Australian Endodontic Journal
The Journal of the Australian Society of Endodontology Inc., the Australian and New Zealand Academy of Endodontists and the Asian Pacific Endodontic Confederation

Aust Endod J 2021

CASE REPORT

Osteosarcoma of the anterior maxilla mimicking a periapical pathology: A case report

Mariana Domingos Pires, DDS, MSc[1]; Jorge N. R. Martins, DDS, MSc[1]; Gonçalo Seguro Dias, DDS, MSc[1]; Delfim Doutel, MD, MSc[2]; and Ronald Ordinola-Zapata, DDS, MSc, PhD[3]

[1] Faculdade de Medicina Dentaria, Universidade de Lisboa, Lisboa, Portugal
[2] Serviço de Anatomia Patológica (SAP), Instituto Português de Oncologia (IPO), Lisboa, Portugal
[3] Division of Endodontics, University of Minnesota School of Dentistry, Minneapolis, MN, USA

Keywords
diagnoses, endodontics, oral cancer, oral surgery, osteosarcoma tumour.

Correspondence
Dr Jorge N. R. Martins, Faculdade de Medicina Dentária da Universidade de Lisboa, Cidade Universitária, 1649-003 Lisboa, Portugal. Email: jnr_martins@yahoo.com

doi: 10.1111/aej.12491

(Accepted for publication 3 February 2021.)

Abstract

Osteosarcomas of the jaws (OSJ) are difficult to diagnose, rare malignant lesions, with uncharacteristic radiographic and clinical presentation. Early diagnosis and treatment are essential to improve long-term prognosis. The current report presents a rare case of a primary conventional osteoblastic osteosarcoma of the anterior maxilla in a 25-year-old female. She presented to a private dental clinic after developing pain, facial oedema and palpation tenderness of a mass associated with the upper right lateral incisor. The signs and symptoms mimicked very closely a regular radiolucent and symptomatic periapical pathology, and the definitive diagnosis was only possible through a combination of clinical, radiographic and histopathological findings. The patient was referred to an oncology facility, where she was submitted to radical excision surgery through a hemi-maxillectomy. Although other pathologies are uncommon, the differential diagnosis of lesions compatible with odontogenic periapical pathology should not be neglected.

Introduction

Cancer is one of the highest ranked causes of death of the current century and is considered the single major obstacle for the increase of life expectancy in the modern world (1).

Head and neck tumours encompass a large variety of different histopathological entities, of which only 2% are sarcomas (2). Osteosarcomas are primary malignant tumours characterised by formation of bone or osteoid tissue, more commonly affecting long bones of the human skeleton, namely the femur, tibia and humerus (3,4). Osteosarcomas are uncommon findings in the head and neck region and are considered rare in the maxilla or mandible (5,6). Two oncology facilities reported 50 osteosarcoma cases in head and neck region over a 10-year period (6), and only 47 in the maxilla or mandible over 40 years (5).

In jaw lesions, pain is generally absent, and swelling associated with growth of the tumour mass is the most common sign (4). The radiographic appearance may be purely osteolytic, osteogenic or mixed, depending on the extension of cortical bone destruction and osteoid bone deposition. These lesions are associated with a histological diversity that renders differentiation from other entities, such as fibrous dysplasia, often difficult. A definitive diagnosis must be based on a combination of clinical and radiographic findings, as well as histopathologic analysis (4,7).

Due to the low incidence of osteosarcoma of the jaw (OSJ), the literature is mainly limited to small retrospective studies (7), and the evaluation of prognostic factors is difficult to standardise. Surgical excision is the recommended treatment plan for osteosarcomas, with clear margins of resection associated with better prognosis and higher life expectancy (5). For OSJ, in particular, such procedures are lengthy and complex and tend to lead to significant disfigurement, with accompanying functional and psychological consequences (3,8). Recurrence is the most common complication (3), and if it occurs, the risk of disease-related death is increased 7-fold (5).

Early diagnosis is paramount for better life expectancy of patients with OSJ (2,4), and dental practitioners serve on the front line for early detection. Diagnoses of OSJ

requires a multidisciplinary approach due to the absence of definitive signs and symptoms associated with the pathology, and a radiographic presentation which often resembles other benign entities (9).

