of additional relevance in women entering the menopause due to the lack of estrogen production – associated with an anti-resorptive stimulus to the bone tissue. Hormonal disequilibrium is known to favour bone resorption, which in turn leads to skeletal fragility and increased risk of fracture. Additionally, preliminary data reports that the bone regeneration process, in osteoporotic conditions, may be somewhat limited mainly due to a decrease of new bone formation, nevertheless specific mechanisms have not been stated.

Aim: The aim of this study is to evaluate bone regeneration process in a rat model of osteoporosis, both in the presence and the absence of a bone-regenerative biomaterial.

Methods: This evaluation was made in a valid animal model of primary osteoporosis – ovariectomized Wistar rats, which can mimic the systemic human condition. This model relies on the usual changes that bone tissue undergoes after ovariectomy. The animals were randomly divided into two groups: sham operation and ovariectomy group (Ovx). The animals of each group were assigned to two sub-groups ($n = 6$): critical size and non-critical size defects. Critical size defects of 5 mm ø were created on the skull of Ovx and sham animals, previously to the placement of a commercial ceramic-based biomaterial (Bio-Oss®), known to report adequate biocompatibility. Non-critical size defects of 3 mm ø were created on the skull of the Sham and Ovx group and left untreated to access the intramembranous ossification process. Routine histological, immunohistochemical, histomorphometric and radiographic evaluations were conducted at adequate time points.

Results: Conducted evaluation techniques allowed to verify that the osteointegration process was impaired in Ovx animals, compared with Sham, in which regards the biomaterial-mediated bone regeneration model. Also, the assessment of the intramembranous ossification process, with the sub-critical model, reported an impaired biological response in the Ovx group.

Conclusions and clinical implications: Osteoporosis seems to greatly affect the biological response to biomaterial's implantation and the structured events of the intramembranous ossification process. Care should be taken on pre-operative preparation and a selective choice of biomaterials should be undertaken when facing bone regeneration in osteoporotic-compromised conditions.

363 | Topic – Basic Research

The osteoblastic differentiation of human dental pulp stem cells and bone formation on two different titanium surface textures

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Background: Bone tissue engineering and oral implantology require the integration of implanted structures, with a well-characterized surfaces, in bone.

Aim: In this work we have challenged acid etched titanium (AET) and Laser Sintered Titanium (LST) surfaces with either

human osteoblasts or stem cells from human dental pulps (DPSCs), to understand their osteointegration and clinical use capability of derived implants.

Methods: Stem cells from human dental pulps (DPSCs) and human osteoblasts were challenged with the two titanium surfaces (acid etched titanium surface, AET, and laser sintered titanium surface, LST) either in plane cultures or in a roller apparatus within a culture chamber, for hours up to a month. During the cultures cells on the titanium surfaces were examined for histology, protein secretion and gene expression.

Results: A complete osteointegration using stem cells from human dental pulps (DPSCs) has been obtained: these cells were capable to quickly differentiate into osteoblasts and endotheliocytes and, then, able to produce bone tissue along the implant surfaces. Osteoblast differentiation of stem cells from human dental pulps (DPSCs) and bone morphogenetic protein production was obtained in a better and quicker way, when challenging stem cells with the LST surfaces.

Conclusions and clinical implications: Our results demonstrate that challenging two titanium surfaces, namely the laser sintered titanium (LST) with respect to the acid etched titanium (AET) surfaces with stem cells from human dental pulp, we are capable to obtain osteoblast differentiation of stem cells from human dental pulps (DPSCs), production of appreciable amounts of bone morphogenetic proteins as well as vascular endothelial growth factor and specific bone proteins. Therefore, a complete osteointegration is obtained. This happens in a better and quicker way when challenging sintered titanium with respect to the acid etched titanium surface. This successful Bone Tissue Engineering gives interesting data for consideration when evaluating the technique as an alternative to standard methods for producing implants for clinical Oral Implantology. Moreover, using stem cells of dental pulp (DPSCs), which are capable of producing woven bone, we can increase the chance to accelerate the time for implant loading.

364 | Topic – Basic Research

Bone healing follow-up around implants in non-destructive animal research

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Background: Many efforts were made in order to improve the time necessary to obtain osseointegration in type four bones. Histology helps to study implant surface influence, but the scintigraphy could asses the osteoblastic activity around implants evaluating the dynamics of the process in an *in vivo* model.

Aim: Compare the osseous activity produced by two implant surfaces and the relationship with the bone implant contact. Work hypothesis: the scintigraphy allows to differentiate implant surface biologic responses.

Methods: Twenty-four implants (12 MKIII TiU/12 MKIII machined 10 × 3.75 Nobel Biocare, Gothemburg, Sweden) were placed in 12 New Zeeland rabbits (12 femoral/12 tibial) under general anesthesia. Protocol was approved by the Ethical Committee (Barcelona University, Spain). In order to obtain the Activity Index (average count pixels in implant region of interest/average count pixel in the control place), at 1 week before implant insertion and at 15 days, 1, 2, 3 months postop, three scitigraphies (whole-body/pinhole colimator –tibial/femoral) were taken in each session with 185 mBq of Tc-99MDP tracer. Two hundred and forty activity index were obtained and when the indexes were almost the same as pre-surgery, the animals were sacrificed and the specimens processed for SEM to evaluate the bone-implant contact. Data were processed statistically (SAS® v8.0 for Windows, – SAS Institute Inc., Cary, NC, USA).

Results: – There was more osseous activity, independently on the anatomic place, around machined implants in the first post-op scintigraphy ($P = 0.0375$, $P = 0.0260$).

– The maximum value in all cases was seen in the first post-op scintigraphy and gradually decreases ($P < 0.0001$).

– The global activity was less in tibia than in femur independent on the surface ($P = 0.0139$).

– There was no statistically significancy comparing the percentage of implant-bone contact at the end of the study (TiUnite® 47.61%, machined 55.61%).

– There was no correlation between osseous activity and bone contact at the end of the study.

Conclusions and clinical implications: In our study scintigraphy has been effective to compare activity generated by two types of implant surfaces. The results demonstrate that more osseous activity around implant not correlates with a better bioactive surface (TiUnite®) or a major percentage of bone contact by SEM at 3 months.

365 | Topic – Basic Research

Actions of Melatonin mixed with collagenized porcine bone vs. porcine bone only osteointegration of dental implants

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Background: Melatonin, due to its antioxidant properties and its ability to detoxify free radicals, may interfere in this function of the osteoclast and thereby inhibit bone resorption. The inhibition of bone resorption may be enhanced by a reaction of indolamine in osteoclastogenesis. Melatonin acts on osteoclasts, multinuclear osseus cells involved in the reabsorption

of osseus matrix in different forms, one of which is via the formation of free radicals.

Aim: The aims of our investigation, carried out with experimental New Zealand rabbits, were (i) to evaluate the effect of the topical application of melatonin mixed with collagenized porcine bone compared with porcine bone alone related to bone regeneration of the cortical bone after 2 months of their insertion and (ii) to assess the feasibility of clinical application of melatonin with porcine bone or porcine bone alone in osteointegration processes in the tibiae bone defects.

Methods: In preparation for subsequent insertion of dental implants, lower molars were extracted from 12 Beagle dogs. Each mandible received two parallel wall expanded platform implants with a discrete calcium deposit (DCD) surface of 4 mm in diameter and 10 mm in length. The implants were randomly assigned to the distal sites on each mandible in the molar area and the gaps were filled with 5 mg lyophilized powdered melatonin and porcine bone and collagenized porcine bone alone. Ten histological sections per implant were obtained for histomorphometric studies.

Results: After a 4-week treatment period, melatonin plus porcine bone significantly increased the perimeter of bone that was in direct contact with the treated implants ($P < 0.0001$), bone density ($P < 0.0001$), and new bone formation ($P < 0.0001$) in comparison with porcine bone alone around the implants. Melatonin combined with porcine bone on DCD implants reveals more bone in implant contact at 12 weeks ($84.5 \pm 1.5\%$) compared with porcine bone alone treated area ($67.17 \pm 1.2\%$).

Conclusions and clinical implications: Melatonin plus collagenized porcine bone on DCD surface may act as a biomimetic agent in the placement of endo-osseous dental implants and enhance the osteointegration.

366 | Topic – Basic Research

Bone response to the immediately placed implant in the maxilla of diabetic rat

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Background: The current knowledge of immediate implantation is quite limited, particularly as it relates to the effects of systemic diseases such as diabetes.

Aim: Our research is to evaluate the effects of insulin in the peri-implant bone healing around immediately placed titanium implants in the diabetic rat maxilla.

Methods: Thirty-two Sprague-Dawley rats were randomly assigned to three different treatment groups: control ($n = 8$), diabetic ($n = 12$), and insulin ($n = 12$). Titanium implants (1.5 mm × 3 mm L) were placed in the fresh extraction socket of maxilla. Animals were sacrificed following 3, 7, 14 and 28 days of healing and the bone block was harvested and assessed by histologically (H&E) and radiographically.

Results: In the histologic exam, more bone was observed around the implants from insulin group the diabetic group. The radiographic results were measured by bone density (BD) between the groups. Values for BD were greater for the non-diabetic control group than the diabetic control group.

Conclusions and clinical implications: The results of this study using a rat model confirm that diabetes inhibits osseointegration. In addition, this study demonstrates that the detrimental effects of diabetes on osseointegration can be modified using insulin.

367 | Topic – Basic Research

An anatomical study related to the mandibular medial surface by cone-beam CT analysis for safer dental implant placement in the mandible

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Background: Currently, the placement of dental implants involves minimally invasive oral surgical procedures that are normally without significant risk. In the mandible, however, some of the complications like perimandibular vessel bleeding can arise during host site preparation, in which the mandibular lingual compact bone can become severely perforated because of the unique morphology of the medial surface.

Aim: The purpose of this study is to analyze and evaluate the anatomical morphology of the medial surface of the posterior mandible using 3D cone-beam computed tomography (CT) images for reducing complications in relation to dental implant placement.

Methods: Fifty patients were included in the study, 31 males and 19 females (29 right first molars and 21 left first molars). Average age ($\pm$ standard deviation) of the patients were 44.28 ± 13.05. On the coronal views cone-beam CT of the first molars, the distance between the top of the canal and the alveolar crest (Vertical distance, VD_X ($X = 0$–7)), the horizontal distance between the top of the canal and the outer lingual cortical margin of the mandible (LD), the location of the starting point of VD for reducing from the vertical reference line (VD point), and the inclination of mandibular medial surface (Lingual inclination) were measured, and a statistical evaluation was done using SPSS for Windows 15.0 (SPSS Inc., Chicago, IL, USA).

Results: The mean VD_o was 16.91 ± 2.47 mm (maximum 23.7 mm, minimum 12.9 mm) and VD*x* showed decreasing patterns as × value is increasing. The mean LD was

5.27 ± 1.36 mm (maximum 9.8 mm, minimum 2.4 mm). The VD started decreasing at the mean location of 6.12 ± 0.96 mm from the vertical reference line. The mean Lingual inclination was 1.52 ± 0.72°.

Comparing male with female, significant differences were found in the VD. At the same time, when comparing the VD_o and Lingual inclination, moderate positive linear relationship were found.

Conclusions and clinical implications: The results of this study will help accurate placement of the dental implant and reducing several complications such as lingual cortical bone perforating following life-threatening bleeding, particularly in case of preoperative implant planning using only two-dimensional imaging methods (ex. Panoramic radiography).

368 | Topic – Basic Research

Molecular biologic response to the immediate implants in diabetic and insulin-treated rats

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Background: Dental implants are routinely used with high success rates in generally healthy individuals. In contrast, their use in patients with diabetes mellitus (DM) remains controversial, as altered bone healing around implants has been reported.

Aim: The objective of this study was to compare uncontrolled diabetic rat with insulin controlled diabetic rat by insulin efficiency by evaluating the expression of biologic molecules on bone regeneration in rat maxilla.

Methods: An experimental group of 20 rats was divided in three groups. : DM ($n = 8$ diabetic rats), DMC ($n = 8$ insulin-treated diabetic rats), and control ($n = 4$ normal rats). All rats received one titanium microscrew implant of diameter 1.2 mm, length 3 mm in extraction socket of maxillary first molar. The rats were sacrificed at 3, 7, 14 and 28 days following implant insertion and bone around implant were cut and analysed by RT-PCR for quantification of expression of TGF-β1, osteonectin, osteocalcin and BMP-4.

Results: The level of expression of TGF-β, osteonectin, osteocalcin and BMP-4 were higher in the insulin-treated groups (DMC) compared with the uncontrolled groups. And there was no significant difference in bone formation and osseointegration between the insulin-treated group and the normal group.

Conclusions and clinical implications: These findings suggested that controlled diabetic rats are associated with increased bone response compared with the control groups and this response was thought to be mediated by treatment with insulin. In subjects with good diabetic control, immediate implant installation after tooth extraction would not be contraindicated.

369 | Topic – Basic Research

Comparative histological bone tissue analysis after laser and drill osteotomy

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Background: The use of drilling procedures has distinct disadvantages, such as broadening of cuts, extensive heat deposition, mechanical traumatization, deposition of metal shavings and bacterial contamination. Haemostatic and aseptic effects, absence of mechanical stress and intricate cut geometry are potential beneficial aspects of noncontact osteotomy with infrared lasers.

Aim: The aim of this study was to compare bone tissue effects after osteotomy site or screw holes performed with Er:YAG laser and surgical drill.

Methods: The study was performed on the five pig ribs prepared with saggital osteotomy to get two equal parts of the rib. Each part was separated in equal plates with similar thickness of cortical and spongious bone mutually. The idea was to simulate height and width of intraoral autologous bone blocks commonly used in bone management. On the each plate two osteotomies were performed. For the osteotomies, non-contact Erbium-YAG laser (AT Fidelis, Fotona, Slovenia) was applied with the 0.9 mm spot size in the max mode (1000 mJ, 20 Hz) and the handpiece was kept at a distance of 10 mm from the bone surface to make bone site within the full thickness of the plate. The other osteotomy, as a control, was performed with the 1 mm wide surgical drill (Screw System, Hager&Meisinger GmbH, Germany), commonly used for the fixation screws preparations, at 15,000 rpm, with simultaneous saline irrigation. For light microscopic investigation, samples were decalcified in 5% nitric acid solution and processed in paraffin wax. Histological saggital sections through each osteotomy site were prepared and stained with hematoxylin and eosin.

Results: Histological evaluation of the laser sites demonstrated an altered layer in the margins of the osteotomy of approximately 30-μm thickness, while drill sites did not present any altered layer. In the case of laser osteotomy, superficially thin affected layer with irregular borders was composed by two different sublayers: a lightly stained superficial layer with no defined structures and a darkly stained underlying layer, presenting minimal thermal damage. Empty osteocyte lacunae could be observed approximately 30 μm distant from the irradiated surface. The surface of the bur-performed grooves was covered with a thin smear layer with regular border. No thermal damage was observed.

Conclusions and clinical implications: Er:YAG laser irradiation caused only minimal thermal damage to bone ablated at the specified parameters and may become applicable as an alternative method for bone surgery.

370 | Topic – Basic Research

The influence of impression material and implant placement depth on stability of open tray impression coping

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Background: The stability of open-tray transfer copings, surrounded by set impression material may be important for final prosthetic outcome. It is proposed that impression coping in the tray should be as stable as possible to avoid displacement and increase precision.

Aim: The aim of the study was to evaluate the influence different impression materials on stability of open tray impression coping, taken form implants, placed in different vertical positions. Additional aim was to define if impression coping stability has correlation with depth of implant placement.

Methods: Plastic models with four Straumann Bone Level implants 4.1 analogs embedded in different vertical positions were fabricated. Analogs were placed equally with surface (A), 2 mm (B), 4 mm (C) and 5 mm (D) below the surface. Open tray impressions were taken, using polyvinylsiloxane materials and A-silicone based occlusal registration materials. Analogs were connected to copings and their stability in the tray measured with special device, consisting of force gauge, firmly connected to moving platform.

Results: Splash Extra Light showed 4.74 ± 0.22 SD for A, 4.68 N ± 0.24 SD for B, 4.56 N ± 0.16 SD for C and 2.55 N ± 0.74 SD for D implant. Splash Light showed 9.8 N ± 0.4 SD for A implant, 6.48 N ± 0.32 SD for B, 5.52 N ± 0.55 SD for C and 5.29 N ± 0.33 SD. Splash Medium showed 14.5 N ± 0.41 SD for A, 12.44 N ± 0.67 SD for B, 11.86 N ± 0.35 SD for C and 8.44 N ± 0.22 SD for D implants. Splash Putty showed 10.12 N ± 0.33 SD for A implant, 9.92 N ± 0.56 SD for B, 8.63 N ± 0.55 SD and 7.91 N ± 0.44 SD for D implant. Occlusal registration material Futar D showed 43.58 N ± 0.66 SD for A implant, 40.45 N ± 0.23 SD for B, 37.28 N ± 0.78 SD for C sample and 35.78 N ± 0.88 SD for D implant. Two-way ANOVA revealed statistically significant differences between occlusal registration materials and A polyvynilsiloxanes ($F[1, 7] = 88.5$; $P = 0$). There was a significant negative correlation between the depth of the implant and force ($r = -1$, $P < 0$).

Conclusions and clinical implications: It can be concluded that impression coping was most stable, when A-silicone based occlusal registration materials were used for impression taking. If implant placement depth increases, the stability of transfer decreases.

371 | Topic – Basic Research

Cortical activation elicited by stimulation of periodontal mechanoreceptors during fMRI

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Background: Intra-oral somatotopy has been hardly addressed, and the few available results are dissenting because of a disparity in methodology. Functional magnetic resonance imaging may be used to unveil the cortical projections of periodontal mechanoreceptors but the application of the method to the oro-facial area remains challenging. For this purpose, we developed a non-magnetic manually controlled device that can apply calibrated mechanical punctuate stimuli to the teeth during fMRI studies.

Aim: To describe the normal cortical projections of periodontal mechanoreceptors.

Methods: Twenty healthy right-handed subjects (six males) with a complete natural dentition were recruited for an fMRI study. Repetitive punctuate stimulation were delivered at a frequency of 1 Hz with a device that used von Frey filaments N° 6.1 (100 g) and 6.45 (180 g) to stimulate the incisive and the canine, respectively. Teeth 11 and 13 were stimulated in 10 subjects while teeth 21 and 23 were stimulated in the others. Gradient echo echo-planar images covering the whole brain were acquired at 3 T (TR/TE: 3000/50 ms) during a block design paradigm. In 10 subjects, three runs alternating active and rest periods of 24 s, six active epochs/run, were performed. In five subjects in each group, a tactile stimulation of the thumb was also delivered and the protocol included four runs. The stimulated sites were interleaved during each run, the same site being stimulated during the whole active epoch. Individual activations maps were created after normalization in the anatomic space defined by Talairach and second level random effect group analyses were performed in SPM5.

Results: At $P < 0.001$ (20 contiguous voxels, uncorrected for multiple comparisons), active clusters were found in somatosensory areas for all stimulated teeth (T). The parietal operculum (SII) was activated bilaterally for T11, T13 and T21, and on the ipsilateral side for T23. The postcentral gyrus (SI) was activated bilaterally for T13, and on the contralateral side for T23 and T11. At a lower threshold ($P < 0.005$, uncorrected),

activations were observed in S2 and S1 bilaterally for all teeth (excepted for T11 in S1), and occasionally in some other areas like the cerebellum, the middle and inferior frontal gyri, the inferior and superior temporal gyri, the supramarginal gyrus, the infero-posterior angle of the insula and the border of the cerebral peduncles.

Conclusions and clinical implications: Bilateral activations of primary and secondary somatosensitive areas are consistently observed when stimulating periodontal mechanoreceptors during fMRI.

372 | Topic – Basic Research

Hypoxia-mimetic agents stimulate the production of VEGF by periodontal fibroblasts

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Background: Hypoxia inducible factor-1 alpha (HIF-1) is a transcription factor that is considered a key stimulator of blood vessel formation. An attractive strategy to improve angiogenesis is based on hypoxia-mimetic agents (HMAs) that prevent the degradation of HIF-1 under normoxia. The development of treatment strategies requires identification of HMAs according to their angiogenic capacity.

Aim: Aim of the study was to focus on the molecular aspects underlying these differences in periodontal fibroblasts.

Methods: We investigated whether HMA can cause periodontal cells to provide a pro-angiogenic environment under normoxia. Human fibroblasts derived from the gingiva and the periodontal ligament were cultured in the presence of four HMAs: dimethyloxalylglycine, desferrioxamine, L-mimosine, and $CoCl_2$. We determined cell activity, cell signaling, and the level of HIF-1. Release of vascular endothelial growth factor (VEGF) was evaluated under basal and simulated inflammatory conditions.