The present report describes a rare case of osteosarcoma in the anterior maxilla, which initially presented as an apparent odontogenic emergency at a private office, and exposed the challenging diagnosis these cases may bring.

Case report

Clinical and radiographic characteristics and treatment planning

A 25-year-old Caucasian female patient was referred for an endodontic consultation at a private practice for the evaluation of tooth #12 (maxillary right lateral incisor). Dental and medical histories were non-contributory, and there was no history of previous trauma. The chief complaint was a 'pressure-like' discomfort in the upper right quadrant. Extra-oral examination revealed the presence of facial oedema of the maxillary anterior right area. Intra-oral examination revealed a firm, non-mobile, palpation tender mass near the apex of tooth #12. No ulceration was present. Clinically, there were no carious lesions or previous restorations, and perio probings were within normal limits. A slight mobility was noted (Miller class 2). Tooth #12 was sensitive to percussion, and also, a milder discomfort to percussion was found on tooth #13 (maxillary right canine). Occlusion was verified, and no premature contacts of anterior teeth could be noted. Teeth #11, #12, #13 and #14 all responded positively and, normally, to cold sensitivity testing (Endo cold spray, Henry Schein, Germany). The pulpal diagnosis for the tested teeth was normal pulp. A panoramic radiograph taken two months before the appointment was obtained from the referring dentist. The image showed alteration of osseous density apical to tooth #13 (Fig. 1a) and the distal displacement of the root of tooth #14. A lateral and apical lesion associated with tooth #12 was noted radiographically, and tooth #13 lamina dura was interrupted and the periodontal ligament was thickened (Fig. 1b). A cone beam computed tomography (CBCT) was requested and showed apparent radiolucent alterations over the apical area of tooth #12 (Fig. 1c–e). Tooth #12 was diagnosed with symptomatic apical periodontitis, and the positive cold test suggested the condition to be of non-endodontic origin. Due to some contradictions between signs, symptoms and clinical findings, it was decided to refer the patient to an oral surgeon, who suggested performing biopsy of the periradicular tissues surrounding tooth #12. The patient accepted the medical advice, and an informed consent was obtained. Non-surgical endodontic treatment of tooth #12 was completed prior to the biopsy.

Root canal treatment

The non-surgical root canal treatment of tooth #12 was performed in one appointment using a dental operating microscope (Alltion AM – 4604, Wuzhou, China). Anaesthesia was achieved through buccal infiltration with 1.8 mL of 4% articaine with 1:200 000 epinephrine (Artinibsa, Inibsa, Spain). After rubber dam isolation, the access cavity was performed using a high-speed diamond round bur and the pulp confirmed to be vital. The root canal was initially negotiated with 0.10 and 0.15 stainless steel K-files (K-File, Dentsply Maillefer, Switzerland). Working length was determined by using a miniRoot ZX electronic apex locator (miniRoot Zx, Morita, Japan) and confirmed radiographically (Fig. 1f). Copious irrigation with 5.25% sodium hypochlorite (Denta Flux, J. Ripoll SL, Spain) using a 5 mL syringe and a 27G needle (Canal-Pro Slotted-End Tips, Coltene, France) was performed throughout the procedure. Root canal preparation was accomplished with WaveOne Gold Primary and Medium files (WaveOne Gold, Dentsply Maillefer, Switzerland), according to the manufacturer instructions. The final irrigation protocol included a one-minute rinse with 10% citric acid, followed by a final flush of 5.25% sodium hypochlorite with sonic activation (EndoActivator, Dentsply Maillefer, Switzerland). The root canal was dried with paper points (Zipperer, VDW, Germany) and filled with gutta percha and an epoxy-based resin sealer (AH Plus, Dentsply Tulsa Dental, USA). The canal was covered with Ionoseal (VOCO GmbH, Germany), and the access cavity was restored with a composite resin (Fig. 1g) at the same day.

Biopsy

The surgery, which was initially set for the following week, was postponed due to time constraints. The patient returned two months after the endodontic treatment, reporting non-subsiding pain on the upper right quadrant, facial oedema with attenuation of the right nasolabial sulcus, and a palpable, firm, non-mobile mass over tooth #14. A new CBCT was requested, and an increase in dimension of the radiolucent lesion (increase of periodontal ligament space) associated with tooth #12 was observed (Fig. 1h). Moreover, an unspecified radiopaque image in the apical buccal region of both teeth #13 and #12 was now evident (Fig. 1h,i). Exploratory surgery and a biopsy were completed 1 week later. Local anaesthesia was achieved with buccal infiltrations of 4% articaine

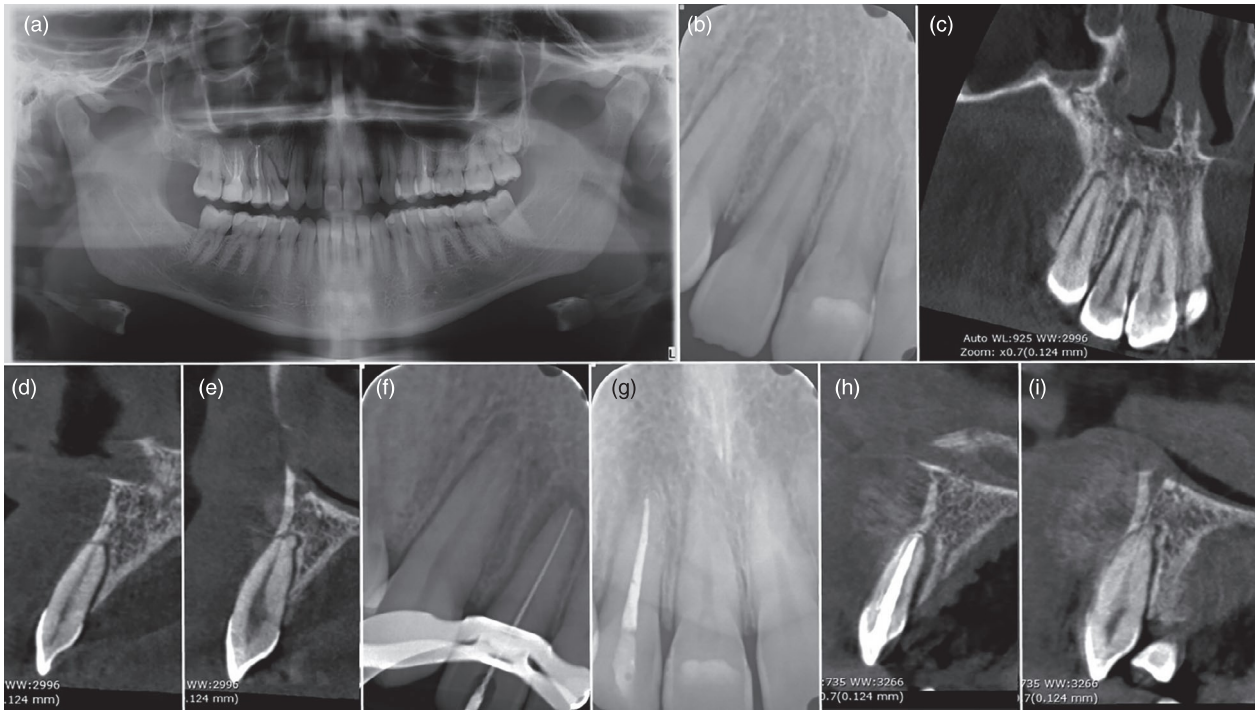

Figure 1 Initial panoramic radiograph (a); initial periapical radiograph of tooth #12 with apparent periapical pathology (b); pre-operative CBCT coronal view of teeth #12 and #13 with widening of both periodontal ligaments (c); pre-operative CBCT sagittal view of tooth #12 (d); pre-operative CBCT sagittal view of tooth #13 with an unspecified radiopaque image in the apical/buccal region that could be artefactual (e); working length measurement of tooth #12 with a clear visible radiolucent image (f); final radiograph following root canal treatment of tooth #12 (g); two months post-operative CBCT sagittal view of tooth #12 showing further thickening of the periodontal ligament space, plus an unspecified radiopaque image on the apical/buccal side (h); and two months post-operative CBCT sagittal view of tooth #13 with an increased volume of the unspecified radiopaque image in the apical/buccal region (i).