Results: We demonstrate that HMA stabilized HIF-1 and increased VEGF expression in periodontal fibroblasts, which was not hampered by a reduced cell activity. Among the four HMAs, L-mimosine had the least detrimental consequence on cell activity. The observed effects occurred independent of mitogen-activated protein kinases and phosphoinositide-3-kinase signaling, indicating that HIF-1 directly regulates VEGF expression. Consistent with this, inflammatory cytokines that activate these signaling pathways did not affect HMA-stimulated VEGF release by periodontal fibroblast. Also blocking of the relevant signaling pathways had no impact on the HMA-stimulated expression of VEGF.

Conclusions and clinical implications: These data suggest that pharmacological stabilization of HIF-1 can stimulate the local release of VEGF by periodontal fibroblasts. In particular, L-mimosine could have desirable effects in enhancing angiogenesis in the periodontium. If these results translate into periodontal regeneration *in vivo* requires further studies.

373 | Topic – Basic Research

Wound healing following mandibular lingual cortex perforation using maxillary sinus lifting procedures in dogs

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Background: Recently clinical applications of numerous crestally approached sinus membrane lifting instruments were reported. But comparisons of wound healing procedures following different instruments were unclear. There are certain limitations such as anatomic variations of maxillary sinus etc.

Aim: The purpose of this primary study was to compare early wound healing processes in the lingual periosteum and bone after linguo-cortical perforation of mandible on beagle dogs using two different types of crestally approached sinus membrane lifting instruments.

Methods: Four mandibular premolars in each three beagle dogs were extracted. After 2 months of healing, three osteotomy sites were prepared with the diameter of 3 mm implant drill from buccal to lingual side without perforation. Then the cortical plates of each hole were perforated without tearing of periosteum using On-site Sinus Compaction (OSC) 018, OSC 026, and the diameter of 3 mm hatch reamer according to each manufactures recommendations. The wound healing processes in periosteum and bone were compared on the day of operation, 3 and 7 days after operation histologically and immunohistochemically through the expression of TGF-ß1.

Results: More bony destruction was observed in the Hatch reamer group. However, on the seventh day after operation similar periosteal healing processes were observed in all three groups.

Conclusions and clinical implications: In the future, more successive studies of healing process will be needed following early healing phase by increasing the number of animals and by extending experimental periods.

374 | Topic – Basic Research

Biomechanical and histomorphometrical evaluation of bone-implant integration at sand blasting with alumina and acid etching (SA) surface

Presenter: Cho I-H
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Background: Implant surface feature has been proposed as a potential factor affecting bone integration.

Aim: The purpose of the present study was to biomechanically/histomorphometrically evaluate the sand blasting with

alumina and acid etching (SA) surface and the resorbable blasting media (RBM) surface in the mandible of beagle dogs.

Methods: All mandibular premolars and first molars were extracted bilaterally in 10 beagles. After 8 weeks of extraction, 48 implants (22 SA surface implants and 26 RBM surface implants) were implanted in the mandible of beagle dogs. After 12 weeks healing, the implants were evaluated biomechanically by removal torque measurements and histomorphometry. Thirty-six implants were used for removal torque test. Twelve implants were processed of histomorphometric analysis. For statistical analysis, *t*-tests were performed ($P < 0.05$).

Results: The mean removal torque value was significantly higher for SA surface (127.2 ± 37 N cm) than for RBM surface (61.9 ± 34.5 N cm). However, there were no significant difference in the BIC and BA between the two groups at 12 weeks.

Conclusions and clinical implications: It can be concluded that the SA surface was more effective in enhancing the biomechanical interlocking at the bone-implant in comparison with RBM surface.

375 | Topic – Basic Research

Histomorphometric and fluorescence microscopic evaluation of interfacial bone formation around different dental implants

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Background: Surface characteristics have the potential to enhance osseointegration. The fluorochrome bone labeling is a useful tool for identification of bone formation. The presence of the fluorochromes indicates site, time and amount of bone deposition.

Aim: The aim of the present study was to evaluate the influence of different surface characteristics on bone apposition of titanium implants.

Methods: Internal non-submerged implants (4.1 mm in diameter and 8 mm in length) consisting of three different surfaces were used: two custom-made experimental implants, resorbable blasting media (RBM), sand blasting with alumina and acid etching (SA) and one commercially available implants, the Sandblasted and acid-etching (SLA). All mandibular premolars and first molars were extracted bilaterally in 12 micro-pigs. After 12 weeks of extraction, 60 implants were implanted in the mandible. The polyfluorochrome sequential labeling was performed at 1 and 2 weeks. The animals were sacrificed after a healing period of 2 and 4 weeks. Bone apposition was evaluated by histomorphometric and fluorescence microscopic analysis.

Results: At 2 weeks, the mean bone-to-implant contact (BIC) values were $63.09 \pm 22.81\%$ for RBM, $79.48 \pm 9.77\%$ for SA and $79.59 \pm 8.51\%$ for SLA. Fluorescent signal on the interface of implant, the SA and SLA surface were more effective in bone apposition in comparison with RBM surface.

Conclusions and clinical implications: Morphology of SA and SLA implants may enhance new bone formation during initial phases of osseointegration. It is suggested that SA implants will increase the success of implant.

376 | Topic – Basic Research

Effect of time of counter torque and transposition of installed implants on their integration in dog tibia

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Background: Nowadays with more use of dental implants, one of aspects of Implantology is getting through counter torque and transposition of implants that were not inserted in an appropriate place or in close proximity to anatomic area such as maxillary sinus, Inferior alveolar nerve, mental foramen or adjacent root. In many clinical cases surgeon must change the position of implant or remove it and also during prosthetic procedure some times during tightening the abutment screw fixture may rotate. In this clinical situations clinician search to find a solution.

Aim: The aim of this study was to evaluate success of osseointegration of the implants after counter torque or transposition at different times and suggest the best time for this purpose.

Methods: Thirty implants were inserted in two tibias of five males dogs in this experimental study. One implant was inserted in each tibia. After 1 week, randomly, one implant in one tibia of each dog was counter torqued and the implant in another tibia was transposed. Then (in the same session), in each dog three new implants were inserted so that two implants were in two different tibias in each dogs considered the 8 week group and another one was considered as the first control group. After 8 week, the 1-week group implants and first control group implants were counter torqued to liberation by applying a device (STW & BGI) that recorded the peak force required to detach the implant. After wards, in each dog one implant of 8-week group was counter torqued and another one was transposed. Then, one implant in each dog was inserted would be second control group. After another 8 weeks, the 8-week group and second control group were counter torqued by the device to record needed torque for implant loosening.

Results: All implants Osseointegrated and reosseointegrated after manipulation. Two implants failed to manipulation because the Internal Hexagon of the implants stripped. Although mean quantities of osseointegration between case and control groups showed differences but this difference was not significant ($P > 0.05$). Generally the quantities for first week group were higher than control groups and 8-week groups.

Conclusions and clinical implications: In accordance with literature review and the results from the present study it could be suggested that we can counter torque or transpose the implants

that were not inserted in an appropriate place 1 or 8 weeks after the implantation. It appears that, these procedures would be more acceptable 1 week after the implantation.

377 | Topic – Basic Research

Immunohistochemical, tomographic and histological study on onlay allograft remodeling

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Background: The information concerning the molecular events taking place in onlay allografts are still incipient in the literature. The use of allografts is claimed to cause less patients morbidity to those requiring great amount of bone in alveolar ridge augmentation procedures for implant therapy as well as these materials could abbreviate the time of surgical intervention.
Aim: The objective of the study was to compare fresh-frozen bone allografts (FFBA) with autogenous calvarial bone graft (ACB) for bone augmentation, considering the following parameters: (1) bone volume and density variation during incorporation process; (2) histological examination and (2) the biomolecular pattern occurring in the grafts.
Methods: Thirty-six New Zealand White rabbits were submitted to bilateral mandibular onlay bone grafting procedure. In one side was used the ACB, while on the other side received the FFBA was installed. Six animals were sacrificed at 3, 5, 7, 10, 20 and 60 days, respectively. Histological sections from the grafted area were prepared for immunohistochemical and histological analyses. Immuno-labeling was found for the following bone proteins: alkaline phosphatase (ALP), vascular endothelial growth factor (VEGF) and tartrate-resistant acid phosphatase (TRAP). The computerized tomography (CT) examination was conducted just after surgery and at the sacrifice. The ANOVA and *t*-test were performed for statistical analysis using $P \leq 0.05$ as significance level.
Results: The histological findings revealed that the grafts of FFBA group were not incorporated into the resident bone. Moreover, some bone fragments presented Howship's lacunae and were surrounded by soft tissue especially in later stages of the experiments. The immunohistochemical analysis showed that ALP peaked from 3 to 7 days in the ACB group but not in the FFBA group ($P \leq 0.05$). The VEGF reached higher labeling values at day 60 in the ACB group compared with FFBA ($P \leq 0.05$). Conversely, the TRAP was higher at 20 and 60 days. The CT outcomes on bone volume based on intra-group data revealed that FFBA lost volume with time to reach minimum values at 60 days compared with 3 ($P = 0.002$) and 7 ($P = 0.004$) postoperative days. The comparison between FFBA and ACB groups in terms of bone volume and density showed no statistic significance ($P > 0.05$).
Conclusions and clinical implications: The volume of bone in both groups did not vary during the experiments although a strong tendency to resorption in the FFBA group at 60 days was evident. The high resorption rate measured in FFBA grafts in this study may indicate that its use in implant therapy should be treated with cautions.

378 | Topic – Basic Research

A tissue engineering approach to generating osseous tissue on titanium

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Background: Tissue engineering offers the potential to achieve bone re-growth as part of implant therapy.
Aim: The aim of this *in vitro* study was to make a three dimensional osteoconductive scaffold that was bonded to commercially pure titanium, in order to support bone growth.
Methods: Commercially pure titanium discs ($n = 48$) were wet ground and low-temperature plasma coated with polyhydrogenmethylsiloxane and tetraethylorthosilicate. Acrylic acid was grafted to the functionalized surface, before placement of the discs in a collagen-glycosaminoglycan (c-GAG) suspension which was freeze dried. The resulting three-dimensional c-GAG scaffold was further cross linked. Cytotoxicity was determined using a lactate dehydrogenase (LDH) assay with MC_3T_3-E1 murine calvarial osteoblasts seeded onto the bonded c-GAG scaffolds ($n = 9$) and the tissue culture medium was monitored for LDH release over 100 h. Primary rat mesenchymal stromal cells (MSCs) were seeded on the surface of the bonded c-GAG scaffold and maintained for 2 weeks, before testing the scaffold for adhesion and mineralized tissue growth. Cell proliferation was studied using a dye-based Hoechst 33258 assay ($n = 9$) and histological sections were stained with haematoxylin and eosin to monitor cell adhesion and location.
Results: The cytotoxicity assay indicated that the MC_3T_3-E1 cells released no more LDH compared with the cells seeded on tissue culture plastic when analysed using a Student's paired *t*-test ($P = 0.75$). The primary rat MSCs seeded on c- GAG scaffold remained adherent to the prepared titanium surface. Statistically significant cell proliferation occurred within the scaffold over the 1-week period ($P = 0.021$) and the histological sections demonstrated cellular attachment with most cells accumulating initially on the surface of the construct with subsequent cellular migration towards the titanium-c-GAG scaffold interface.
Conclusions and clinical implications: This *in vitro* study demonstrated that a three dimensional c-GAG scaffold, which is known to be osteoconductive, could be chemically bonded to a titanium surface. Moreover, the bonded scaffold supported cell attachment and growth. Further studies will be needed to test the hypothesis that bone growth can be achieved clinically on a titanium implant surface.

379 | Topic – Basic Research

Buccal bone dimensions of immediate implants after 5 years follow-up

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Background: The remodeling pattern and the dimensions of buccal hard and soft-tissues are still being discussed in the literature for immediately placed implants. The introduction of Cone Beam Computed Tomography (CBCT) has opened the way to assess these parameters.

Aim: The purpose of this study is to evaluate the long-term stability and the dimensions of buccal bone and soft-tissues of immediately placed implants in the esthetic zone.

Methods: Twenty-four patients with immediately placed implants were followed for 5 years at the Harvard School of Dental Medicine. To assess the dimensions of the buccal hard and soft tissues a thin layer of flowable composite resin was applied on the buccal and palatal aspect of the peri-implant mucosa and gingiva of the adjacent teeth. CBCT images for each patient were acquired and the following parameters were measured at the 5 years follow-up: (1) the distance between Gingival Margin to Implant Shoulder (GM-IS); (2) Gingival Margin to First Bone to Implant Contact (GM-FBIC); (3) Implant Shoulder to First Bone to Implant Contact (IS-FBIC); (4) First Bone to Implant Contact to the Junction of the Rough and Smooth border of the Implant (FBIC-JUNC); (5) Buccal bone width at every 1 mm along the entire surface of the Implant (JUNC + 1,2,3, etc.); and (6) Buccal bone width that corresponds to the Intra-surgical measurements of the most coronal bone level. The results of these measurements were compared with the Intra-surgical measurements obtained at the time of implant placement.

Results: More than 50% of the assessed implants showed buccal bone remodeling with a vertical loss ranging from 9 mm to 11.8 mm. As for the horizontal width, buccal bone remodeling ranged from 1.5 mm to 2 mm. In cases where the buccal bone remained stable, the gain in vertical distance ranged from 1.6 mm to 2.3 mm and that of the horizontal width ranged from 0.1 mm to 1.5 mm. Regardless of the buccal bone dimensions, the soft tissues remained mostly stable.

Conclusions and clinical implications: The methodology used to assess the dimensions of the buccal hard and soft tissue was consistent. Five years after immediate placement of implants in the esthetic zone, the dimensions of the buccal soft tissues remained stable despite buccal bone remodeling in more than 50% of the cases. Other factors such as bone grafting, width of defect and gingival biotype may play an important role in the hard and soft tissue stability on immediate implants.

380 | Topic – Basic Research

NF-kB ligand (RANKL) and osteoprotegerin (OPG) in the crevicular fluid of immediately loaded implants in patients with osteopenia

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Background: The successful outcome of immediate loading is influenced by a number of confounding factors, such as bone remodeling response and bone quality in the peri-implant site. Bone resorption is controlled by the interaction of the receptor activator of the NF-kB ligand (RANKL) and osteoprotegerin (OPG). RANKL induces osteoclast formation and activation, while OPG is a decoy receptor for RANKL that inhibits osteoclastogenesis.

Aim: The aim of this prospective-controlled study was to evaluate the osteoclastogenesis-related factors (RANKL and OPG) levels in the Peri-implant crevicular fluid (PICF) of immediately loaded implant with platform switching in patients with and without osteopenia.

Methods: Twenty-three patients were divided according to criteria established by the World Health Organization: control ($n = 10$ patients; T-score ≥ -1) and osteopenia ($n = 13$ patients; $-1 <$ T-score ≤ -2.5). Clinical parameters and PICF were taken at baseline and 120 days after surgery.

Results: Ninety implants were immediately loaded being 40 implants in control group and 50 in the osteopenia group. The levels of RANKL, OPG and RANKL:OPG ratio as well as clinical parameters were similar between groups in both periods ($P > 0.05$), although there were significant differences between baseline and 120 days post-surgery PICF levels ($P < 0.001$).

Conclusions and clinical implications: Within the limits of this study, it could be suggested that osteopenia did not influenced the peri-implant tissue response around immediately loaded implants, at least, after 120 days post-surgery.

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381 | Topic – Basic Research

Passivity of fit of implant-supported CAD/CAM restorations

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Background: Non-passively fitting implant superstructures might be the cause of failures of prosthetic components and restorations. It has been claimed that besides optimal aesthetics and cost-effectiveness, the major advantage of CAD/CAM-generated restorations would be the passive fit of the framework.

Currently, quantitative data on the amount of stress evoked by the fixation of CAD/CAM fabricated implant-supported restorations as compared with conventionally cast superstructures is missing. It is also unknown whether the choice of restorative material used with one specific CAD/CAM system may affect the accuracy of fit.

Aim: To compare the strain development of conventionally cast and CAD/CAM fabricated three-unit fixed dental prostheses (FDPs) using the strain gauge technique.

Methods: A patient situation with two implants was transferred to an acrylic resin model and strain gauges were attached mesially and distally adjacent to the implants. Seven groups ($n = 10$) of cement-retained FDPs were manufactured from all restorative materials available for the Etkon® CAD/CAM system (Straumann CADCAM GmbH, Gräfelfing, Germany). Three groups ($n = 10$) of conventionally cast screw- and cement-retained superstructures served as control. Strain development during FDP fixation was recorded and the logarithm of the absolute strain values used for statistical analysis (multivariate analysis of variance with Pillai's trace; $\alpha = 0.0033$).

Results: Significantly higher strain values for screw-retained FDPs were found as compared with all other restorations ($P < 0$). Conventionally cast cement-retained restorations showed significantly higher strain levels as compared with CAD/CAM restorations fabricated from titanium ($P = 0.0032$) and green-machined zirconia ($P = 0.0026$). Screw-retained superstructures bonded to gold cylinders showed significantly lower strain levels as compared with FDPs made from titanium ($P = 0.0001$) and green-machined zirconia ($P = 0.0012$). No significant differences between the various groups of CAD/CAM restorations could be detected except for polyamid-resin restorations showing significantly higher strain levels than InCeram Zirconia® restorations ($P < 0$).

Conclusions and clinical implications: CAD/CAM fabricated restorations show levels of fit, which are at least as good as in conventionally, fabricated superstructures. The choice of restorative material seems to have only a minor effect on the passivity of fit.

382 | Topic – Basic Research

Etiopathogenesis of peri-implant disease in humans: a clinical-laboratorial study

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Background: Despite several studies for understanding the development of the peri-implant disease, the relationship between microorganisms and immunologic response, clinical and radiographic features and a true influence from genetic polymorphism to peri-implant disease are still unclear.

Aim: The aim of the present study was to correlate clinical and radiographic aspects with microbiological, immunologic and genetic findings in patients with health and peri-implant disease.

Methods: Thirty non-smoking individuals, aged 30–76 years were included in this study. Group A ($n = 10$) presented peri-implant health, group B ($n = 10$) presented peri-implant mucositis, and group C ($n = 10$) were patients with peri-implantitis. Peri-implant tissues were clinically examined as for periodontal phenotype, presence of bacterial plaque, depth and bleeding on probing and suppuration. Oral hygiene and history of periodontal disease were also considered on clinical evaluation. Radiographic analysis evaluated the presence of bone loss around implant. Samples from peri-implant crevicular fluid were collected in order to analyze IL-1b and IL-10 levels, the presence of *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Treponema denticola* e *Tannerella forsythensis* species of bacteria and IL-1b^{-511}, IL-10^{-819} and IL-10^{-592} genetic polymorphism. The Chi-square test (χ^2), Cochran test and McNemar test were used for statistical analyses.

Results: Patients with thin periodontal phenotype have 81 times more chance to develop peri-implant disease. Patients with periodontal disease history showed 36 times more chance to develop peri-implant disease. The disease status was significantly associated with poor oral hygiene and bacterial plaque. All species of bacteria were present in all groups. Lower levels of IL-1b were present in-group A. IL-10 levels were higher in group A than in groups B and C. No statistic difference were observed for IL-1b^{-511} and IL-10^{-819} genotypes among groups A, B and C. However, IL-10^{-592} was significantly different between health and disease groups.

Conclusions and clinical implications: These data indicate that thin periodontal phenotype and periodontal disease history are high risk factors for peri-implant disease development; thick periodontal phenotype provides protection against peri-implant disease; the bacterias analysed are present in peri-implant tissues presenting health and disease; high levels of IL-1b characterize clinical conditions of health and disease, however, these levels do not differentiate peri-implant mucositis from peri-implantitis; the clinical diagnostic for these three conditions can be differentiated through IL-10 levels. Frequencies of IL-10^{-592} are associated with healthy peri-implant tissue and high production of IL-10.

383 | Topic – Basic Research

Biomechanical analysis of platform switching in internally connected implant system using FEM

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Background: Although positive reports of clinical and histological evidences have been published on platform switching as an abutment replacement concept to prevent and reduce bone loss during implant function, biomechanical information is still inadequate regarding implant assembly and peri-implant tissue.

Aim: The purpose of this study was to investigate biomechanical effectiveness of platform switching in internally connected implant in mandibular molar area.

Methods: After having analyzed CT images of 60 patients who installed implant in mandibular molar area, 3D Finite Element model was constructed, including Xive® S PLUS SCREW (Dentsply–Friadent, Mannheim, Germany) implant fixture with a dimension of 5.4 mm in diameter and 11 mm in length and having a crest of the remaining alveolar bone 7–8.5 mm, bucco-lingually 13.4 mm wide and 31 mm long. Four models were created with implant abutment, matched with a same diameter of implant fixture in MD model or with 4.5 mm implant abutment in PL model and presuming cortical bony thickness to be 1.5 mm or 0.75 mm after implant placement. Vertical loads of 200 N were applied to all models at centric fossa of molar tooth and 200 N of oblique load at buccal and lingual incline of mesiobuccal functional cusp.

Results: On vertical load, PL model showed increased maximum von Mises stress by 6–14% at abutment and increased by 40% at implant fixture compared with those of MD model. The value at abutment screw was decreased by 13%. The maximum von Mises stress of PL model at peri-implant bone was increased by 13% in thick cortical bone and by 32% decreased in thin cortical bone, respectively. On buccally oblique load, PL model showed increased maximum von Mises stress by 9–18% at abutment and increased by 39–48% at implant fixture compared with those of MD model. The value at abutment screw was decreased by 15%. In thick cortical bone and increased by 14% in thin cortical bone. The value of peri-implant bone was decreased by 27–35%. On lingually oblique load, PL model showed increased maximum von Mises stress by 74–85% at abutment, increased by 13–32% at abutment screw and increased by 34–51% at implant fixture, compared with those of MD model. The maximum von Mises stress of peri-implant bone was decreased by 14–20%. For all models, stress concentration was increased on oblique loads, compared with vertical load.

Conclusions and clinical implications: It seems that platform switching in internally connected implant contribute to concentrate the stress at abutment and implant fixture. On the contrary, platform switching had biomechanical advantage to peri-implant bone by even stress distribution.

384 | Topic – Basic Research

Repartition of microbial biofilms on metallic structures in oral implantology

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Background: Many oral pathologies, such as dental caries, periodontal disease and peri-implantitis are plaque-related. Dental plaque is a microbial biofilm formed by organisms tightly bound to a solid substrate and each other by means of an exopolymer matrix. Bacteria exhibit different properties when contained within a biofilm. Knowing the mechanisms controlling the formation and development of biofilms can help to understand the emergence and progression of such pathologies and to plan effective treatment.

Aim: The constitution of mictrobial strains collection isolated from dental plaque. We studied the development of monospecific biofilms on dental alloys, in order to establish the influence of the physical and chemical structure of the alloys, with the dynamics of experimental biofilms.

Methods: The analysis of bacterial diversity of dental plaque samples was realised with: optic microscope, scanning electronic microscope, determination of bacterial loading, identification of the most important bacterial species and genus, after cultivating and isolation in anaerobic and aerobic media and also automatic identification with VITEK systems. Were tested the patogenity and the virulent status and also the resistance of the cells with no adherence and of the cells included in artificial developed biofilms on dental alloys. Selected materials were titan IV, T4A6V alloy, noble alloys (gold- palladium, gold-platinum), seminoble alloys (silver-palladium) and stainless alloys (cobalt-chromium, nickel-chromium alloys).

Results: Dental plaque has a great structural complexity (there are, in the same time: spiral bacterium, fungus, some gram-positive and gram-negative morphological types) and physiological (aerobic and anaerobic respiratory types). Tested strains have a high capacity of adherence on the dental alloys above mentioned, even after 24 h of incubation. These bacteria are more resistant in adhered state, comparing with initial condition.

Conclusions and clinical implications: Repartition of the selected monospecific microbial biofilms on dental alloys is determined by antiseptic potential of the alloys components: the development on stainless alloys, titanIV and T4A6V alloy of much more thicker biofilms, than seminoble and noble alloys. Microbial biofilms appeared preferentially in surface irregularities, while on flat surfaces bacteria formed a continuous layer

385 | Topic – Basic Research

Prevalence and location of maxillary sinus septa in dental computed tomography

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Background: The presence of maxillary sinus septa increases the risk of sinus membrane perforation during sinus elevation procedure. Detailed knowledge of maxillary sinus anatomy and the possible anatomic variations are important for surgical planning. However, information obtained from previous studies varies between radiographic methods, observation, and studied populations.

Aim: To determine the prevalence and location of sinus septa in maxillary sinus from dental computed tomography (Dental CT) in a group of Thai population.

Methods: A group of 121 patients (65 women and 56 men, with a mean age of 41.29 years, ranging between 8 and 79 years) undergoing dental computed tomography (i-Cat) for planning of oral and maxillofacial surgery, particularly dental implants, were included in the study. Data comprised of 242 sinuses, which were analyzed from reformatted computerized tomograms using DentiPlan version1.2 software.

Results: A total of 63 septa were found in 242 maxillary sinuses (26.03%), corresponding to 38.84% of the patients (47 of 121). Completely dentate patients presented with 42.86% of the total septa, while partially edentulous patients presented 53.97%, and edentulous patients presented 3.17%. The anatomic location of the septa within the sinus revealed that 10 (15.9%) septa were located in the anterior region (anterior to first molar), 37 (58.7%) were in the middle (first and second molar), and 16 (25.4%) were in the posterior region (posterior to second molar). Thirty-five septa (52.24%) were located in close proximity to the apical region of the teeth and the remaining 28 septa (47.76%) were related to edentulous areas.

Conclusions and clinical implications: The prevalence of sinus septa are found nearly 30% from dental CT, the greater prevalence is in the middle region and in partial edentulous regions, which are the common areas for single tooth implant placement. The prevalence of sinus septa is possibly related to tooth loss and sinus pneumatization. Dental CT and DentiPlan software are accurate tools for thorough planning of sinus operation. Findings from this Thai population study could possibly be extrapolated to the Asian population.

386 | Topic – Basic Research

Histological study about tissues around two different implant-to-abutment connections

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Background: Peri-implant bone remodeling may have a negative influence on the aesthetics of implant-supported prostheses. A firm implant-to-abutment connection does not allow any micro-movement and leads to tight bacterial seal, preserving tissues from inflammatory reactions. The association of a stable connection with other biomechanical factors (i.e. Platform Switching design, micro-roughened implant neck) appears to have a positive influence on peri-implant tissues reaction and favour their long-term maintenance.

Aim: The aim of the study was to evaluate the connective tissue composition and the amount of inflammatory cells around two different implant-abutment connections, a self-locking conical connection and a butt joint one.

Methods: After acceptance of the Ethical Committee of Sapienza University of Rome, the histological exams were performed on 14 patients (male gender, 39 years mean age, well healthy, no smokers) having dental implants divided in two groups: seven with implant-abutment conical connection (experimental group) and seven with butt joint one (control group). All of them signed an informed consent. Block biopsies containing the tissues were dissected using a circular mucosa punch. The composition of the connective tissue compartment was analyzed in the different samples.

Results: Composition of connective tissue showed an increasing number of inflammatory cells proceeding from the coronal to the middle and apical portion of the implant-abutment unit. Different amount of such cells was found around the two connections. Bone growth coronally to the implant-to-abutment junction was found when using the conical connection and peri-implant connective tissue was comprised of a higher density of collagen and a lower fraction of fibroblasts than at control sites.

Conclusions and clinical implications: Histological analyses, focused on connective tissue composition and number of inflammatory cells around the implant-to-abutment connection, confirm the presence of healthier tissues surrounding a conical connection than around a classical butt joint one.

387 | Topic – Basic Research

Extremely low frequency pulsed magnetic fields accelerate osteoblast differentiation

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Background: Osseointegrated implants require newly formed bone around implant bodies. To obtain the initial primary stability is the key for the success of dental implant treatments. In fact various studies both *in vitro* and *in vivo* have been promoted to evaluate the effect of surface modification of dental implant whether it induces bone adoption to dental implant surfaces and accelerates osseointegration. Recently, some researchers take notice of an environment around bone and dental implant in addition to the surface modification such as ultrasound stimulation or magnetic field to lead early osseointegration. It has been discussed that extremely low frequency (ELF) pulsed magnetic fields could cause biological effects. In this study, we focused on ELF pulsed magnetic fields around osteoblast *in vitro* and investigated the effect of magnetic fields on osteoblast proliferation and differentiation.

Aim: The aim of this study is to examine whether the ELF pulsed magnetic fields enhance osteoblast proliferation and differentiation.

Methods: MC3T3-E1 osteoblastic cells were cultured in 7000 mG (0.7 mT) 6 Hz ELF pulsed magnetic field. Following 24 h of culture within the magnet, cell proliferation was evaluated by Cell Counting Kit-8 (Dojindo, Kumamoto, Japan) by fluorescence signal at 450 nm. To detect morphology changes in MC3T3-E1 osteoblastic cells, we stained cells with Alexa fluor

488 phalloidin (Molecular Probes, CA, USA) 24 h after culture in magnetic field. Cells were examined by Confocal Laser Microscan (LSM 5 PASCAL, Carl Zeiss. Inc). Every 1 week of culture, mRNAs were obtained from cells to determine osteoblast differentiation with or without magnetic stimulation. Quantitative real time PCR was performed for osteocalcin, runx2, osterix, collagen type 1. Cell lysate was collected to assess alkaline phospatase activity at every 1 week. Results were compared using the Student's *t*-test. *P*-values <0.05 were considered statistically significant.

Results: With ELF pulsed magnetic fields, proliferation of MC3T3-E1 osteoblastic cells at early time point was slightly decreased compared with controls. Any morphology changes were not detected significantly between cells with or without magnetic stimulation. On the other hand, in magnetic fields, cells produced alkaline phosphatase more than cells without magnetic stimulation.

Conclusions and clinical implications: ELF pulsed magnetic field did not affect cell proliferation, but accelerated cell differentiation in MC3T3-E1 osteoblastic cells *in vitro*. This magnetic system could have a possibility of clinical implications by supporting earlier wound healing and osseointegration around a dental implant because it can induce early maturation of osteoblast.

388 | Topic – Basic Research

The influences of SLA and slactive titanium implants on neonatal rat calvarial osteoblast-like cells

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Background: Titanium surface modifications have gained significant attention in the field of dental implant research. New surface types are being presented in order to improve or accelerate the osseointegration process. SLA and SLactive surfaces are among the surface modification techniques used in dental implants.

Aim: The aim of this present study was to evaluate the morphological changes of neonatal rat calvarial osteoblast-like cells cultured on SLA and SLActive titanium implant surfaces

Methods: Sand-blasted and acid-etched (SLA) (Straumann, Basel, Switzerland) and SLA surfaces of the same roughness that was chemically modified to have high wettability/hydrophilicity (SLActive) (Straumann, Basel, Switzerland) were used. Machine surface titanium (Straumann, Basel, Switzerland) was used as control. Cells were cultured on titanium discs for 24 and 72 h. Cell morphologies were examined by scanning electron microscopy (SEM) at both time intervals.

Results: Scanning electron microscopy views showed that there were no morphological differences between the groups.

Conclusions and clinical implications: Considering the similar cell responses to all the three surfaces, further studies are required in order to understand the different bone formation processes on different surface types.

389 | Topic – Basic Research

Influence of attachments on load transfer in implant overdentures

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Background: From the Mcgill consensus, it is evident that two-implant overdentures should be the first choice of treatment for the edentulous mandible. In implant overdentures, various attachments have been used for retentive appliances. Clinical reports have previously compared the prosthetic aspects and satisfaction levels in patients treated for edentulous mandible with two-implant overdentures; however, in these reports have little information regarding the placement manner of attachments and occlusal conditions. Standardized criteria for the placement manner as well as for the selection of attachments are required in a clinical situation.

Aim: This study aimed to investigate the load transfer characteristics of different types of attachment systems retained by two implant overdentures through *in vitro* analysis and to clarify the criteria for the selection of attachments and placement manner.

Methods: Six attachments that were magnetic type (flat type, dome type, cushion type and self-adjusting type), anchor type (locator attachment), and ball type were prepared. An acrylic mandibular edentulous model with two implants were placed in the bilateral canine regions and a removable overdenture were prepared. The two implants and bilateral molar ridges were connected to three-axis load cell transducers. A vertical force of 50 N (crosshead speed of 2 mm/s) was applied to each site of the occlusal table in the premolar and molar regions by using a universal testing machine. Three-dimensional forces acting on the implants and molar ridges were subsequently evaluated.

Results: The site to which the load was applied became more posterior, and the stress at the molar ridge was higher. When load was applied, time patterns and stress distributions were varied for the six attachments.

Conclusions and clinical implications: The present analyses of a sophisticated experimental model developed for edentulous mandible clarified the load transfer characteristics in the resilient system for each of the six attachments. These findings could help in choosing an appropriate attachment and its use in each clinical case and to predict the clinical outcome.

390 | Topic – Basic Research

The influences of pulsed electromagnetic field and low level laser therapy on neonatal rat calvarial osteoblast-like cells

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Background: Studies have shown that laser phototherapy and application of pulsed electro magnetic field (PEMF) could stimulate osteogenesis and accelerate fracture consolidation.
Aim: The aim of this study was to evaluate the effects of (PEMF) and low level laser therapy (LLLT) on the behavior of neonatal rat calvarial osteoblast-like cells.
Methods: Neonatal rat osteoblastic cell lines were harvested and primary osteoblast cell cultures were obtained. Osteoblastic cell cultures were irradiated with a diode laser (950 μm, 700 mW, continue mode) and PEMFs of 0.06 and 0.2 mT were applied. Cells were cultured for 24 and 96 h. Proliferation rate, number, and viability scores of cells were examined. Cell proliferation rates were assessed by bromodeuxyuridine (BrdU) immunohistochemical technique. Cell numbers were counted by hemocytometer. One-way analysis of variance was used for the evaluation of the differences between all the four groups at 24 and 96 h. Between-group statistical comparisons at the two time intervals were undertaken at $P \leq 0.05$.
Results: Cell numbers were significantly high in the control group at 24 h ($P \leq 0.05$). The cells treated with 0.06 mT PEMF had lower cell proliferation rates at 24 h ($P \leq 0.05$). The number of cells was higher in the 0.2 mT group at 96 h. 0.2 mT group also had a higher cell proliferation rate together with the control, at the end of 96 h ($P \leq 0.05$).
Conclusions and clinical implications: PEMF application of 0.2 mT has more positive effect on bone formation when compared with a low dose of PEMF and LLLT.

391 | Topic – Basic Research

Influence of implant design on stress distribution

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Background: The influence of occlusal loading location on stress distribution of an implant and surrounding bone is less documented.
Aim: To investigate the influence of abutment and implant design on stress distribution in the implant and surrounding bone by finite element analysis (FEA) method.
Methods: Six different abutment-screw shaped commercial implant systems (Friadent (F), Germany; SPI (S), Switzerland & Zimmer (Z), USA, Astra (A), Sweden; Straumann (S), Switzerland and Bego Semados (B), Germany) and a mandibular section of bone with missing second premolar were modelled. Both implants and abutments were scanned by using a laser scanner (NextEngine, USA) to create 3D models. After the scanning process, the solid CAD model was created from the point cloud using a software (Rhinoceros, USA). The mesh generation process and stress analysis were carried out using a software (Algor Fenpro, USA). A 300 N vertical force was applied from upper surface of the abutment and the stress distribution was calculated.
Results: The highest stress values were obtained both on the abutments and on the crestal section of the implants, relatively more on the abutments. The maximum principal stress values (N/mm^2) were calculated as 4.35, 2.25 and 2.39 for S, A and B, respectively. Maximum principal stress values were calculated as 1.91, 3.43 and 1.13 for F, S and Z, respectively. The stresses in the cortical bone were very limited for F and S, while they were distributed on a larger area for Z. The distributions of von Mises stresses were found to be different from each other. Stresses in the cortical bone were limited for B and A, whereas they were distributed on a large area for S. The magnitudes of stresses were decreased from upper surface to the bottom of the cortical bone.
Conclusions and clinical implications: The stresses transferred to the abutment, implant and cortical bone were effected from abutment and implant design. The highest stress values were observed on the upper section of both the abutment and the implant.

392 | Topic – Basic Research

The effect of a combined external and internal saline irrigation during implant site drilling

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Background: An extended frictional heat generated by surgical drills during implant site preparation can cause bone tissue injuries and necrosis. This surgical trauma is one of the main causes that can lead to early implant failure.
Aim: The aim of this investigation was to evaluate temperature changes with different irrigation methods during implant site preparation under standardized conditions.
Methods: An *in vitro* study model was designed to simulate clinical conditions in human bone during implant site preparation. To standardize the drilling procedure a computer aided custom surgical unit was constructed with definable

parameters. Reproducible drill cycles were performed with different saline irrigation methods [(A) combined-external & internal/(B) external/(C) internal] at room temperature (25°C). Reproducible drilling sequences (800 rpm, Nobel Replace™ Select Tapered) of diameter (2 mm/3.5 mm/4.3 mm) and length (10 mm/16 mm) were performed and thermal changes during implant site preparation were recorded by two custom devices with eight calibrated thermocouples in real time with measuring points at 2, 4, 10 and 16 mm depths in a predetermined distance (1&2 mm) to the implant preparation sites. The implant drilling procedures were performed in bovine ribs as published in previous investigations. To standardize the bone density all bovine specimens were taken from the VII. bovine rib.

Results: The highest temperature increase was observed at cortical measurement points (thermocouple depths of 2 mm/4 mm) by the use of cutting drills of 2 mm diameter at depths of 10 mm with different irrigations A = 1.52°C (± 0.72)/B = 1.88°C (± 0.22)/C = 1.23°C (± 0.45) and at depths of 16 mm A = 1.44°C (± 0.14)/B = 1.84°C (± 0.63)/C = 1.54°C (± 0.24). At cortical measurement points significant differences were observed between combined and external irrigation by the use of cutting drills of 2 mm at 10 mm preparation and between combined and external irrigation and external and internal irrigation by the use of implant drills of 4.3 mm diameter at 16 mm preparation. At cancellous measurement points significant differences were investigated between combined and external irrigation and external and internal irrigation by the use of implant drills of 4.3 mm diameter at 16 mm preparation.

Conclusions and clinical implications: This pilot study under standardized conditions recorded a decreased efficiency of an external saline irrigation in deep implant preparation sites. Frictional heat generated by surgical drills during deep implant site preparation was reduced significantly by the use of a combined and internal irrigation. This pilot investigation confirms a computer aided custom surgical unit for reproducible standardize drilling procedures for further implant drills investigations with beneficial irrigation methods.

393 | Topic – Basic Research

Lateral lingual foramina of the mandible: cadavers study with CBCT

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Background: Dental implant procedures for inter-foraminal region are considered to be relatively safe. Although, surgical complications may arise during or after implant installation where the mandibular lingual cortex is perforated, resulting in a severe hemorrhage at the floor of the mouth. It is because that the branches of artery run through the lingual foramina (LF). By preventing the vascular damage of these arteries, implant treatment would be safer.

Aim: The present study was performed to investigate the variations of the lateral lingual foramina (LLF) and its bony canals that were observed in the canine/premolar region of the cadaver mandibles, using cone beam CT (CBCT) images.

Methods: The 70 Japanese cadaver mandibles were used in this study. The CBCT (Alioth: Asahi Roentgen Ind. Co. Ltd, Kyoto, Japan) images around the inter-foraminal region were acquired for a cylindrical imaging area of 71 mm in height and 79 mm in diameter (voxel size: 0.155 mm^3). The frequency, location, and diameter of LLFs were evaluated from CBCT images. After observing the images, courses and contents of LLFs were evaluated from cadaver dissections.

Results: Forty-six (65.7%) of the 70 mandibles presented at least one (1–4) LLF. The total number of the LLFs was 69 per 140 sides (49.3%). Thirty-one (67.4%) of 46 mandibles presented the LLF unilaterally, and 15 (32.4%) bilaterally. The average location of LLFs was 10.3 mm (SD: 2.3 mm) inferior to the centre of the mental foramen. The average diameter of LLFs was 1.3 mm (SD: 0.3 mm). The intraosseous canals from LLF ran slightly upward and anteriorly penetration the cortex.

From dissection, arteries could be identified in 25 LLFs; all of them were submental arteries which had anastomoses with incisal branch of inferior alveolar arteries.

Conclusions and clinical implications: Although the LF around the median region of the mandible is widely recognized, the LFs in the canine/premolar region are not taken into consideration. This study indicated that the LLFs were observed frequently in about 2/3 of all mandibles, although. Also, it was revealed that the branch of submental artery ran in the LLF through the cadaver study.

It is thought that the possible injury of the vessels and the consecutive complication during implant surgery could be reduced by recognizing LLF of the mandible in the preoperative radiographs, critical for implant surgery for inter-foraminal region.

394 | Topic – Basic Research

The intramandibular course of the inferior alveolar nerve

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Background: The inferior alveolar nerve (IAN) may be injured during surgical interventions. The topographic anatomy of the mandibular canal (MC) in the edentulous posterior mandible was evaluated by dental CT. Seven distances each were determined at the site of the first and second molars.