with 1:200 000 epinephrine. A full-thickness mucoperiosteal flap was raised with a #11 blade scalpel through a submucosal horizontal incision extending from tooth #11 to tooth #14, with two vertical releasing incisions. An exophytic lesion, loosely adhered, osteoid-like mass was detected extending over the cortical bone of teeth #12 and #14. The lesion was attached at the base and was removed using surgical bone curettes (Fig. 2a–e). The excised material was placed in a 10% formalin solution and sent for histopathological analysis. Given the nature of the lesion encountered, and since there seemed to be no invasion of the underlying bone, no osteotomy was performed on the apical area of tooth #12, since it was determined to be unnecessary at that point since it was possible to collect the biological material needed for biopsy without needing to excavate into the tooth apical area or by doing an apicoectomy. The cortical bone was contoured with the aid of bone cutting burs and sterile water irrigation (Fig. 2f), and the flap was repositioned with the aid of non-resorbable 4.0 silk sutures (Braun, Tuttlingen, Germany). A 0.20% chlorhexidine gel (Elugel, Pierre Fabre Oral Care, Castres, France) was applied with a sterile cotton gauze pad over the surgical site. Post-operative instructions were provided, and the patient was given prescriptions for a systemic antibiotic (875 mg amoxicilin + 125 mg clavulanic acid, 1 pill every 12 h for 8 days), and a non-steroidal anti-inflammatory drug (ibuprofen 600 mg, 1 pill every 12/8 h for 3–5 days) and a pain medication (clonixin 300 mg, up to 2 pills a day to manage symptoms) were recommended as well as post-surgical instructions. Sutures were removed seven days after the procedure without complication. Soft tissues appeared to be healing well, and the patient was not experiencing any significant discomfort.

Histopathological findings

The biopsy report suggested the diagnosis of osteosarcoma, and the patient was immediately referred for an oncology consultation at Instituto Português de Oncologia (IPO). The material collected was reviewed at the IPO, and a diagnosis of conventional osteosarcoma, with osteoblastic pattern, was confirmed. The histological analysis noted a solid tumour, in which areas of bone