Aim: To asses the clinical significance of IAN damage for distraction osteogenesis and implant placement.

Methods: The study sample consisted of 37 dry human edentulous mandibles. For dental CT a Philips Brilliance TM CT

was used. Images where recorded by a radiologist. Four cross sectional views of each mandible were investigated. Cawood classification was applied to assess the grade of atrophy.

Results: Left vs. right ($P = 0.05$) and first vs. second molar differences were detected. At the first molar site mean distances were: Total height − 18.28 mm (right), 18.2 mm (left); total thickness − 13.72 mm (right), 14.01 mm (left); buccal cortical bone width − 2.37 mm (right), 2.28 mm (left); MC diameter − 3.45 mm (right), 3.73 mm (left); distance between buccal MC and lingual cortical bone − 8.53 mm (right), 8.99 mm (left); distance from superior MC border to alveolar crest − 6.94 mm (right), 6.4 mm (left); width of buccal cortical bone to buccal MC − 5.2 mm (right), 5.02 mm (left). No anatomic variants of the MC (bifid, trifid) were found. Cawood class IV was most common ($n = 56$). A decrease by one class between first and second molars was shown.

Conclusions and clinical implications: There was no bilateral symmetry in edentulous mandibles, neither left vs. right nor between molars, except two variables (buccal cortical bone width, MC diameter). Surgeons are most likely to deal with knife-edge ridges of class IV. No MC variants were found. Distraction device placement in the posterior mandible is possible using a distraction screw of 2 mm lateral to the IAN (safety clearance 3.5 mm between buccal cortical bone and buccal MC) in 87.84% ($n = 65$) near the first and in 93.24% ($n = 69$) near the second molar. Implant placement is not recommended in most of the cases, because minimum distance of 8 mm from the alveolar crest to the MC was achieved in only 35.14% ($n = 26$) near the first and in 21.62% ($n = 16$) near the second molar. At a minimum distance of 5 mm between MC and upper alveolar border sandwich osteotomy appears to be an alternative option in 68.02% of cases ($n = 102$) to avoid nerve damage.

395 | Topic – Basic Research

Correlation of drilling frequency with torque, and with vertical force

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Background: There are various factors for success of the implant treatment. One of the keys is to make an appropriate hole by using an appropriate drill. Each implant system has its recommended drill frequency which is unique to each system. However, it is not clear how the drill frequency should be set.

Aim: The aim of this study is to evaluate the correlation of drilling frequency with torque, and with vertical force.

Methods: The maximum torque, maximum vertical force and minimum vertical force were measured by cutting power meter (Kistler Japan Co., Ltd.) by drilling up Polytetrafluoroethylene block by the diameter 2 mm twist drill. Frequencies of drill were 500, 1000, 1500 and 2000 rpm. The measurement was performed three times by each rotational speed.

Results: Maximum torque of 500, 1000, 1500 and 2000 rpm were 5.61SD0.49, 6.05SD0.52, 6.36SD0.26and 6.06SD0.49, respectively. Maximum vertical force of 500, 1000, 1500 and 2000 rpm were 19.55SD2.83, 13.12SD0.87, 9.56SD1.75and 10.12SD4.23, respectively. Minimum vertical force of 500, 1000, 1500 and 2000 rpm were 0.22SD0.86, − 2.27SD1.46, − 4.91SD0.71and − 6.46SD1.42, respectively.

Conclusions and clinical implications: The cutting torque increases when the frequency increases.

Maximum and minimum vertical force decreases when the frequency increases.

These results show

- If frequency is too high, we should be careful for the bone burn.
- If frequency is too high or too low, we should be careful for the over drilling.

396 | Topic – Basic Research

Detection of intracellular bacteria within human peri-implant sulcular epithelial cells by fluorescence *in situ* hybridization

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Background: The epithelium is a barrier that protects the host from various irritants. Periodontal pathogens can invade the host tissue. Morphologic studies have revealed bacteria within the pocket epithelium, gingival connective tissues, alveolar bone, and oral epithelium. Some species of bacteria, such as *Porphrymonas gingivalis,* are able to survive and multiply within the host cells.

Aim: The objective of this study was to visualize and evaluate the presence of *Porphyromonas gingivalis* and *Tannerella forsythia* within crevicular epithelial cells of 12 implant patients.

Methods: Numbers of intracellular bacteria were observed from 605 peri-impalnt crevicular epithelial cells. Presence of *P. gingivalis* was studied in 314 cells, and that of *T. forsythia* studied in 291 cells.

Specific probes for *P. gingivalis* and *T. forsythia* and univeral probe for detection of all eubacteria targeting 16S rRNA for fluorescence *in situ* hybridization were used in conjunction with confocal microscopy.

Results: Average number of bacteria found in each cell was 37 and for *P. gingivalis*, the average number was 5.1. On the average, 6.15 *T. forsythia* was found in each cell studied.

Conclusions and clinical implications: *P. gingivalis* and *T. forsythia* can invade into peri-implant sulcular epithelial cells and intracellular bacteria may play a role as a source of peri-implant infection.

397 | Topic – Basic Research

The stress distribution effect of platform switching on external and internal hex type implant in the maxillary incisor area (3-D FEA study)

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Background: Finite element analysis (FEA) has been proven to be a precise and applicable method for evaluating dental implant systems.

Aim: The aim of this study is to evaluate the stress distribution of platform switched internal, external hex type implants in the maxillary incisal area by the method of three-dimensional Finite Element Analysis.

Methods: Two selected implants were external hex type Branemark® (Nobel biocare, Sweden) and internal hex type Xive® (Dentsply–Friadent, Germany). Platform switching was done by reducing of abutment diameter through the milling method. Stress distribution of 4 models was analyzed by vertical and 30°, 60° inclined load (from palatal to labial side) in the maxillary incisal area. Used modeling program was Pro/ENGINEER WF4.0 (PTC. Inc, MA, USA) and analysis program was MSC/Nastran 2007 (VISC software corporation, CA, USA).

Results: The results were as followings: (1) More stress was concentrated as following sequences in all models; surrounding cancellous bone < surrounding cortical bone, palatal crestal bone < labial crestal bone, vertical load < inclined load. (2) More stress was concentrated at more inclined angle in all models. (3) Stress to the surrounding cortical bone was decreased, but stress to the abutment screw was increased in the platform switched Branemark® and Xive® with inclined load. (4) The least stress to the surrounding cortical bone was distributed in the platform switched Xive® regardless of the loading direction.

Conclusions and clinical implications: In summary, platform switched internal hex type implant showed the decreased tendency of stress distribution to the surrounding cortical bone.

398 | Topic – Basic Research

Light and electron microscopy study of two BioHelix™ implants retrieved from one patient

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Background: Titanium implants are used as a routine treatment for bone anchoring of dental prosthesis. It has been suggested that a micro-rough implant surface increases the bone response while clinical follow-up of different implant surfaces have shown that the machined surface have a reduced risk of being affected by peri-implantatis.

The BioHelix™ concept combines the machined surface with a micro- and nano-strucutured surface, where only the thread valleys have been modified because this micro environment have been associated with faster bone growth.

Aim: The aim of this paper was to evaluate the osseointegration, by light and electron microscopy techniques, of implants retrieved from a patient.

Methods: Two implants retrieved from one patient where embedded in plastic resin. Implants were placed in the mandible for a full jaw reconstruction, whereof two implants were removed intentionally after 2.5 months of healing at the time of abutment connection. Ground-section was prepared for histological analysis and Focused Ion Beam (FIB) prepared Transmission Electron Microscopy (TEM) sections were prepared using an *in situ* lift out method. A total of four TEM samples were prepared (two with machined surface and two with laser modified surface). TEM analysis was performed in high angular annular dark field scanning mode (HAADF-STEM) at 300 kV combined with elemental analysis by Energy dispersive X-ray spectroscopy (EDS).

Results: The implants showed bone in direct contact with both implant surface at the light optical resolution, with mean 31% and 28% of bone implant contact and bone area within the threads, respectively. At higher magnification in TEM a separation was always present between the bone tissue and the machined surface, often filled with plastic resin. Bone remnants were observed in direct contact with the implant surface, confirmed by EDS with the presence of calcium (Ca) and phosphorous (P). The bone bonding to machined surface is not enough to sustain the forces during fixation, dehydration and resin embedding. For the laser-modified surface an intimate contact between the bone tissue and surface oxide was observed indicating bone-bonding. Elemental line scans at the interface showed coexistence of titanium (Ti), oxygen (O), Ca and P indicating bone in growth in the nanomodifed surface oxide.

Conclusions and clinical implications: With novel analytical techniques osseointegration on the nano level could be imaged

and analyzed, increasing the understanding of the bone response to titanium implants.

399 | Topic – Basic Research

Accuracy of computed tomography for the measurement of masticatory mucosa

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Background: Masticatory mucosa has been measured using a number of methods. However, these methods had problem which reliability and validity. Recently, CT for measuring thickness of masticatory mucosa has been introduced. However, accuracy of masticatory mucosa measurement using CT has not been established.

Aim: The purpose of the present study was to precisely assess the accuracy of oral mucosa measurement using spiral CT with measurement guide.

Methods: Thickness of maxillary masticatory mucosa was measured in five cadavers. The measurement sites were set up in buccal, palatal and middle of the crest in the missing tooth region. Each cadaver was exposed to spiral CT after installing the measurement guide. After that, each site was measured by endodontic reamer. Linear regression and correlation analysis were performed to describe the association between radiographic and physical measurements.

Results: Twenty-three buccal sites were not possible to be measured with spiral CT. The value of the physical measurement was 0.67 $\pm$ 0.15 mm. A total of 114 measurements were performed with statistical analysis. The radiographic and physical measurements demonstrate strong correlation ($r = 0.87$, $P < 0.01$). Measurement error was 0.62 $\pm$ 0.4 mm.

Conclusions and clinical implications: Spiral CT is a useful diagnostic tool in implant treatment planning and periodontal surgery. In the case of thin mucosa, spiral CT may be unable to display the difference of image density between the bone and mucosa.

400 | Topic – Basic Research

Comparative study of cone beam-computed tomography and panoramic radiography in the evaluation of maxillary sinus septa

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Background: The maxillary sinus is one of the anatomical limitation for implant installation in the maxilla. Especially maxillary sinus septa in the sinus makes difficult operation for sinus bone graft. So the panoramic radiography and CT are taken in the pre-operation for identification of sinus septa.

Aim: This study was aimed to evaluate anatomic variations in the maxillary sinus with panoramic radiography and cone beam computed tomography, and to assess incidency and morphology of maxillary sinus septa in Korean adults and the accuracy of radiographic studies.

Methods: Panoramic radiography and CBCT were used to evaluate 100 patients who visited Chonnam National University Dental Hospital. The patients were 20–40 years old and they had full dentition. With the panoramic radiography and CBCT, number, location and height of maxillary sinus septa were evaluated. In measurement of maxillary sinus septa, there were categorized as anterior, middle and posterior part, and also as medial, middle or lateral.

Results: 1. Maxillary sinus septa were found in 50 patients with 65 sinuses in panoramic view, but in CBCT, maxillary sinus septa were found in 41 patients with 63 sinuses

2. Twenty-four septa were found in the right sinuses, and 39 septa were found in the left sinsus. Most of the septa were found in the anterior part of the maxillary sinus and mean height of sinus septa were 4.93 mm in the right sinus, 6.49 in the left.

3. After assessment of sinus septa with panoramic view, sinses were re-examined with CBCT, and the sensitivity of panoramic view to find the sinus septa was 22.64% and specificity was 25.32%.

Conclusions and clinical implications: The anterior and middle part of the maxilla contains the maxillary premolar and molar area, and the maxillary septa exist mostly at the anterior and middle part of the sinus, and therefore, it is important to evaluate the existence of maxillary septa with panorama and, especially CBCT. Also further study of edentulous patients to evaluate alteration of the maxillary sinus septa should be performed.

401 | Topic – Basic Research

The analysis of gene expression during the wound healing process of tooth extraction

Presenter: Hsieh YD
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Background: The genes expression pattern during the wound healing process is of important for dental implant and tissue engineering.

Aim: The aim of present study is to evaluate the gene expression pattern during the wound healing process of tooth extraction socket.

Methods: Right upper molars were extracted from 30 rats, six rats were sacrificed at day 0, day 5, day 10, day 14 and day 28, respectively. Tissue around tooth extraction socket was collected for further analysis. mRNA was extracted from those tissue and microarray was performed to analysis the gene

expression pattern during the wound healing process of tooth extraction socket. Twenty-five thousand genes were examined on each microarray chip. All gene expression during wound healing process were examined and categorized using the bioiinformatic software ''Expressionist''.

Results: The result show 14 major categorized clusters were noted after bioinformatic analysis.

Conclusions and clinical implications: The similar gene expression pattern from some clusters is strongerly correlated with wound healing process of tooth extraction socket.

402 | Topic – Basic Research

Clinical experience in post-extraction technique with a new platform switched implant generation: clinical and radiological evaluation

Presenter: Sacco LM

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Background: The use of post-extraction dental implants technique may be a valid treatment alternative that reduces clinical treatment time and ensures success,

but in other studies have shown that after implant insertion and loading, crestal bone usually undergoes remodelling and resorption, and the positioning of healing screw determines invasion of space biological components not biocompatible with a migration apical extent organic in perfect agreement with previous trials.

In 1997, Cochran has conducted research on ''Biologic Width'' around implants loaded and not loaded and concluded that whatever the load around implants to establish a biological depth stable over time, all similar to what happens in natural teeth

The morphological characteristics as the Implant Platform, the abutment and kind of connection influence the ''Biologic Witdh''.

Restricting the connection respect to the shoulder implant we obtain a horizontal shift of inflammatory connective tissue by moving away from peri-implant bone area, determining also removal of chronic inflammatory tissue said, forming a protective barrier or seal.

Aim: The aim of this work is to evaluate finding confirmation of the results of other authors to the ability of improving of biologic results of peri-implant tissues and better aesthetic results and utilizing a Post- extractive technique using a new Platform switched system Implants.

Methods: Eight patients, five males and three females between 25 and 60 years in excellent systemic health, had part at this study.

These patients were selected in accordance with certain requirements that were:

1. the lack of metabolic diseases affect the success of the trial
2. Presence of sufficient bone to insert implants
3. the presence of mucosa gingival healthy and devoid of gum disease

The RX control at 1, 2, 8, 12 weeks were done. Periodontal and occlusal checks were successfully done.

Amount of 10 Implants were inserted: eight in maxilla and two in mandible.

Were used a new class of Osteointegrated/Implant called SAS1 (''Screw Abutment System'' : PHI, Legnano; Italy).

Results: The results of our study were:

All Implants showed no bone resorption at RX control

No areas of inflammatory peri-implant tissue was present

All Implants not showed periodontal complications at probing and bleeding controls.

Conclusions and clinical implications: All implants post-ex inserted no showed bone resorption during healing and after the prosthetic load but above all seemed to have a condition of good health. We believe that use the technique post-ex Implant insertions, in communion with the use of platform switching Implants can improve the aesthetic and biological results

403 | Topic – Basic Research

Phosphoserine-poly(lysine) coatings promote osteoblastic differentiation and Wnt signaling on titanium substrates

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Background: In tissue engineering, stimulating cells to differentiate along the right lineage requires an environment capable to provide the same factors that govern cellular processes *in vivo*. A novel surface for endosseous implants has been developed by absorbing dendrimers of phosphoserine and poly (lysine) to commercially pure, sand-blasted, acid etched (SA) titanium discs titanium surfaces.

Aim: The goal of the present study was to investigate the effects of this biocoating on cell differentiation and the activation of pathways that mediate cell differentiation.

Methods: The murine osteoblastic cell line MC3T3 and primary murine bone marrow cells were plated on smooth titanium discs, SA and SA discs with biocoating (cSA) and cultured in complete medium for up to 6 days. Cell adhesion was measured by MTT assay and gene expression was assessed by quantitative Real Time PCR. To investigate the activation of Wnt canonical signaling, a fundamental pathway for the commitment to the osteoblast lineage, we transfected the murine uncommitted cell line C2C12 on titanium surfaces with a reporter vector carrying the Firey Luciferase gene under the control of a promoter binding the dimer TCF/beta-catenin and a control vector expressing Renilla Luciferase.

Results: The biocoating improved cell adhesion at 48 h and increased the levels of transcripts of Alkaline Phosphatase and Osteocalcin, two osteoblastic markers at day 6 of culture, as confirmed with murine primary bone marrow cells. The mRNA levels of Osterix, an early osteoblastic marker decreased from day 3 to day 6 in all groups, although at day 6 they were still

higher on cSA. Noticeably, the expression of Osteoprotegerin, a protein antagonizing the formation of osteoclasts was higher in cells growing on cSA both at 3 and 6 days of culture. Similarly, the mRNA levels of a Wnt target gene, Wisp-2, and of beta catenin, the co-transcription factor mediating this pathway, were markedly increased in this group at day 6. We then stimulated transfected C2C12 with either vehicle or the soluble recombinant protein Wnt3a and observed a higher increase in the luciferase activity in cells on cSA.

Conclusions and clinical implications: The results of the present study show that this novel biocoating improves cell adhesion and promotes the expression of a mature osteoblastic phenotype. Moreover, this biocoating stimulates the activation of Wnt canonical signaling, and enhances its activation by exogenous stimuli.

Posters: Topic – Material Research (Abstracts 404–446)

404 | Topic – Material Research

Bone marrow stromal cells response to fluoride-modified implant surfaces

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Background: The possibility to enhance the biological performance of dental implants by modulating their topographic and chemical surface features represents a growing aspect of dental research. Fluoride ion incorporation into titanium surfaces has been suggested to positively affect bone cell and tissue response. Being the precursors of the entire osteoblastic lineage, bone marrow stromal cells play a central role in osteogenesis and bone reparative mechanisms, representing an ideal tool to investigate the interaction between bone cells and implant surface.

Aim: In the present study we have examined the response of human bone marrow stromal cells (hBMSC) to fluoride-modified grit-blasted (F-GB) titanium surfaces compared with grit-blasted ones (GB).

Methods: Implant surfaces were qualitatively and quantitatively analysed by atomic force microscopy (AFM) and scanning electron microscopy (SEM); height (Sa, Sq), spatial (Sds) and hybrid (Sdr) roughness parameters were measured. hBMSC were isolated from healthy donors and grown on implant surfaces. Cell adhesion and proliferation, type I collagen (Col I) synthesis, osteoblastic differentiation (in terms of alkaline phosphatase activity, osteocalcin synthesis and extracellular matrix mineralization) were assessed. Furthermore, the ability of implant surfaces to affect the synthesis of osteoprotegerin (OPG), a key factor of the osteoblastic/osteoclastic balance, was also investigated.

Results: AFM and SEM analysis showed higher values of all roughness parameters (at least $P < 0.05$) for F-GB surfaces together with the presence of nano-scaled structures compared with GB. Comparable cell morphology and similar adhesion values on both surfaces were detected at early time, whereas higher proliferation values on F-GB samples were observed at 7 and 10 days. Cells grown on F-GB showed increased Col I and OPG levels, while a similar expression of early and late osteogenic markers on both surfaces was detected.

Conclusions and clinical implications: Chemical and micro/nano-scale modifications induced by fluoride treatment of grit blasted surfaces have coupled with an increase of hBMSC proliferation, extracellular matrix deposition, and OPG levels. These results offer further insight into the mechanisms underlying the encouraging experimental and clinical performances of fluoride-modified implant surfaces, including a possible role in regulating osteoblast/osteoclast interaction.

405 | Topic – Material Research

Early bone regeneration by novel nanogel cross linking membrane

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Background: Cholesterol-bearing pullulan (CHP) nanogel is a unique biomaterial because it stores molecules and then releases them slowly. We have reported that the application of CHP nanogel alone stimulates wound healing in rats.

This material is also used as DDS for cancer immunotherapy, which has already started in Japan.

Aim: The aim of the present study was to evaluate the effectiveness of the novel CHP nanogel membrane as a GBR membrane, in comparison with a collagen membrane at early time point.

Methods: Twelve adult Wistar rats (16-week-old male) were used. Bilateral symmetrical full thickness bone defects of 5 mm diameter were created with a bone trephine bur under saline irrigation. Each defect was covered with a collagen membrane (Tissue Guide, Koken® JAPAN) or a CHP nanogel membrane or untreated without any membrane. The animals were sacrificed at 2 weeks and analyzed radiologically and histologically.

Results: In the all animals post-operative soft tissue healing was uneventful and membrane exposure was not observed in both membrane groups. New bone area in the bone defect was the highest in nanogel group compared with control and collagen groups ($P < 0.05$ and $P < 0.01$, respectively). Bone mineral density in nanogel group was also the highest at 2 weeks ($P < 0.01$ and $P < 0.05$, respectively). Notably, the newly formed bone in the bone defect in nanogel group was uniform and histologically indistinguishable from the original bone whereas the one in collagen group showed irregular structure, which was completely different from the original bone.

Conclusions and clinical implications: These results indicate that our novel CHP nanogel membrane enhances early bone regeneration and it would be potentially effective as a GBR membrane.

406 | Topic – Material Research

The use of different materials in the treatment of infrabony periodontal defects

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Background: Periodontal regeneration refers to the restoration of bone, cementum and periodontal ligament to their original

levels before they were damaged by the periodontal disease process. It has been shown that clinical improvement of intrabony periodontal detects can be achieved with the use of enamel matrix proteins or by grafting with bovine porous bone mineral. There is no report on the potential synergistic effect of enamel matrix proteins and bovine porous bone mineral in periodontal regenerative therapy.

Aim: The purpose of this study was to compare the clinical effectiveness of enamel matrix proteins used alone or in combination with bovine porous bone mineral in the treatment of periodontal intrabony defects in humans.

Methods: Twenty-one paired intrabony defects were surgically treated using a split mouth design. Intrabony defects were treated either with enamel matrix proteins or with enamel matrix proteins combined with bovine porous bone mineral. Re-entry surgeries were performed at 6 months. Preoperative probing depths, attachment levels, and transoperative bone measurements were similar for the enamel matrix proteins and bovine porous bone mineral groups.

Results: Post-surgical measurements taken at 6 months revealed a significantly greater reduction in probing depth in the enamel matrix proteins and bovine porous bone mineral group (3.43 ± 1.32 mm on buccal sites and 3.36 ± 1.35 mm on lingual sites) when compared with the enamel matrix proteins group (1.91 ± 1.42 mm on buccal sites and 1.85 ± 1.38 mm on lingual sites). The enamel matrix proteins and bovine porous bone mineral group also presented with significantly more attachment gain (3.13 ± 1.41 mm on buccal sites and 3.11 ± 1.39 mm on lingual sites) than the enamel matrix proteins group (1.72 ± 1.33 mm on buccal sites and 1.75 ± 1.37 mm on lingual sites). Surgical re-entry of the treated defects revealed a significantly greater amount of defect till in favour of the enamel matrix proteins and bovine porous bone mineral group (3.82 ± 1.43 mm on buccal sites and 3.74 ± 1.38 mm on lingual sites) as compared with the enamel matrix proteins group (1.33 ± 1.17 mm on buccal sites and 1.41 ± 1.19 mm on lingual sites).

Conclusions and clinical implications: The results of this study indicate that bovine porous bone mineral has the ability to augment the effects of enamel matrix proteins in reducing probing depth, improving clinical attachment levels and promoting defect fill when compared with pre-surgical levels.

407	Topic – Material Research

Surface modification of titanium by blue-violet semiconductor laser and ultraviolet light emitting diode

Presenter: Ichikawa T

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Background: Nowadays, dental implants have recently gained importance in prosthetic dentistry. Many studies have been conducted for surface modification of titanium for accelerating osseointegration. Further, peri-implantitis is occasionally observed found in a long survey. Therefore, there is growing importance for restoring osseointegration following the occurrence of peri-implantitis. Recently, it has been reported that the photocatalyst anatase titanium dioxide greatly expresses antibiotic properties and hydrophilicity under ultraviolet ray irradiation. Because their development, blue-violet semiconductor laser (BV-LD) and ultraviolet light emitting diode (UV-LED) have been used to modify the surface of titanium implants.

Aim: The aim of this study was to reveal the efficacy of BV-LD and UV-LED exposures on surface modification of titanium from the standpoints of enhancement of osteoconduction and antibacterial property.

Methods: Surfaces of commercially pure titanium specimens were polished, and half of the specimens were treated with anatase titanium dioxide solution. A BV-LD ($\lambda = 405$ nm), UV-LED ($\ddot{e} = 365$ nm), and black light ($\ddot{e} = 355$ nm) were used as light sources. The surface modification was evaluated physically and biologically: surface roughness, surface temperature during irradiation, and X-ray diffraction (XRD) analysis; contact angle test for hydrophilicity; methylene blue degradation test for photocatalytic evaluation; deposition of hydroxyapatite by immersing the specimens in SBF solution; proliferation of three cell lines as *in vitro* evaluations for biocompatibility; histological observations *in vivo* experiment (rat femurs), and the attached numbers of *Porphyromonas gingivalis* as antibacterial property.

Results: No significant change was found in the surface roughness and XRD after the specimens were exposed to the abovementioned light sources. BV-LD and UV-LED did not affect surface temperature. The contact angle was significantly decreased and methylene blue was significantly degraded. The number of cases of *P. gingivalis* was significantly lower than that in the no exposure group, and the hydroxyapatite deposition was significantly higher in the exposure group. The number of osteoblast-like cells attached to UV-LED-irradiated surfaces was significantly increased, whereas the number of myoblasts and fibroblasts did not change significantly. Histological evaluation revealed new bone growth around the modified specimens, and both the bone-to-specimen contact ratio and new bone area increased significantly in the exposure group. The abovementioned effects were enhanced in the specimens treated with anatase titanium dioxide solution.

Conclusions and clinical implications: It is suggested that the exposure to BV-LD and UV-LED can enhance the osteoconductivity of titanium surface and provide antibacterial protection. The efficiency could help promote osseointegration and re-osseointegration in a clinical condition.

408 | Topic – Material Research

Plasma rich in growth factors and autologue fibrin membrane with and without Bio-Oss in rabbit cranium

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Background: Reconstruction methods are an essential prerequisite for functional rehabilitation of the stomatognathic system. Plasma Rich in Growth Factors (PRGF) offers a new and potentially useful adjunct to bone substitute materials in maxillofacial reconstructive surgery.
Aim: This animal study was carried out to investigate the influence of PRGF and Fibrin membrane on regeneration of bony defects with and without deproteinized bovine bone mineral (DBBM) at rabbit calvaria.
Methods: Twelve New Zealand white rabbits were included in this randomized, blinded, prospective study. Four equal 3.3 × 6.6 mm cranial bone defects were created and immediately grafted with DBBM, PRGF + DBBM, PRGF + Fibrin membrane and no treatment as control. The defects were evaluated with histologic and histomorphometric analysis performed 4 and 8 weeks later.
Results: Adding of PRGF to DBBM led to increased bone formation as compared with the control group in 4 and 8 weeks interval. In DBBM and PRGF + Fibrin membrane samples, no significant increase was seen compared with the control group. There was also a significant increase in rate of biodegradation of DBBM particles with the addition of PRGF in 8 weeks interval. No noticeable foreign body reaction or any severe inflammation was seen in each of the specimens evaluated.
Conclusions and clinical implications: Under the limitation of this study, adding of PRGF to DBBM enhanced osteogenesis in rabbit calvaria. Applying autologue fibrin membrane in defects was not helpful.

409 | Topic – Material Research

Immobilization of collagen on titanium implant surface enhances bone-implant contact

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Background: Titanium (Ti) surface modifications can influence the osseointegration process, the final goal being accelerate/increase bone formation around implants. In this context, biochemical modification of Ti surface provided by collagen immobilization seems to be a promising strategy.
Aim: This study aimed at evaluating the effect of collagen-coated Ti implants on bone formation in a mandible dog model.
Methods: Ten mongrel dogs were submitted to premolar extraction and after 12 weeks collagen-coated (CC) and acid-etched (AE) self-screw Ti implants (3.75 × 8.5 mm) were placed into edentulous areas. Animals were killed at 3 and 8 weeks (five per period) and bone fragments with implants harvested and processed to obtain thin ground sections. Histomorphometric analysis was carried out to determine the percentage of bone-implant contact (BIC) and data were compared by two-way ANOVA followed by Tukey's test.
Results: Bone healing resulted in the formation of lamellar bone trabeculae adjacent or in direct contact with implant surfaces. BIC was higher in CC implants compared with AE ones ($P = 0.001$). For AE implants BIC increased from 3 to 8 weeks (12.9% and 31.8%, respectively) while for CC implants there was a non-statistically significant difference between 3 and 8 weeks (36.7% and 46%, respectively). At 8 weeks CC implants presented a non-significant increase in BIC compared with AE implants.
Conclusions and clinical implications: These results suggest that collagen immobilization on Ti surface accelerates and increases the osseointegration of implants.

Financial support: FAPESP and CNPq
Key words: Implant surface, osseointegration, collagen

410 | Topic – Material Research

Evaluation of trabecular metal dental implant in a canine model

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Background: Optimizing stability during osseointegration is critical for the long-term success of a dental implant. Trabecular Metal (TM) is a highly porous tantalum material that mimics the characteristics of trabecular bone, and has been successfully used to achieve bone ingrowth in orthopedic implant surgeries.
Aim: The objectives of this study were to investigate whether TM applied on a dental implant would osseointegrate, and to compare the findings with traditional tapered screw-design dental implants.
Methods: Experimental TM ($n = 24$) and control tapered screw ($n = 24$) dental implants were placed in mandibles of eight dogs (six implants per dog). Two animals each were euthanized at 2, 4, 8 and 12 weeks after implantation. Implant stability quotients (ISQ) were measured at the time of implantation and euthanization. Calcein was injected before necropsy to label newly mineralizing bone tissue. Two histological sections from each implant were prepared: one section was used to assess the

calcein-labeled tissue and the other was stained by Goldner's Trichrome to assess osteoid and matured bone. Effects of implant type and healing time on the histomorphometric and ISQ measurements were statistically analyzed.

Results: At all time periods, the average bone to implant contact (BIC) exceeded 70% for both implant types and average ISQ value was 60 or above for controls and 65 or above for TM implants. There was no statistical difference in either BIC or stability between implant types. New bone formation in TM pores was evident at 2 weeks and bone ingrowth across the full thickness of the porous surface was observed at 4 weeks. Histomorphometric analyses of bone in TM pores indicated: (1) the highest amount of newly mineralizing tissue was observed at week 2 (36.08%) and significantly lower at later weeks (17.69%, 22.4% and 19.95%, respectively, $P < 0.05$) and (2) osteoid was highest at week 2 (63.53%) and significantly lower at weeks 8 and 12 (35.97% and 41.94%, respectively, $P < 0.05$). Matured bone significantly increased during the same time intervals (3.32%, 9.01% and 18.69% at 2, 8 and 12 weeks, respectively, $P < 0.05$).

Conclusions and clinical implications: The level of osseointegration and stability achieved with TM implants was comparable to the clinically successful tapered screw design. Active bone formation into the porous surface of TM implant observed at the early healing stage suggests its potential use in dental applications. This study was supported by Zimmer Dental Inc.

411 | Topic – Material Research

Promoting bone formation on the surface by wire-type EDM *in vivo*

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Background: Our recent study already revealed the titanium surface modified by wire-type electric discharge machining (EDSurface) demonstrated excellent bone biocompatibility *in vitro* because of microfabricated surface with irregular morphology and oxidized surface chemical structure.

Aim: In this study, we aimed to investigate of EDSurface predominated by examining new bone formation *in vivo*.

Methods: The implants with EDSurface (4 mm diameter, 10 mm height) were manufactured by Wire-type EDM processing commercially pure titanium block. As control, implants with machined surface were prepared. Japanese white rabbits, weighing 2.5 kg ± 100 g, were used for this research. The implants with EDSurface and with machined surface were implanted in the femur of rabbits. The femur was removed 1 and 2 weeks implantation, and the interface of the implant and the bone was observed by light-powered microscope. Each tissue slice stained with hematoxylin-eosin was looked at under a high-powered microscope. The volume and process of new bone formation was evaluated by 3D images reconstructed from X-ray micro-CT scanner. All animal experiments in this study were approved by the committee for the care and use of laboratory animals in Showa University, Japan.

Results: After 1-week implantation, the new osteoid tissue was seen to cover the area surrounding the implant with EDSurface but not with machined surface, both macroscopically and histologically. After 2 weeks implantation, it was seen both with EDSurface and machined surface. Histologically, EDSurface was more rich and hard osteoid than another in particular. New bone formation was detected remarkably in the artificial space that EDSurface not abutting bone in the time of implanted. 3D images showed the same phenomenon and provided evidence for them.

Conclusions and clinical implications: Our results are in accordance with other studies in the promoting bone formation by modified titanium surface, and show EDSurface keeps an advantageous condition on doing osseointegration. In the future, it should be evaluated the animals implanted for a long period of time.

412 | Topic – Material Research

Effect of the bovine collagen matrix on bone formation in rat calvarial and mandibular defects

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Background: Bovine collagen matrix used in this study consists of a porous collagen matrix of bovine origin (spongiosa) and has been evaluated as potential candidates for bone regenerative therapy. It has been used in the oral cavity under a variety of indications.

Aim: This study was performed to evaluate the bone formation effect of the bovine collagen matrix in rat calvarial and mandibular defects.

Methods: Critical-sized eight-mm calvarial defects and five-mm mandibular defects were created in 60 male Sprague–Dawley rats using trephine bur. The animals were divided into four groups. Each group received one of the following: Control (sham-surgery), and experimental (bovine collagen matrix) for calvarial defect and mandibular defects. In the mandibular defect model, both sides of the mandible were used for the experiment. Defects were evaluated by histologic and histometric parameters following 2- and 8-week healing intervals (10 animal/group/healing interval).

Results: Overall results were uneventful without any defect exposure or inflammation. The amount of new bone formation and bone maturity increased with the increase in healing period at each group. On histologic observation, a large amount of newly formed bone was observed in the experimental group.

Although bovine collagen matrix was observed at 2 weeks, by 8 weeks, the bovine collagen matrix appeared to be completely absorbed. Histometric analysis revealed that the amount of new bone was significantly greater in the collagen matrix treated sites than in the control at 8 weeks in calvarial defects ($P < 0.05$).

Conclusions and clinical implications: Within the limits of the study, these results suggest that the use of the bovine collagen matrix on the calvarial and mandibular defects in rats has a beneficial effect on the regeneration of bone tissue.

413 | Topic – Material Research

Functionally loaded microplasma sprayed CaP-coated oral implants in dogs. II: long-term results

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Background: A new microplasma spraying equipment (MSE) to deposit calcium phosphate ceramic (CaP) coatings onto titanium substrates has been developed. With this system it is possible to spray fine particles and to apply textured hydroxylapatite coatings onto titanium surfaces. Moreover, due to the low heat power of the microplasma jet, overheating of the powder particles, as well as excessive local overheating of the substrate is diminished. Furthermore, because of the small laminar plasma jet it is possible to achieve high spray efficiency in the case of spraying for dental implants. Also, the low level of noise (25–50 dB) and hardly any dust makes it possible to operate MSE under conditions of normal workrooms.

Aim: The aim was to investigate in a mandibular dog model the effect of functional load on bone adaptation around titanium implants provided with newly developed microplasma sprayed calcium phosphate (CaP) coatings.

Methods: For histomorphometrical evaluation 56-screw type titanium implants were inserted in the mandibles of seven adult beagle dogs. The implants were either acid etched without additional coating, coated with conventionally plasma sprayed CaP ceramic, coated with micro plasma sprayed CaP ceramic, or with a micro plasma sprayed coating at the apical part only. To assess the effect of occlusal loading a split mouth design was used. Six weeks after implantation, the implants in one half of the mandible of each dog were functionally loaded while the contra lateral implants served as control. One year after loading the animals were sacrificed. Bone-to-implant contact, amount of bone and coating degradation were assessed.

Results: Irrespective of loading, bone healing was comparable for all surfaces tested.

Conclusions and clinical implications: It was concluded that functional loading of MPS CaP coated implants evokes a favorable bone response and moreover that the bone response, irrespective of the loading condition, does not differ from PS CaP coated implants.

414 | Topic – Material Research

Zirconia dental implants with femtosecond laser microstructuring. A new way to guide cell growth

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Background: Physical and chemical microtexturizing techniques which are currently applied to zirconia dental implants produce various surface geometries and differing degrees of surface roughness. The laser microtexturizing no requires contact and can create organized and repetitive geometric patterns. Different laser has been used on zirconia and except for the diode laser all produce some degree of thermal damage to adjacent surfaces. Ultrashort lasers can resolve the thermal damage. There are no references to microstructuring techniques with femtosecond laser on cylindrical zirconia implant surfaces.

Aim: To develop microtexturizing parameters of femtosecond laser on zirconium dental implant.

To perform surface characterization of femtosecond laser processed zirconia dental implants.

To comprobe osteoblasts behaviour at different times on laser processed surfaces and controls.

Methods: Sixty White Sky® (Bredent Medical® GMBH & Co. KG, Senden, Germany) zirconia implants of 4 mm diameter and 8 mm length were used.

Divided into three groups: Control (20 implants without laser treatment), Group A (20 implants treated with grooves), Group B (20 implants treated with pores).

Surface characterization by SEM, elemental microanalysis, optical interferometry, and x-ray diffraction analysis was performed.

Osteoblasts hFOB1.19 was seeded and culture at 7, 15 and 30 days.

Descriptive statistics of roughness parameters in micrometers, percentage in weight of chemical elements and percentage volume of monoclinic and tetragonal phases was performed.

Kolmogorov – Smirnov test, ANOVA test for independent variables and Bonferroni test were applied. $P < 0.005$.

Results: Femtosecond laser creates a hybrid surface with micrometric and nanometric features inside grooves and pores. Minimal thermal damage was observed around processed zones. Laser modification brings an increase of surface roughness by 6X on grooved and 1.5X on pored surfaces compared with control. Group A vs. Control (7.92, $P < 0.001$), Group B vs. control (0.85, $P < 0.001$), Group A vs. Group B (7.07, $P < 0.001$).

On laser treated surfaces Oxygen and Zirconium percentages increased ($P < 0.005$), and contaminant elements Carbon and Aluminium decreased ($P < 0.005$).

X-ray diffraction analysis showed weak monoclinic phase in all implant surfaces (Control 0.6–6%), (Group A 0.1–4%), (Group B 0.3–4.5%) $P < 0.005$.

Cell adhered and grew inside grooves and pores adapted to the size of 30 μm of diameter and spread with the geometric pattern or grooves and pores.

Conclusions and clinical implications: Its possible to control and guide the cell form, direction and growth on zylindrical zirconia implants.

The femtosecond laser increases the roughness, reduces the residual processing elements, reduces the thermal damage, increase the Oxygen percentage on surface, is reproducible and offers an alternative to conventional surface treatments for zirconia dental implants.

415 | Topic – Material Research

Titanium with heparin and bone morphogenic protein-2 (BMP-2) for inhibition of inflammatory and enhancement of osteoblast function

Presenter: Ohe J-Y

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Background: Bone morphogenic protein (BMP) has often been used in bone repair, with successful results reported in various aninal experiments. BMP-2 is a potent osteoinductive factor that induces osteogenic differentiation of mesenchymal cells, and the administration of recombinanat BMP-2 protein *in vivo* induces de novo orthotopic or ectopic bone formation. BMP-2 was incorporated into biomimetric calcium phosphate coatings and shown to induce and sustain bone formation at an ectopic implantation. Although encouraging results have been achieved with BMP-2, several problems remain, including their high cost, the required high dose, and the short protein half-life. The objective of present study was to evaluate the osteoinductive activity and simultaneous administration of an implant material by coating the surface of titanium with BMP-2 and heparin *in vitro*.

Aim: Titanium used implants have problems that they are vulnerable to infection and slow in making new bone formation. It is purpose of this study to confirm the effect of titanium with heparin and bone morphogenic protein-2 (BMP-2) for inflammatory and enhancement of osteoblast function.

Methods: 1–1 Fixation of heparin and bone morphogenic protein-2 (BMP-2) on titanium surface

1. The introduction of amine using 2-aminopropyltriethoxysilane (ATPES) to titanium surface

2. Fixation of heparin using EDC/NHS on amine group containing Titanuim.

3. Fixation of BMP-2 using EDC/NHS on heparinized Titanium.

1–2 Surface analysis method

1. X-ray Photoelectron Spectroscopy

2. Contact angle

1–3 BMP-2 release behavior

Affirmance of BMP-2 release behavior fixed Titanium surface (1, 3, 8, 24 h; 3, 5, 7, 10, 14, 21, 28 days)

1–4 Cell experiments

1. Experimental condition: positive control: Ti group, group 1: heparin grafted Ti, group 2: BMP-2 ionic-cross linked heparin-grafted Ti, group 3: BMP-2 chemical-cross linked heparin-grafted Ti).

2. Experimental method: measurement of scanning electron microscopy (SEM), Attachment test (2, 6, 24 h), Proliferation test (1, 3, 7 days), Alkaline phosphate activity (1, 3, 7, 14 days), Alizarin red S (7, 21 days), Calcium content (7, 21 days).