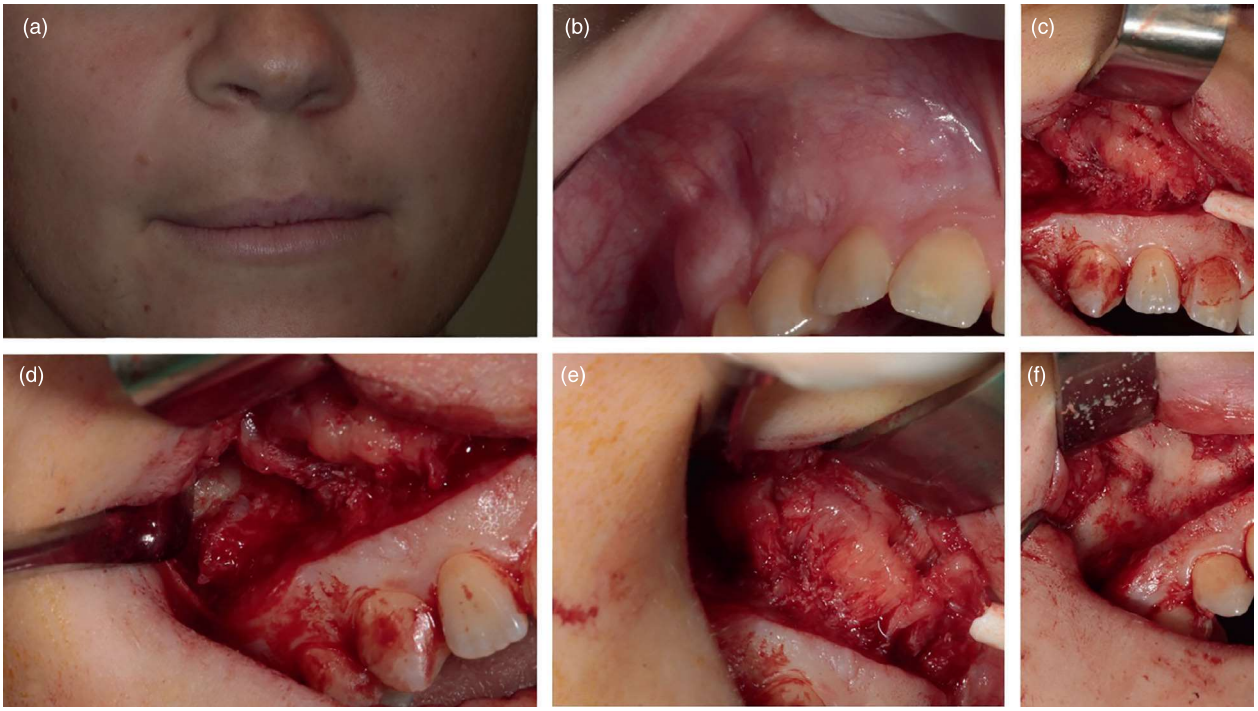

Figure 2 Pre-surgical clinical condition with a facial oedema and attenuation of the right nasolabial sulcus (a); intra-oral view over the buccal region between #12 and #14 (b); intra-surgery image showing an exophytic, loosely adherent, osteoid-like mass over the cortical bone adjacent to tooth #12 (c); similar intra-surgery finding adjacent to tooth #13 (d); similar intra-surgery finding adjacent to tooth #14 (e); and intra-surgery image after tissue collection and cortical bone regularisation (f).

formation were observed, organised in a thin trabeculae, with inter-trabecular cell proliferation (Fig. 3a). The tumour cells presented a vast cytoplasm, with poorly defined limits, eosinophils and oval to fusiform nuclei, sometimes with evident nucleolus. Atypia was predominantly mild (Fig. 3b,c). Moreover, there were areas where cells had a clear cytoplasm and fusiform hyperchromatic nuclei. In these areas, the atypia was moderate to severe (Fig. 3d,e). The cells had mild atypia throughout most of the sample; thus, it was necessary to make the differential diagnosis between conventional osteosarcoma and low-grade osteosarcoma. An immunohistochemistry evaluation was performed with MDM2, and the negative result suggested a conventional osteosarcoma (Fig. 3f).

Further treatment

At the oncology facility, the patient's medical history plus collected material was reviewed and the following treatments were properly planed and performed by a specialised medical team in the oncology field. The patient was posteriorly submitted to a radical excision surgery (hemi-maxillectomy) and was recovering from the surgery at the time of the last contact, approximately fifteen days after the ablation surgery. Complementary chemotherapy was planned. Taking into account that the preferred medical area to treat these cases is outside the dentistry field, and in order to preserve the privacy and the complex process that the patient was going through, the dental team decided to make themselves available to help but without pursuing a permanent contact with the patient at this point.

Discussion

Osteosarcoma constitutes the most common malignant osseous tumour, representing almost ¼ of all diagnosed sarcomas, with a reported incidence in the jaws of less than 10% (10). OSJ accounts for less than 1% of all head and neck malignancies (11). There is a slight trend to affect more men between the ages of 20–40, and there is no difference in incidence between the upper and lower jaws. OSJ is most commonly found in the alveolar ridge, the antrum of the maxilla and the body of the mandible (12,13). There is no known specific aetiology established to date, but several predisposing factors have been suggested, including possible genetic links, Paget's disease, congenital retinoblastoma, a history of trauma, fibrous dysplasia and radiation therapy (14). OSJ commonly