Results: The introduction of amine using 2-aminopropyltriethoxysilane (ATPES) to titanium surface was confirmed by XPS. It could be confirmed using contact angle that hydrophilicity increased as the introduction of heparin & BMP-2 to titanium surface. BMP-2 release behavior was gradually emitted from titanium surface. And inflammation tends to have fewer heparin grafted Ti group than only Ti group. The functional improvement of osteoblast can be confirmed experimentally such as cell attachment, proliferation, alkaline phosphatase activity, Alizarin red S, immunohistochemistry. Proliferation and differentiation of osteoblast in-group 3 was much better than other groups.

Conclusions and clinical implications: It is confirmed that titanium with heparin and BMP-2 has functions of improvement of osteoblast and anti-inflammation *in vitro*. Therefore, these data suggested that titanium with heparin and BMP-2 is valuable material for inhibition of inflammation and stimulation of new bone formation in process of implantation.

416 | Topic – Material Research

Vertical bone augmentation: a comparison between 3D printed monolithic monetite blocks and autologous onlay grafts in the rabbit

Presenter: Torres J

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Background: Onlay autografting is among the most predictable techniques for craniofacial vertical bone augmentation, however, complications related to donor site surgery are common and synthetic alternatives to onlay autografts are desirable. Recent studies have shown that the acidic calcium phosphates, brushite and monetite, are osteoconductive, osteoinductive and resorb faster *in vivo* than hydroxyapatite. Moreover, they can be 3D printed allowing precise host bone-implant conformation.

Aim: The objectives of this study were to confirm that craniofacial screw fixation of 3D printed monetite blocks was possible and to compare the resulting vertical bone augmentation with autograft.

Methods: Eight New Zealand rabbits were used for this study. 3D printed monolithic monetite onlay implants were fixed with

osteosynthesis screws on the calvarial bone surface of New Zealand rabbits. After 8 weeks, integration between the implant and the calvarial bone surface was observed in all cases.

Results: Histomorphometry revealed that 42% of the monetite was resorbed and that the new bone formed within the implant occupied 43% of its volume, sufficient for immediate dental implant placement. Bone tissue within the autologous onlay occupied 60% of the volume. We observed that patterns of regeneration within the implants differed throughout the material and propose that this was due to the anatomy and blood supply pattern in the region

Conclusions and clinical implications: Rapid prototyped monetite being resorbable osteoconductive and osteoinductive would appear to be a promising biomaterial for many bone regeneration strategies.

417 | Topic – Material Research

Tomographic, histological and immunohistochemical evidences on N-butyl-2-cyanoacrilate for graft fixation

Presenter: Faria PEP
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Background: Experimental studies on the bone tissue responses to cyanoacrylate can be found in the literature, although neither evaluating the histological response nor the fixation of onlay bone grafts with N-butyl-2-cyanoacrilate (Nbc).

Aim: The aim of the proposed study is (1) to analyze the bone grafts volume maintenance fixed on to rabbits mandible body using either Nbc or titanium screw, (2) to assess the incorporation of onlay grafts on perforated recipient bed and (3) the differences of level expression of tartrate resistant acid phosphatase (Trap) protein involved in the resorption of bone grafts fixed either with Nbc or titanium screw.

Methods: Eighteen adult New Zealand White rabbits were submitted to calvaria onlay grafting on both sides of the mandible. On one side the graft was fixed with Nbc, while on the other side the bone graft was secured with an osteosynthesis screw. A computed tomography (CT) was performed just after surgery. The animals were killed after 1 ($n = 9$) and 6 weeks ($n = 9$) and submitted to another CT. The CT images were used to estimate the bone grafts volume along the experiments. Histological paraffin sections of the grafted areas were prepared to evaluate the healing of bone grafts and to assess the expression of Trap protein.

Results: The CT scan showed better volume maintenance of bone grafts fixed with Nbc ($P \leq 0.05$) compared with those fixed with screws, in both experimental times (ANOVA). The immunohistochemical evaluation showed that the Trap expression in 6-week period was significantly higher compared with the 1-week period, without showing significant difference between the groups (Wilcoxon and Mann–Whitney). Histological analysis revealed that although the Nbc caused periosteum damage, the stability provided by the adhesive allowed for bone graft revascularization and incorporation in a similar manner as observed in control group.

Conclusions and clinical implications: The perforation provided by screw insertion into the graft during fixation may have triggered early revascularization and remodeling to render increased volume loss compared with experimental group. These results indicate that the Nbc possesses equivalent properties to titanium screw to be used as bone fixation material in osteosynthesis.

418 | Topic – Material Research

Powder-size effect on the biocompatibility of porous-titanium produced using moldless-process

Presenter: Naito Y
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Background: Porous titanium has been recently developed for biomedical devices such as dental implants. However, it is difficult to construct custom-made porous devices because they require sintered molds of different shapes. From the viewpoints of cost and time, a new technique without the use of a mold is required for producing porous titanium. We have developed a new technique for the high formability of porous titanium without the use of a mold.

Aim: The objective of this study was to estimate the biocompatibility of porous titanium produced using a moldless process. Moreover, we evaluated the effect of powder size on the biocompatibility of porous titanium produced by using this process.

Methods: Gas-atomized titanium powders (average diameters; 120 and 200 μm) were mixed into inlay casting wax. Square plates (10 × 10 × 2 mm) were processed manually in the same manner using a wax-up technique. For the control, we prepared bulk plates, which were of the same size as the porous specimens. The specimens were debindered in air at 380°C and then sintered in Ar at 1100°C. To examine the bioactivity of porous titanium, osteoblast-like cells were cultured in the specimens. In addition to specimen surface observation using scanning electron microscopy, the cell proliferation on the specimens was measured with a special assay kit. To evaluate their osteoconductivity, the specimens were immersed in Hanks' solution (simulated body fluid) at 37°C for 4 weeks. Subsequently, the specimens were rinsed in distilled water, dried, and weighed. The mass changes occurring because of the immersion in Hanks' solution were determined. Statistical analysis performed using one-way analysis of variance (ANOVA) followed by Tukey's *post-hoc* tests for multiple comparisons revealed significant differences.

Results: The osteoblast-like cells were well spread and grew evenly on the surface of the specimens. The number of

osteoblast-like cells was significantly higher in the specimens of 200-μm powder than in those of 120-μm powder. The mass changes per unit area calculated on the basis of the plate dimension were 47.6 μg/mm² (for specimens of the 120-μm powder) and 98.4 μg/mm² (for specimens of 200-μm powder). These values were extremely high as compared with those of the control.

Conclusions and clinical implications: The porous titanium produced using our new technique without a mold exhibited sufficient biocompatibility for biomedical applications. In a clinical situation, controlling the powder size may contribute toward preparing a biomaterial with the desired biocompatibility.

419 | Topic – Material Research

Immobilization of bisphosphonates on surface-modified anodic TiO_2 nanotubes

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Background: Because the founding of the osseointegration concept, the characteristics of the interface between bone and implant, and possible ways to improve it, have been of interest in dental implant research.

Aim: This study was designed to investigate the drug loading capacity of anodized nanotubular titanium surfaces, and to evaluate the preosteoblastic cell response to surface immobilized bisphosphonates (BPs) on anodized nanotubular titanium surfaces *in vitro*.

Methods: We investigated three groups of titanium implants (1) pure titanium group; (2) anodized and heat-treated titanium group (500); and (3) anodized, heat-treated and bisphosphonate coated Ti group (1 mg/mL of ibandronate immersing).

Titanium dioxide (TiO_2) nanotube arrays were prepared by electrochemical anodization of titanium plates. The glycerol solution containing 1 wt% NH_4F and 10 wt% deionized water was used as an electrolyte. Pulse signals with a potential of 20 V and current density of 20 /were applied for 40 min. TiO_2 nanotubes were heat-treated at 500 for 2 h.

The surface-modified specimens and controls were immersed in a solution of ibandronate, which is one of bisphosphonate drugs, for 24 h at 37°C, then dried in a desiccators.

High performance liquid chromatography (HPLC) was used to detect the drug loading of the specimens for 12 days. The data collected were analyzed by using SPSSWIN 12.0.

SEM photography was performed after adhering the mouse preosteoblast MC3T3-E1 cells for 48 h in order to assess the osteoinductivity.

Results: The loaded ibandronate of pure titanium and anodized and heat-treated titanium released 46.7 ± 4.475 ng/mL and 85.26 ± 39.76 ng/mL, respectively, on day 1. The duration of drug release was enhanced by the anodic surface modification. The drug release rate was also increased with surface modification.

Preosteoblasts on the pure titanium had a more rounded shape, with no cellular extensions or filopodia propagation, whereas those cultured on anodized, heat-treated and bisphosphonate coated titanium showed the greatest number of filopodia extending at the leading edges. It can be speculated that the interplay between the cell and the nanotubes allows for enhanced dynamic propagation and an overall increase in osteoblast activation, and

Conclusions and clinical implications: The drug loading capacity of titanium surfaces was enhanced by anodizing surface modification. Bisphosphonate-immobilized implants with modified surfaces have positive effects in osteoblastic cells.

420 | Topic – Material Research

Study of titanium implants modified by laser – hydroxyapatite

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Background: The surface of implants always causes concern and interest in scientific communities, because the surface has a close relationship with the time required for osseointegration. Consequently, the delay between surgery and prosthesis installation over implants troubles patients and professionals alike as implant surface micro-topography deeply affects bone healing. As a result, research topics like implant surface and the bone-implant interface have gained significant importance in modern implant dentistry.

Aim: Surface and biomechanical analysis of titanium implant modified by laser with and without hydroxyapatite.

Methods: Titanium implants with 3.75 X 10.00 mm were inserted by Branemark's method in the tibia of 30 male rabbits (New Zealand – *albinus*) at 6 months age, between 3 and 4 kg. The animals received three types of different titanium implants surface: machined (control group – GI), laser beam (GII), and laser beam + hydroxyapatite (GIII). These rabbits were divided into two periods of observation: 4 and 8 weeks post-surgery. *Modification of implant surface*: inGII and GIII, the implants were irradiated with high intensity Nd-YAG laser with potency pre-determined. In GIII after laser beam, the surface received a coating of hydroxyapatite by biomimetic method.*SEM (scaning electron microscope)*: all implant surfaces were analyzed using SEM before being inserted into the rabbits. *Removal torque*: after 4 weeks half of the implants were re-opened, the bone and soft tissue covering the implants were removed, the mount implants were connected to the torque machine – ATG24CN Tohnich Tokio – Japan, an anti-clockwise movement was performed to remove the implant. The maximal torque value for breakage of bone-implant interaction was measured in Newton centimeters (N cm) and the value were sent for statistic analysis. No forces were applied in the vertical direction so as to

avoid alterations in the data. After 8 weeks the remaining implant received the same process. *Statistic analysis*: Student-Newman–Keuls Method.

Results: In GII and GIII the surface analysis showed a morphology affected by melt and quick solidification zones, resulting in sphere-like structures on the entire surface. In short the laser treatment yielded a homogenized, porous surface, which increased surface area and volume. The biomechanical analysis at 4 weeks, of GI, showed less force at torque removal when compared with GII and GIII. At 8 weeks there were no significant statistical differences among the three groups.

Conclusions and clinical implications: Titanium implants modified by laser irradiation can increase osseointegration during the initial phase. The delay between surgery and prosthesis installation over implants troubles patients and professionals.

421 | Topic – Material Research

The osteogenic differentiation of adipose-derived mesenchymal cells on three modified titanium surfaces

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Background: Long-term stability of dental implant depends on the integration between the bone tissue and the implanted biomaterial, which requires the continuous differentiation of the osteoblastic precursor cells and the biocompatibility of the implanted biomaterials. The adipose tissue-derived mesenchymal stem cells (ADSCs) have been suggested to be convenient osteoblastic precursor cells from mesenchymal origin in bone tissue engineering when regarding their abundance and accessibility.

Aim: This study was to investigate the proliferation and osteogenic differentiation of SD-rat ADSCs on three modified titanium surfaces.

Methods: Commercial pure titanium discs were used as the substrates for smooth, acid-etching and micro-arc oxidation (MAO) surfaces. The samples were placed in a 24-well cell culture cluster and ADSCs were seeded at a density of 20,000 cells/cm^2 on the acid-etching and MAO surface serving as experimental group, while smooth surface served as control. The cells were left to adhere and grow to 80% confluence and then induced to osteogenic differentiation by adding osteogenic supplement (10 nM/L dexamethasone, 0.2 mM/L ascorbic acid and 10 mM/L β-glycerolphosphate) to the DMEM/F12 medium. MTT was carried out to compare the growth of ADSCs on the three different titanium surfaces. The alkaline phosphatase (ALP) enzymatic assay kit was used to determine the ALP activity of ADSCs after induced to osteogenic differentiation. Quantitative real-time PCR (QRT-PCR) was used to determine the expression of osteoblast-associated genes (ALP, BMP-2, OCN, MSX2, Runx2, Smad2, Osterix and collagenase type I).

Results: Our present study provided the evidence for a time-dependent growth of the cells on the smooth surface, acid-etching surface and MAO surface. No significant difference between the number of cells on the acid-etching and MAO surface could be observed in the testing duration of 11 days. The number of cells on the smooth surface was significantly lower than the other two substrates at each time point. ALP activity was detected by day 7, with greatest absorbance seen at 14 days. The experimental groups demonstrated significantly greater activity than the control group at all time periods ($P < 0.05$). A time-dependent increase of gene expression was also observed. QRT-PCR showed lack of expression for osteoblast-associated gene markers except ALP at day 7. At day 21, all the gene markers were observed with variation in amount.

Conclusions and clinical implications: The proliferation and osteogenic differentiation of ADSCs were enhanced on both the acid-etching and MAO surfaces compared with the smooth surface.

422 | Topic – Material Research

Effect of smoking on early bone healing around oxidized surfaces: a prospective-controlled study in human jaws

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Background: Peri-implant bone healing is a complex phenomenon. This process involves a cascade of synthesis and activation of matrix proteins, growth factors, cytokines, and angiogenic stimulators that coordinate the restoration of mechanical stability of bone at the peri-implant interface. However, smoking tobacco has been shown to be a risk factor for bone healing.

Aim: This prospective and controlled histologic study evaluated the impact of smoking on bone-to-implant contact (BIC%), the bone density in the threaded area (BA%) as well as the bone density outside the threaded area (BD%) around micro-implants with anodized surface retrieved from human jaws.

Methods: Twenty-four subjects (mean age 51.32 ± 7.5 years) were divided in two groups: Smokers ($n = 13$ subjects) and non-smokers ($n = 11$ subjects). Each subject received one micro-implant with oxidized surface during conventional mandible or maxilla implant surgery. After 8 weeks, the micro-implants and the surrounding tissue were removed and prepared for histomorphometric analysis.

Results: Three micro-implants placed in smokers showed no osseointegration. The newly formed bone showed early stages of maturation, mainly in the non-smokers. Marginal bone loss, gap and fibrous tissue were present around implants retrieved from smokers. Histometric evaluation indicated that the mean BIC% ranged between 25.97 ± 9.02% and 40.01 ± 12.98% for smokers and non-smokers, respectively ($P < 0.001$). Smokers

presented 28.17 + 1032% of BA% while non-smokers showed 46.34 + 19.12%. The mean of BD% ranged between 18.76 and 25.11% for smokers and non-smokers, respectively ($P > 0.05$).

Conclusions and clinical implications: The present data obtained in human subjects confirmed that smoking has a detrimental effect on early bone tissue response around oxidized implant surfaces.

423 | Topic – Material Research

Biomechanical behaviour of a prefabricated bar system – a numerical study

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Background: A novel prefabricated chair-side bar system (SFI-Bar, Cendres + Métaux SA, Switzerland) has been introduced aiming to reduce chair time as well as simplifying the workflow in the dental practice and lab.

Aim: An extensive study has been performed to investigate the behaviour of the bar system using methods from materials testing, numerical methods and clinical investigations to study the fitness for use of this system. This work presents some of the results of the numerical part.

Methods: Finite Element (FE) models of the bar system mounted on top of three different implants (one idealised and two commercially available, all components titanium) were generated. According to EN ISO 14801 the implants were embedded in resin with a Young's modulus of 3 GPa, 3 mm below the nominal bone level. A load of up to 500 N was applied equally on both bar ends. Beside the implant geometry, following parameters were varied: implant distance, tightness of fit of the components, angulations of the implant axis of 15°. Stresses in the bar system and in the implants as well as strains in the embedding surrounding the implants were recorded. All simulations were performed with the FE package MSC. Marc/Mentat.

Results: Highest stresses in the system were found in the bar itself. Even for high loads of 500 N only minor plastic deformation was registered. Stresses in the bar slightly increased for smaller implant distances. A tight press fit of the components introduced unfavourable high stresses in the whole system, while a small play resulted in a slight reduction of the stresses. Independent of the implant geometry only small stresses were found in the implants. Divergence of the implant axis had no influence on the stresses in the bar and the implants, but resulted in an increased strain in the embedding. At 500 N, only for parallel bended implants the strains in the bone were locally above the physiological limits of 3000 μ strain.

Conclusions and clinical implications: The analysis of the prefabricated bar system proved that clinically there will be no risk of failure. It could be seen that the implant geometry has only a minor influence on the biomechanical behaviour of the bar. The simulations showed that in clinical application a tight fit between the components should be avoided. Besides that, the bar can easily be adopted to the clinical situation with acceptable fitting tolerance and without risk of reducing the stability.

424 | Topic – Material Research

Biomechanical behaviour of the SFI-Bar – mechanical and clinical investigations

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Background: A novel prefabricated chair-side bar system (SFI-Bar, Cendres + Métaux SA, Switzerland) has been introduced aiming to reduce chair time as well as simplifying the workflow in the dental practice and lab.

Aim: An extensive study has been performed to investigate the behaviour of the bar system using methods from materials testing, numerical methods as well as clinical investigations to study the fitness for use of this system. This work presents results of the mechanical testing and first results form the clinical application.

Methods: Dynamic fatigue testing of the SFI-Bar on two implants (Thommen Medical Implants SPI® Element Æ4.0/L14.0) for two implant distances were performed according to EN ISO 14801. The implant distances of 26 and 8 mm represented the longest and the shortest available bar, respectively. Implants were embedded in resin (PalaXpress, Haereus Kulzer GmbH, Germany) at a level of 3 mm below nominal bone level. The bars were loaded with forces of 90, 180, 270, 360 and 450 N over 1 million loading cycles in an especially designed loading apparatus. Assuming 250 loading cycles per day in a patient's mouth, this corresponds to a total retention period of more than 10 years. The deflection of the bar was recorded, and deflections above 0.5 mm were considered as failure criteria. For each combination of implant distance and loading force, a number of five specimen was put to cycling testing. A clinical case using a 21 mm long SFI bar mounted on two implants is presented.

Results: None of the conducted permanent loading tests, neither with an implant distance of 26 mm, nor with a distance of 8 mm, resulted in fatigue failure of the bar system. For forces up to 180 N only minor plastic deformations of the total system could be observed, which mainly consisted of a relative movement of the components. Loading the bar with a force of 450 N resulted in extensive plastic deformation even in the first

loading cycle. However, a significant amount of the total deformation of the bar system was caused by a relative sliding movement of the different components of the SFI bar. Clinically, chair side time was reduced successfully as the bar system could be places in only one visit.

Conclusions and clinical implications: The permanent loading behaviour of the bar showed that the bar is fit for the clinical application for a retention period of more than 10 years.

425 | Topic – Material Research

New surgical planning with 3D simil-bone system: *in vivo* study

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Background: Anatomical three-dimensional printing systems are a powerful tool in planning, preoperative diagnosis and treatment, in the field of surgery. Simile-bone anatomical replicas are manufactured from printing in composite, generating the model from the information contained in a CT (computerized axial tomography) technology. Printing composite powder is a rapid prototyping which consists in obtaining a physical object in three dimensions on a succession of layers of dust agglutination technology.

Aim: Validate loyalty of 3D system in their applications for oral surgery.

Methods: We conducted a series of 50 cases with the 3D system in maxilla and mandible. We measured distances platform-bone in both the 3D model, as in CT and the patient. The accuracy obtained with this technology is described by two values: a layer thickness of 0.085 mm and a resolution of 600 × 540 dpi. The model consists of composite powder: Gypsum (50–95%), silica (< 1%), vinyl polymer (2–20%), carbohydrate (1–20%), sulfate (1–20%) and one infiltrating based urethane and beta-Metaetil of cyanoacrylate (80–100%). Radiological protocol: helical CT without contrast or reconstruction filter. Printing matrix model: the 3D model is divided into a succession of layers in two dimensions, which will be printed one by one with a solution binder in a composite powder reservoir. Of the resulting object is finally removed the composite powder, which has been adhered bind to the model by means of compressed air. Sterilization by ethylene oxide. Statistical analysis performed by spss v. 15.0; comparation of mean ± standard deviation. ANOVA test was realized. $P < 0.005$ was taken as significative.

Results: The bio-replicas made by this procedure can be fully mechanized. This includes drilling, tapping, cutting, application of bone tissue, etc. Are also indicated for the use of piezoelectric scalpels, due to their high similarity with the bone consistency. Measurements show no significant differences between the actual clinical situation and the 3D model $P < 0.005$.

Conclusions and clinical implications: The 3D replication system is a faithful reproduction system and can therefore be used in the field of surgery. This system can be used for surgical guides and immediate prosthesis.

426 | Topic – Material Research

Corrosion behaviour of dental ceramics

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Background: The corrosive nature of the saliva in oral cavity requires degrees of restraint to achieve maximal material safety. Although the ceramic materials are considered to be bio-inert, none of them is non-corroding.

Aim: The aim of this study was to determine the level of corrosion of selected ceramic materials.

Methods: In total, 11 types of ceramic materials (glass ceramics, glass-infiltrated ceramics, oxide ceramics) have been chosen for the analysis. The composition of ceramic materials was qualitatively evaluated by X-ray spectrometry using the wave disperse XRF spectrometer Spectroscan MAKV-GV (Spectron NPO, Russia). For evaluation of a corrosive behaviour, leaching under extreme conditions that does not occur in real usage was carried out. Hydrochloric acid was used (3 mL 0.1 mol/L HCl, 120 h, 37 ± 1°C), then extracts were filled up to 10 mL and analysed by mean ICP–OES (Integra XL2, Australia).

Results: In extracts, measurable amounts of followed elements were found: sodium (0.065–1.1), magnesium (0.012–0.15), iron (0.32–1.2), manganese (0.0042–0.096), zinc (0.014–2.7), silicon (up to 0.63), aluminium (up to 0.97), yttrium (up to 0.21) and titanium (up to 2.6, all in mg/L). Zirconium and gold were found in leachates.

For each material, the reproducibility of the analysis was evaluated.

Conclusions and clinical implications: The presence of released ions in the extracts was confirmed for all ceramic materials tested. None of the known dental materials including ceramics can preserve absolute resistance against all corrosion forms.

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427 | Topic – Material Research

Comparison of three nano-HA coatings deposited on titanium implants

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Background: Nowadays nano-HA implants coatings are investigated and developed. Nanometre scale of HA crystals posses better biological properties compared with that of micro particles. Many methods of preparing nano-HA coating are used:

plasma-spray processing, sol-gel processing, biomimetic method, electrochemical deposition. The last method may be processed in different electrolytes, temperature, time, current density and on differently prepared titanium surfaces. Modifications of any of those factors may result in different coatings and implant surface characteristics. Because topography and composition of implants surface play a key role in osteogenic response, they influence implant clinical outcome.

Aim: In present study three nano-HA surfaces prepared by electrochemical deposition were investigated. A surface for further osseointegration analysis in animal model was searched.

Methods: Two-electrode system was used. Commercially pure Ti screw implant with diameter of 4 mm and length of 7 mm was a working electrode. Platinum mesh served as a counter electrode. Titanium implants surface was sandblasted and etched with H_2SO_4 before use. The electrolyte contained 2.08×10^{-4} M $CaCl_2$, 1.25×10^{-4} M NaH_2PO_4 and NaCl and its pH was adjusted to 6.3 by NaOH. The HA coating preparation was performed by electrochemical workstation. In a galwanostatic mode, a current density of 5 mA was controlled. The process lasted for 60, 105 or 120 min at about 100°C.

Chemical composition of the coating was evaluated using XPS. The surface morphology of the coating was observed using SEM.

Results: Qualitative analysis of deposited coating with use of XPS analysis indicated presence of HA.

After a 60 min deposition on the implants surface only couple single crystals were present in the SEM micrograph.

After 105 min deposition a uniform, integrated layer of HA crystals was observed in the SEM micrograph. The coating revealed nano-scale rod-like HA crystals.

In case of 120 min process deposited layer had a two level structure. The base was formed by a uniform layer of nano-scale rod-like HA crystals. Second layer of the HA was formed by circular, thicker centers of crystals. On these layer crystals with much greater diameter occurred.

Conclusions and clinical implications: Length of electrochemical deposition process plays an important role in deposition of HA layer.

Thin, uniform layer of nano-HA crystals can be processed in 105 min electrochemical deposition.

Further analysis in animal model is needed to evaluate biological properties of HA surface deposited after 105 min process.

428 | Topic – Material Research

One-year clinical pilot study of marginal bone resorption of mono-body implant

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Background: This research is clinical pilot study of monobody implant. One year prospective study of marginal bone resorption of monobody implant. This innovative design of monobody implant is characterizing by no micro-gap, one-piece type and platform switching design.

Aim: The purpose of the prospective investigation was to observe clinically bone changes, for a year period, around tapered Mono-body implants restored with immediate loading, immediate non-occlusal loading, delayed loading protocol.

Methods: For this study, 39 implants was being loaded to 13 patients with the average age of 53.8 (form 27 to 72). Implant is tapered Mono-body design, named Onebody™ (Warrentec, Seoul, S. Korea).

Surgical protocol was followed by guidelines of manufactures. Time of implantation is restricted to delayed implantation at this pilot study.

Three types of loading protocol were used. Fifteen implants were assigned to immediate occlusal loading (IOL), 20 implants to immediate non-occlusal loading (INOL), and four implants to conventional loading (CL).

At implant placement, the maximum value of insertion torque was recorded. Radiographic bone level change was measured by periapical radiographs obtained at the time of implant placement and 12 months after insertion.

Radiographic-change was evaluated by image pro reading. Base line of bone level was recorded by mesial and distal aspect of implant. After 1-year implantation, change of bone level was recorded by mesial and distal aspect of implant. The endpoint was change in crestal bone level from baseline (implant placement) to 12 months.

Results: None of implants has been failed. According to the loading protocol, the crestal bone level increased 0.21 mm by conventional loading, decreased 0.17 mm by immediate occlusal loading, and decreased 0.04 mm by immediate non-occlusal loading. Consequently, average bone level decreased 0.02 mm in a year after implant placement.

Distribution of the implants was evaluated accord to the ranges of the bone level change. 55% of implants showed 0–0.5 mm increase, 36% showed 0–0.5 mm decrease, 9% showed 0.5–1 mm decrease.

Conclusions and clinical implications: The innovative design of Onebody™ guaranteed stable crestal bone level around implant after 1 year of implantation, regardless of type of loading protocol.

429 | Topic – Material Research

Surface modification of titanium by plasma polymerization and its effect on bacterial adherence

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Background: Titanium and titanium alloys (Ti6Al4V) are superior to many materials in terms of mechanical properties and biocompatibility. However, they are still not sufficient for prolonged clinical use because the biocompatibility of these materials must be improved.

Aim: The aim of this *in vitro* study was to evaluate the applicability of the plasma polymerization technique with monomer containing thiol functional group on frequently used titanium implant biomaterial surfaces and the effect of the surface modification on microorganism adhesion.

Methods: The study was performed using grade 4 commercial type (cp-Ti) pure titanium. Twenty discs of 4 mm diameter and

1 mm height were prepared and each samples' surface was metallographically polished with a diamond paste. Ten of these samples were modified with the plasma polymerization technique under equal conditions. The remaining 10 samples of unmodified polished titanium were used as the control group. Surface roughness was determined by using atomic force microscopy. Thickness of the plasma-polymerized film was measured by an ellipsometer. Contact angle measurements were performed with the sessile drop method using the OCA 20 contact angle system. Thereby, a video camera equipped with an image analyser visualizes the shape of the drop and the contact angle. The corresponding picture is saved in the computer and the contact angle is determined by software. In order to evaluate the bacterial colonization on different titanium surfaces, titanium discs were incubated in 5 mL of a suspension containing streptococcus mutans. Bacterial microcolonies were fixed in 2.5% glutaraldehyde followed by an additional fixation step in 1% Acridine Orange at room temperature for 1 h. Quantitative analysis was performed using a fluorescence microscope. Samples were examined at 40-fold magnification and the number of microcolonies was determined on five randomly selected representative fields on each disc.

Results: The study determined that plasma polymerized sample surfaces (Ra: 2.853 nm) were smoother than the uncoated sample surfaces (Ra: 5.761 nm). Also, improvements in the hydrophilic character on modified titanium were determined by the contact angle measurements. Average contact angle value of control group was measured as 42.5° whereas the modified titanium surface was 61.9°. Thickness of the plasma-polymerized film was measured as 49.4 nm using ellipsometer. The reduction of microorganism adhesion was significant on coated surfaces. The number of adhered bacterial microcolonies on plasma-coated discs (3747 per mm²) was distinctly lower for S. mutans compared with the uncoated titanium discs (9894 per mm²).

Conclusions and clinical implications: Considerations of these findings may be beneficial in the production of the part of an implant penetrating the soft tissue and as implant abutments in order to reduce bacterial colonisation.

430 | Topic – Material Research

Stainless steel as an alternative to Ti6Al4V for orthodontic miniscrews

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Background: The orthodontic anchorage devices are increasingly used over the last decade because of their great efficiency and because their effectiveness is not subject to patient compliance. The tissue integration of these devices can condition their success as an orthodontic anchoring (bone-to-miniscrew contact, bone remodeling).

Aim: The aim of this study was to evaluate the tissue integration to immediate-loaded miniscrews of two commercially available systems in growing pigs.

Methods: Sixteen miniscrews of stainless steel and 16 miniscrews of Ti6Al4V were implanted and immediately loaded in the mandible of eight 3-month-old Large White pigs. The protocol was approved by the ethical committee on animal research of the National Veterinary School of Lyon in France, and all procedures were conducted in accordance with the European and French legislations on animal experimentation. Two loading periods were assessed; 4 and 12 weeks. During the study duration, an oral hygiene program was put up (tooth brushing) and bone labeling was performed just before sacrifice by intramuscular injections of tetracycline. Survival rate was assessed at the end of the loading periods. Histological and histomorphometric analyses were performed to measure the bone-to-miniscrew contact, and static and dynamic bone parameters in the vicinity of the miniscrews. A mixed effects logistic regression was performed using the R statistical software.

Results: The survival rate decreased from 100% to 62.5% for the stainless steel devices, and from 75% to 50% for the Ti6Al4V devices (after 4 and 12 weeks, respectively); the stainless steel devices always presented the greatest values of survival rate (OR = 33 at 12 weeks). The bone-to-miniscrew contact did not increase from 4 to 12 weeks for the stainless steel devices (always < 15.6%), but considerably increased for the Ti6Al4V devices (0–5.32% to 0–36.14%). Values of trabecular bone volume, trabecular thickness, trabecular number and trabecular separation of bone in the vicinity of both kind of devices were not significantly different, whatever the loading period may be. However, the mineral appositional rate was always greater for the bone nearby stainless steel miniscrews, without significant difference.

Conclusions and clinical implications: Stainless steel and Ti6Al4V miniscrews for orthodontic anchorage exhibit differential bone tissue response with greater clinical performance (survival rate) for the stainless steel devices. The risk highlighted in the literature of toxic ion release from Ti6Al4V devices when fluoride mouthwashes are used allows proposing the stainless steel miniscrews as an alternative to Ti6Al4V miniscrews in adolescents.

431 | Topic – Material Research

The effect of new ultrasonic tips on implant surface: an *in vitro* study

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Background: Instruments for cleaning implants should be efficient, bring minimal damage to titanium surface, and have the durability. Conventional ultrasonic scalers with stainless steel

tips have an advantage in that they can remove plaque efficiently, but induce considerable modification to implant surface. Although alternative various instruments have been tested, there is still little consensus as to which instruments are most appropriate for use on implant surfaces. The composition of the scaler tip may be a crucial factor. Some authors showed scalers with Teflon-coated, plastic, or carbon tips caused minimal damage to implant. However, they did not consider mechanical properties of scaler tips, such as fracture resistance or wear resistance. Recently, the scaler tips have a new composition are introduced. They are made of copper, iron, and modified stainless steel which have similar hardness with titanium or smaller hardness than it.

Aim: The purpose of this study is to examine the effect of new metallic tips on titanum surface.

Methods: The scaling test was performed on polished surface of titanium alloy sample under standardized conditions using conventional ultrasonic scalers with new metallic implant tips, a plastic-headed tip, a plastic tip and stainless steel tip. Average surface roughness (Ra) and the mean roughness profile depth (Rz) were measured using surface roughness tester. Surface roughness was viewed with a scanning electron microscope (SEM).

Results: Surface roughness values produced by new metallic groups are significantly lower than the other groups. Stainless steel tips produced the highest mean roughness profile depth values. Mean roughness profile depth values between new metallic tips and a plastic-headed tip are not differed, whereas a plastic tip produced significantly higher values.

Conclusions and clinical implications: New metallic tip caused minimal surface damage, similar to a plastic-headed tip and plastic tip. Further studies about the durability and the efficacy of new tips are required.

432	Topic – Material Research

Straumann bone ceramic vs. Bio-Oss: a histomorphometrical and histological animal study

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Background: Although autogenous bone grafts are considered as gold standard in bone regeneration, some limitations do exist. In this regard, synthetic bone substitutes are available to overcome these limitations.

Aim: The present study aimed to compare osteogenic properties of Straumann Bone Ceramic (SBC a kind of biphasic calcium phosphate ceramic) and bovine bone mineral (Bio-Oss).

Methods: Twelve rabbits were Included and four 6.5 mm symmetrical defects were prepared on the calvarium of each. Three sites were filled with Bio-Oss, small (S-SBC) and large (L-SBC) particle Straumann Bone Ceramic, and the fourth was left empty as a control site. After 4 and 8 weeks, histological and histomorphometrical examinations were performed and the obtained data were analyzed by Friedman, Wilcoxon, and Multiple Comparison Mann–Whitney U tests.

Results: There were not any statistically significant differences in the amount of bone fill between the four groups. L-SBC showed more inflammation and foreign body reaction than the other groups.

Conclusions and clinical implications: Strauman bone ceramic can be used as an osteoconductive bone substitute material. As any statistically significant differences between the groups were not found, further studies on this issue seem necessary.

433	Topic – Material Research

Bone response to antimicrobial noble metal nano-coating on titanium implants

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Background: Medical device-related infections are a severe problem causing patient suffering and increased societal costs. Implants that resist bacterial colonisation would be an attractive solution to the problem. An infection resisting noble metal coating was previously applied on urinary and central venous catheters. Up to 50% reduction of infections was demonstrated in several clinical trials involving more than 80,000 patients. The nano-coating consists of Au, Pd and Ag, and can be applied on most substrate materials and to complex shapes such as tubes and screws.

Aim: The aim of this study was to apply a variant of this noble metal Bactiguard®-coating onto machined titanium implants and to evaluate the bone response compared with non-coated implants.

Methods: Noble metal coated and non-coated machined titanium screws were characterised chemically and topographically, and were inserted into rabbit tibiae and femurs for 6 or 12 weeks. Retrieved implants were embedded in plastic for sectioning and the bone-implant interfaces were evaluated using both light and electron microscopy. Blinded histomorphometry was performed and the results (mean $\pm$ standard deviation) were statistically evaluated by Wilcoxon signed rank test ($n = 7$–9).

Results: It was verified that the coating consisted of Au, Pd and Ag and the metals were observed as small discrete deposits on the surfaces, adding a nanotopography onto the implants. Large amount of new bone around the screws was observed after 6 and 12 weeks. The bone volume within the threads increased over time for both bone sites and no differences were found between

coated and control implants. Most of the bone observed around the tibial implants originated from endosteal down growth, while for the femoral implants it originated both from cortical and trabecular bone. The bone-implant contact did not change considerably over time and was similar for the two implant types, with the exception for femur after 12 weeks where it was significantly lower for the coated screws (26 ± 8) compared with the control screws (36 ± 9).

Conclusions and clinical implications: Noble metal coated implants performed equally well as machined titanium, with the exception of the bone-implant contact in rabbit femur at 12 weeks, implying that the osseointegration of the titanium implants was not considerably hampered by the coating. The coating may thus add extra implant functionality in the form of increased infection resistance without the use of antibiotics. Nano-structured noble metal coatings constitute a promising implant surface modification that should be further studied in bone as well as soft tissue applications.

434 | Topic – Material Research

Surface bioactive with nanoparticles of calcium and magnesium for dental implants – a clinical and laboratory study

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Background: The search for an implant surface that can accelerate and enhance osseointegration has received much attention from the international scientific community in recent years. Several suggestions have been made, however, there is great difficulty in this technology.

Aim: This study is the development and characterization of a new dental implant surface bioactivated through deposition of calcium and magnesium and evaluation of their behavior *in vivo* after implantation into the tibia of rabbits.

Methods: *Animals*: Twenty-six rabbits New Zealand adults, with an average weight of 3.5 kg, obtained from Central Animal University of Santa Maria (UFSM). The study was approved by the Ethics Committee of UFSM. *Implants*: A total of 12 implants cylindrical internal hexagon manufactured by the company Implacil – Dental Material (Implants Debortoli), which had its surface macrotexturizada by blasting with particles of titanium oxide and received on that surface a deposition by other blasting microparticles calcium and magnesium. *Topographic analysis*: The samples were analyzed by SEM at the Center for Microscopy and Microanlisys (CEMM) PUCRS to view and characterize the surface morphology obtained. *Histological analysis*: After 8 weeks of implantation, the animals were sacrificed and the implants removed with a portion of bone and set-based solution of formalin for 3 days. Following these were dehydrated in alcohol and included in special resin for SEM. Cuts were made in a microtome to obtain the samples, which were analyzed and compared verifying the contact areas of surfaces with the bone tissue and its quality.

Results: The results show that the variation of metals present on the surface of dental implants can influence the amount of newly formed tissue in that area as well as mineralization. Therefore the potential loading of implants can be anticipated.

Conclusions and clinical implications: We conclude that, in the methodology used in this study and based on analysis of data obtained by SEM and EDS is possible to have ions of calcium and magnesium free surface implant, and that fact seems to increase the quality and speed matrix mineralization of newly formed bone tissue in these areas.

435 | Topic – Material Research

Immediate OsseoSpeed™ placement in fresh extraction sockets: clinical and radiographic report using beta TCP or autologous bone

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Background: To study the outcome of OsseoSpeed TM placement in fresh extraction sockets using autologous bone graft material or beta TCP to fill the gap between implant and sockets walls.

Aim: The aim of the study was to compare the results clinically and radiographicaly for the two groups 24 months follow-up.

Methods: Forty-seven patients were included in this study (25 men and 22 women) between January 2006 and June 2007 they were analyzed with an esthetic risk assessment. Fifty OsseoSpeed TM were placed, and the gap between the implant and sockets walls was filled with beta TCP for 25 cases, and autologous bone grafting material for the other 25 cases. Beta TCP is replaced in 6 or 7 months by neoformed bone tissue. All the implants were placed in the anterior maxilla.

Results: One implant was lost during during the healing phase due to immediate infection. The others 49 OsseoSpeed TM were osseointegrated without clinical complications. The over-all oral hygiene standard among the patients was high. After 2 years follow-up no difference were noted between the group with beta TCP and the group with bone grafting material. Radiographic examination showed only marginal bone reduction of 0.84 mm (SD = 0.07) vs. 0.80 (SD = 0.12).

Conclusions and clinical implications: In this study, the alloplastic bone substitute has the same properties that the bone graft to fill the gap between OsseoSpeed™ and sockets. The mean of bone loose was 0.82 mm, which seems to confirm the marginal bone maintenance with the Bio Management Complex TM.

436 | Topic – Material Research

Studies on anodized titanium and Ti6Al4V alloy bioactivity

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Background: The biocompatibility and bioactivity of titanium or titanium alloy-base dental implants ensure their successful insertion in living tissues.

Aim: While biocompatibility is related to the metal phase stability in living tissues, bioactivity signifies the capacity of dental implant materials to generate hydroxyapatite ''*in situ*'' on their surface.

Methods: There have been used 10 samples (5 mm diameter, 1 mm thickness) of titanium and Ti6Al4V alloy, in various stages of processing: simple, sandblasted, sandblasted and acid etched, sandblasted, acid etched and anodized in three types of electrolytes. Three of the anodized samples were subsequently subjected to thermal treatment in air at 500°C, for 60 min. ''*In vitro*'' tests were performed by maintaining the samples in Hank solution, at 37°C (LAUDA E200 thermostat, 9L bath), for 192 h. After careful rinsing in water, samples were dried for 48 h in a desiccator and investigated by QUANTA INSPECT F SEM, with field emission gun, 1.2 nm resolution and EDAX. When examining the morphology of deposited saline layers, the presence of hydroxyapatite was evidenced by evaluating the presence of P, Ca and O. By observing the intensity diminish of titanium spectral lines (the metal base of samples) due to the presence of salt layers, the layers thickness was semiquantitatively and comparatively evaluated. The nature of the compounds present on a sample surface was also tested by Panalytical X'PERT MPDXRD. Electrochemical investigations were performed with VOLTALAB 40 RADIOMETER electrochemical device.

Results: All samples show the capacity to form layers of hydroxyapatite-type compounds on their surface in Hank solution, at 37°C. These compounds are uniformly distributed, crystallized in nanometer forms and posses a general globular aspect. It is difficult to observe differences between the morphology of these layers. However, experimental data show differences concerning the layer growth rate, directly related to interface stability. Unanodized samples show the highest rates of hydroxyapatite growth, but also the highest corrosion rate in Ringer solution (above 5 μ/Ay), while anodizing reduces interface corrosion rate (below 2 μ/Ay, interface stability increases) and reduces but does not cancel the surface capacity to generate hydroxyapatite. Supplementary thermal processing of samples can alter titanium oxide layer continuity, consequently decreasing interface stability, but increasing the capacity to generate hydroxyapatite.

Conclusions and clinical implications: Oxide layers anodically grown at the interface are stable, thin, continuous and capable of hydroxyapatite spontaneous generation in Hank solution, which proves the anodized titanium and Ti6Al4V alloy bioactivity.

437 | Topic – Material Research

Titanium released from titanium surface after bacteria *in vitro* incubation

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Background: Metals such as titanium and titanium alloys are widely used as implants either in orthopaedics or dentistry because of corrosion resistance. However, sometimes particles released from titanium implants have been observed into surrounding tissue (Meningaud et al. 2001). Titanium deected in tissues around implants is commonly associated to wear and fretting (Mu et al. 2000), but titanium particles released either plates or screws in maxillofacial surgery have been reported and associated to corrosion by body fluids (Hanawa 1999) or cells involved into immunological process (e.g. macrophages) (Mu et al. 1999).

Aim: The aim of this work is to study the effect caused by bacteria metabolism on titanium surfaces.

Methods: Bacteria cultures (*S. sanguinis* CECT480) on titanium samples were performed in modified artificial. After incubation at 37°C (1, 2, 4, 6, 8, 24, 48, 72 h), samples were observed by Scanning Transmission Microscopy (SEM), whereas bacteria medium was analyzed by ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry).

Results: SEM results showed a damage o on titanium surfaces after 2 h of bacteria incubation. Furthermore, small bacteria colonies were observed nearby holes. At the same time ICP-OES quantification evidenced titanium presence in modified artificial saliva after bacteria incubation.

Conclusions and clinical implications: Our results showed a possible bacterial metabolic effect on titanium surface, due to: (1) damage observed on titanium surfaces and (2) titanium detected by ICP-OES in modified artificial saliva. This problem might be directly involved in peri-implantar disease, increasing the inflammatory response into gingival tissue, combined to dental plaque reaction. Although titanium presents a corrosion resistance, the outer surface layer consists in a nonstoichiometric TiO_2 (may be amorphous or low cristallinity), which might be diluted or damaged in biological environment (Hanawa et al. 1998; Hanawa 1999, 2004).

438 | Topic – Material Research

The effectivity of different implant surfaces placed into sinus grafts

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Background: The success rate of dental implants inserted into sinus grafts could be influenced by implant surface and the material used for sinus elevation.
Aim: To analyze the success rate of healing period in relation to three implant surfaces and five bone substitutes.
Methods: Fifty-two-stage sinus elevations were performed. After 9 months of healing, 94 dental implants (Impladent®, Lasak, Czech Republic) were placed. After 6 months of healing period, suprastructures were delivered and, after the next 6 months of functional loading, the success rate of implants was evaluated. For the sinus elevation, ß-tricalciumphosphate (TCP) or deproteinized bovine bone (DBB) was used – in pure state or with the addition of 20% of autogenous bone (TCP-B, DBB-B). Pure autogenous bone was used in the control group. The implants have sandblasted surface (SB), titanium chemically treated Bio® surface (BIO), and hydroxyapatite coated surface (HA), respectively. The Bio® surface was made by acid-etching and subsequent alkali treatment of sandblasted titanium. Both BIO and HA surfaces show signs of bioactivity. Statistical analysis was performed using Fisher exact test.
Results: The success rate of SB, BIO and HA implants was 86.2%, 94.1%, and 97.4%, respectively. The difference SB vs. BIO, and SB vs. HA was significant ($P < 0.05$), other differences were not significant ($P > 0.05$). The difference between pure non-autogenous materials (TCP, DBB) and the same materials with the addition of 20% of autogenous bone (TCP-B, DBB-B) were not statistically significant either.
Conclusions and clinical implications: Dental implants with bioactive surfaces (HA, BIO) showed significantly higher effectivity of healing period in sinus graft. However, the risk of long-term instability of hydroxyapatite coating could not be neglected. The increase of the success rate by addition of 20% of autogenous bone to the bone substitute was not proved.

439 | Topic – Material Research

Calcium sulfate barrier in bone defects. Clinico-radiological RDB study

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Background: Several experimental studies have been performed in order to evaluate the behavior of different types of biomaterials involved in the process of tissue and bone regeneration. The guided bone regeneration (GBR) principles are applied in the rebuilding of periodontal tissues, damaged by the periodontal inflammatory process (1–3). Bone defects resulting from various causes, such as, infection, trauma, tumor resection, endodontic problems and localized alveolar bone reabsorption, are invaded by connective tissue, stopping the bone defect from sealing completely.

At present, the autogenous material continues to be considered the best choice when reconstruction of bone defects is intended (8, 9). The calcium sulfate barrier is also a rapid absorption biocompatible material and has been used for many years in the dental area in treatments of bone and periodontal defects. Calcium sulfate can work as a completion material, space maintainer, vehicle for a controlled release of certain drugs, associated with other graft materials (23–25).
Aim: The aim of this experimental study was to evaluate the bone tissue behavior of calcium sulfate barrier in bone repair in human bone, observing the GBR biological principles.
Methods: The chosen bone defect was then be submitted for examination with serial X-Ray sections, from which approximately 10 image sections were obtained. All these sections were randomly analysed for Radiomorphometric analysis by two different clinicians. Subsequently, radiological fields from each section, in the surgical bone defect region, were compared and furtherly analyzed. For the accomplishment of this work 40 patient, divided in two groups of 20 (Study and control group), have been enrolled in the study. The study has been randomized for a prospective double blinded. After surgical extraction of permanent teeth the clinician knew at that time if he had to fill the extraction socket with calcium sulphate or with collagen membrane as barrier.
Results: Conclusive result showed no difference between two protocols and eventually conform the possible use of Calcium Sulphate as bone barrier.
Conclusions and clinical implications: This study showed that the use of calcium sulfate as a barrier can halt the ingrowth of soft connective tissue, in accordance with the osteopromotion principle. By acting as a mechanical barrier, the calcium sulfate allowed bone cells to fill osseous defects. This study indicates that, even after 3 weeks, calcium sulfate barriers can exclude connective tissues, allowing bone regeneration during healing, most likely because of the mechanical hindrance of a barrier to the ingrowth of connective tissue.

440 | Topic – Material Research

Fatigue load performance of narrow diameter two-piece implants

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Background: Narrow diameter two-piece implants (generally range from 3 to 3.5 mm in diameter) are frequently used in cases

of limited anatomical geography. Specifically, these implants are used for the replacement of teeth with narrow cervical diameters and in the case of restricted interadicular bone. However, because of the mechanical disadvantage of the narrow diameter, these implants require enough fatigue strength to avoid fatigue failure.

Aim: This study investigated the fatigue load performance of narrow diameter implants (-abutments) to measure the fatigue strength.

Methods: GC implants of 3, 3.4 mm, Xive implant of 3 mm, Osseotite implant of 3.25 mm, and other implants were used in this study. Implants, respectively, have differences of diameter (3, 3.25 or 3.4 mm), material (pure Ti grade 2, pure Ti grade 4 or Ti6Al4V alloy), thickness (especially sectional area), screw gauge (M1.4 × 0.3, M1.6 × 0.35 or M2 × 0.4) and retaining screw torque. These implants were connected to each cement-retained abutments with retaining screws.

The fatigue test was performed in accordance with ISO 14801. Implants connected to the abutments with the screw retaining were mounted in acrylic resin, and were set up at an angle of 30° to the loading direction of the load fatigue machine. Fatigue performance of each implant was measured at 15 Hz in frequencies and load to 5×10^6 cycles.

We identified the load values of the failure point. Failure was defined as implant cracking or implant fracture.

Results: The result was that GC implant of 3 (3.4 mm) was not cracked up to the 170 N (240 N) load value within 5×10^6 cycles. Similarly, Xive implant was not cracked up to the 160 N. As for Osseotite implants was not 170 N.

Conclusions and clinical implications: These results indicated that implant fatigue strength mainly had a close relation to diameter, material, thickness, screw gauge and retaining screw loosening.

GC implants of 3 (3.4 mm) made of Ti6Al4V alloy and M1.6 × 0.35, had high strength, enough thickness and low retaining screw loosening, and demonstrated enough fatigue strength.

Therefore, for clinical situations with significant functional loading, this narrow implant was proved beneficial at the low risk of fatigue failure.

441 | Topic – Material Research

Exophytic bone formation using collagen membranes and porous titanium membrane

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Background: Alveolar bone resorptions usually occur after tooth extraction, making it difficult to restore the missing teeth with dental implants. In such cases, alveolar ridge augmentation using guided bone regeneration is needed. Porous titanium membrane is the commonly used membrane for its hardness and adaptability in guided bone regeneration. However, due to its vulnerability against invasions of gingival connective tissue through its pore, further study on blocking gingival connective tissue is necessary.

Aim: The purpose of this study is to evaluate the effect of resorbable collagen membranes [cross-linking type I collagen membrane (Bio-ARM™: BA) & double layered porcine collagen membrane (Bio-Gide®: BG)] on exophytic bone formation and inhibition of connective tissue infiltration in guided bone regeneration using porous titanium membrane(TM).

Methods: Prefabricated rectangular-parallelepiped TM (8 × 5 × 4 mm) was placed over 8 × 5 mm decorticated defect of rabbit calvaria for guided bone regeneration procedure. Freeze-dried bone allograft (Ora-GRAFT™:OG) was used for filling inner space of TM. Thirty-four adult male New Zealand white rabbits were used and six rabbits allotted to each test group except the negative control group(TM only) of four rabbits. The test groups were divided into six groups as follows: TM only (negative control), TM + OG (positive control), TM + BA (experimental group 1), TM + BG (experimental group 2), TM + OG + BA (experimental group 3), TM + OG + BG (experimental group 4). Non-decalcified sections were prepared for histologic evaluation and histomorphometric analysis of new bone formation after 8 and 16 weeks. Statistical analyses were performed by analysis of variance (ANOVA) and *post-hoc* test using the least significance difference (LSD) method.

Results: 1. Resorbable collagen membrane combined with porous titanium membrane promoted new bone formation and maturation.

2. Freeze-dried bone allograft presented favorable condition in new bone formation and maturation.

3. More new bone formation was found in groups using Bio-Gide® than Bio-ARM™.

4. New bone formation was increased at 16 weeks compared with at 8 weeks, but there was no statistically significant difference.

Conclusions and clinical implications: More favorable result in new exophytic bone formation could be obtained when using resorbable collagen membrane combined with porous titanium membrane and freeze-dried bone allograft material in guided bone regeneration.

442 | Topic – Material Research

Radiographic evaluation of the crestal bone level around mono-body implants: 5-year retrospective clinical study

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Background: This research is a 5-year retrospective clinical study of monobody implant. Five-year retrospective study of marginal bone resorption of monobody implant. This innovative design of monobody implant is characterizing by no micro-gap, one-piece type and platform switching design.

Aim: The aim of this study was to evaluate the changes of the crestal bone level around mono-body implants over a 5-year period.

Methods: Nineteen patients, average 54.4 years old (27–72 year), were involved in this study. Implant (Onebody™, Warrantec, Co., Seoul, Korea) was designed as a tapered mono-body, so the abutment and the fixture were processed as a one-piece design without a joint.

A total of 58 implants were placed. Thirty implants were placed in the maxilla (premolar to molar), 28 implants were placed in mandible (canine to molar).

All implants, except three implants, were placed with insertion torque value over 25 N cm.

Thirty-nine implants were placed at healed sites, six implants were placed 8 weeks after extraction, and 13 implants were placed at the fresh extraction site.

Three different loading protocols were adopted. Nineteen implants were assigned to immediate occlusal loading, 33 implants to immediate non-occlusal loading, and six implants to conventional loading.

Eight implants were restored with single crowns, and 50 implants were restored with fixed partial prostheses.

The changes of the crestal bone level were measured on the periapical radiographs obtained at the time of implant placement and 3, 6 months, 1 , 2 , 3 , 4 , 5 years after insertion.

Results: All implants were healed uneventfully, and the survival rate was 100% for 5 years (average years). The change of the crestal bone level at the time of 3 , 6 months, 1 , 2 , 3 , 4 , 5 years after insertion was 0.05, 0.05, −0.40, −0.51, −0.53, −0.44, −0.51 (the negative value means bone increase). The crestal bone level from the abutment-fixture junction was −0.08, −0.18, 0.39, 0.19, −0.01, −0.05, 0.04, 0.07, at the time of insertion, 3 , 6 months, 1 , 2 , 3 , 4 , 5 years after insertion.

Conclusions and clinical implications: The unique design of Onebody™ showed stable crestal bone level around implant after 5 years of loading.

443 | Topic – Material Research

Effect of implant surface treatments on bone integration

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Background: Optimization of the process of osseointegration constitutes one of the research ways in dental implantology. This could be obtained by implant coatings able of interact actively with surrounding tissues. Enhancing bone formation around implant may confer better stability during the healing process, allowing more rapid loading of the implant.

Aim: The aim of this study was to analyze stability and osseointegration of titanium implants, having received various surface treatments: blasted and etched (BE Group), calcium phosphate (CaP) coated by electrodepostion technique (CaP Group), incorporation of bioactive molecules (Adenosine Monophosphates Cyclic and Dexamethasone) in CaP coatings (AMPc and Dex Groups).

Methods: Twenty-four implants ($n = 6$) were inserted in the femoral epiphyses of rabbits for 4 weeks. Implant stability was measured by resonance frequency analysis (Osstell®) the day of implantation and 4 weeks later, and correlated to histomorphometric parameters (Bone Implant Contact and Bone Growth).

The data were analyzed using SPSS software (16.0 for Windows). Non-parametric tests were used for statistical analysis: Mann–Whitney test for comparing two independent groups and Wilcoxon test for comparison of paired data. Differences were considered to be statistically significative if the P-value was < 0.05.

Results: Bone formation was evaluated by histomorphometric parameters (Bone-implant contact and Bone Growth). No differences were observed in bone-implant contact between the four groups. Nevertheless, our results showed that CaP coating by electrodeposition tends to improve bone growth. However, the incorporation of the AMPc and Dexamethasone in CaP coatings did not have any effect on bone growth, compared with the balsted and etched group.

Implant stability was not different between the groups, but increased in each group after 4 weeks of healing. Our results showed that the stability seems correlated to the osseous growth around implants.

Conclusions and clinical implications: Within the limitations of this study, CaP coating seems to enhance bone formation around implants. Furthers studies should be conducted in order to improve the effect of bioactive molecules incorporation in implant coatings.

444 | Topic – Material Research

In vivo electric potential measurements of titanium osteointegrated implants. Relation with peri-implant tissues

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Background: Titanium electric potential has been measured in several *in vitro* studies due to his role in galvanic corrosion. However, it has not been measure before *in vivo* in humans. The electric potentials may influence galvanic corrosion, as well as, electric continuous currents which could affect peri-implant tissues and others oral tissues.

Aim: The aim of this study was measure the electric potential of titanium osteointegrated implants in humans. We also study the relation between electric potential and peri-implant tissues.

Methods: Measurements were taken twice on each implant, first connected with the superstructure. The second measurement was taken on implants without prostheses. The measurement device is composed by one electronic redox-potential meter, one periodontal probe as counter electrode and one

referential electrode (Ag/AgCl, KCL). Gingival health was measure using the Löe and Silness Gingival and Plaque Index. Marginal bone loss was evaluated in standardized radiographs at the moment of prosthetic connection and at the moment of electric measures.

Results: Seventy-two Microdent System implants in 26 patients were evaluated. Implants were in function for a mean of 25 months (range, 12–60 months). All implants were connected to cobalt-cromiun prostheses. Overall mean electric potential was 221 mV (standard error = 13 mV) for implants and 165 mV (SE = 9 mV) for the couple implant-prostheses. Gingival Index mean values was 0.8 (SE = 0.1) and Plaque index was 1.0 (SE = 0.1). Thirty-three implants (45.8%) had not plaque and 35 implants (48.6%) did not show gingival bleeding. No significant differences ($P > 0.05$) in electric potentials were found between implants with low index values (healthy gingival) and high index values (with plaque and gingivitis). Forty implants (55.5%) showed marginal bone loss. Mean marginal bone loss was 0.14 mm (SE = 0.12 mm). No significant differences in electric potentials were found between implants with and without marginal bone loss.

Conclusions and clinical implications: Titanium osteointegrated implants had measurable electric potentials. We did not found relation between electric potential and plaque-induced gingivitis in patients with titanium osteointegrated implants. Contact of base metal with titanium in the presence of oral fluids doesn't produce galvanic currents which could lead to further bone resorption.

445 | Topic – Material Research

Characterization and evaluation of macro- and microtexturiuzed surfaces of dental implants – clinical and laboratory study

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Background: The surface texturing is very important of the osseointegration of implants. This is demonstrated in many works.

Aim: The aim of this study was to characterize and evaluate the implant-bone interface in two different types of texturing the surface of dental implants in animals using scanning electron microscopy (SEM).

Methods: Animals: Twenty-six rabbits New Zealand adults, with an average weight of 3.5 kg, obtained from Central Animal University of Santa Maria (UFSM). The study was approved by the Ethics Committee of UFSM. Implants: A total of 24 implants cylindrical internal hexagon manufactured by the company Implacil – Dental Material (Implants Debortoli), of which 12 had their surface macrotexturized by blasting with particles of titanium oxide, and another 12 were on that surface by the microtexturized control acid concentration/time/temperature. Topographic analysis: the samples were analyzed by SEM at the Center for Microscopy and Microanlisys (CEMM) PUCRS to view and compare the two types of surface morphology obtained. Histological analysis: After 8 weeks of implantation, the animals were sacrificed and the implants removed with a portion of bone and set-based solution of formalin for 3 days. Following these were dehydrated in alcohol and included in special resin for SEM. Cuts were made in a microtome to obtain the samples, which were analyzed and compared verifying the contact areas of surfaces with the bone tissue.

Results: We observed that the different areas analyzed the bone contact with the surface of the implants promoted a better ossification in the models where we had a more uniform surface, promoted by the control of your texturing.

Conclusions and clinical implications: We conclude that, in the methodology used in this study and based on analysis of data obtained by SEM, the surface texturing of dental implants can be controlled and makes a significant difference in osseointegration.

446 | Topic – Material Research

Comparative analysis of osseointegration between cylindrical and conical implants in rabbits by scanning electron microscopy

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Background: The design of implants is an importat component of the bone healing.

Aim: The objective of this study was to evaluate the implant-bone interface in two different models of dental implants: cylindrical and tapered, more specifically check and compare the difference in area osteointegrated in each model by scanning electron microscopy (SEM).

Methods: Twenty-three rabbits New Zealand adults, with an average weight of 3.5 kg, obtained from Central Animal University of Santa Maria (UFSM). The study was approved by the Ethics Committee of UFSM.

Implants: A total of six implants cylindrical and six conical implants with internal hexagon manufactured by the company Implacil – Dental Material (Implants Debortoli), who have blasted surface of titanium oxide.

Histological analysis: After 8 weeks of implantation, the animals were sacrificed and the implants removed with a portion of bone tissue and fixed and fixed-based solution of formaldehyde for 3 days. Following these were dehydrated in alcohol and included in special resin for SEM. Cuts were made in a microtome to obtain the samples, which were analyzed and compared verifying the contact areas of surfaces with the bone tissue.

Results: The results showed no significant differences in osseointegration implants in models of conical and cylindrical, however, the area that is greater than the cylindrical implants largely linear surface.

Conclusions and clinical implications: We conclude that the model design implant influence the quality of osseointegration of dental implants and directs the growth and bone tissue corticalization, so logically influences the contact area of bone/implant.