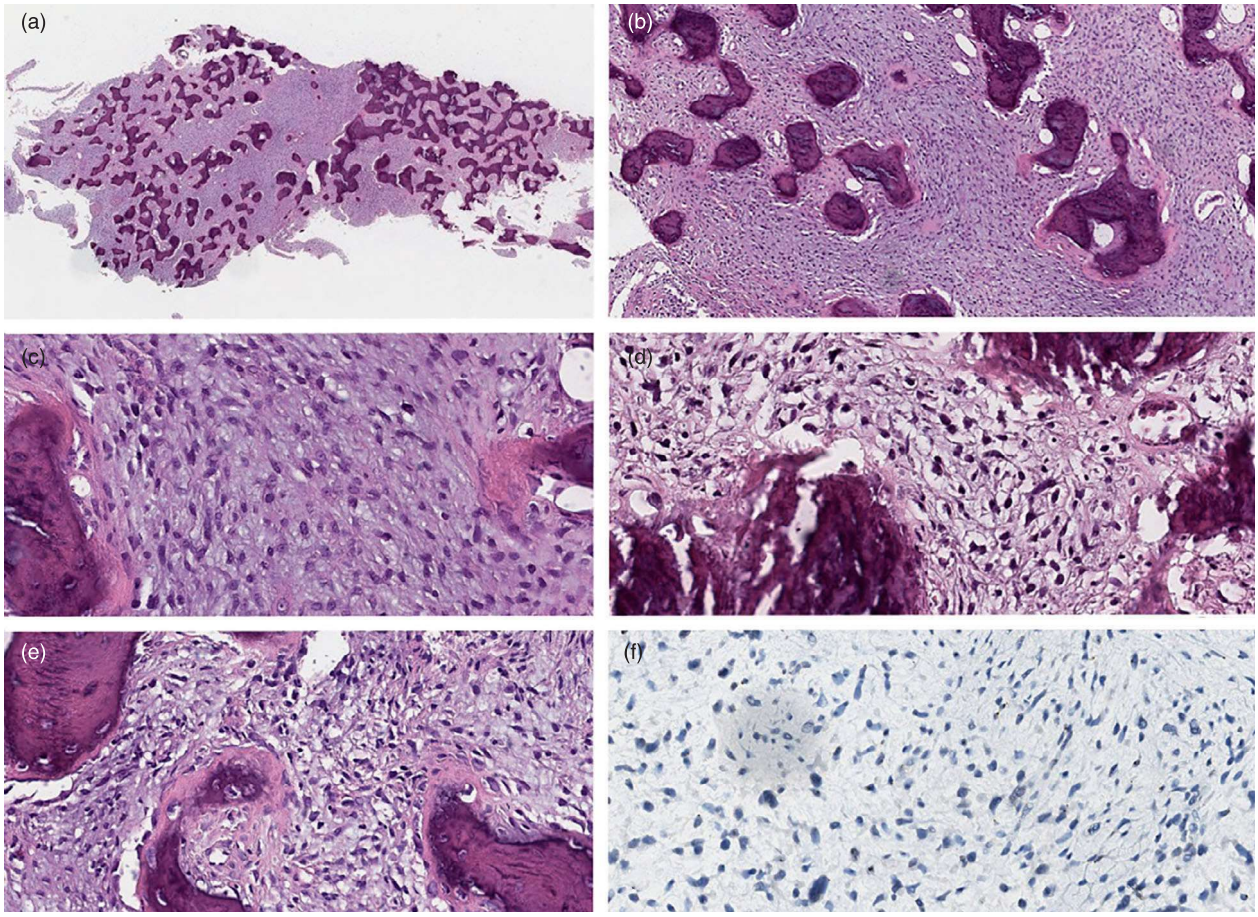

Figure 3 Part of the biopsied material under a small magnification (a); biopsied material under medium magnification (b); biopsied material under high magnification where a predominantly mild cell atypia can be noticed (c); biopsied material under high magnification where areas of moderate to severe cell atypia can be observed (d); biopsied material under a high magnification where areas of moderate to severe cell atypia can be detected (e); and immunohistochemistry evaluation was performed with the biopsied material (f).

presents with swelling of the affected area and tooth mobility, sometimes in the absence of pain. OSJ tumours have the ability to invade neighbouring structures and cause neurological damage, resulting in paraesthesia (12).

A retrospective study over 40 years documented only 47 cases (5). Of those, 32 were found in males (68%) and 15 in females (32%), and there was an equal distribution in the location between the maxilla and mandible. The mean age was 30.9 years with a range from 4 to 74 years. The most common symptoms were swelling (75%), pain (32%), paraesthesia (17.0%) and teeth displacement (15%). To the best of the authors' knowledge (after reviewing Medline and Embase electronic databases), only 11 case reports of intramedullary OSJ and 3 cases of periosteal OSJ have been published from January 2015 to present date (April 2020) (15–25). Among those cases, radiologic findings (panoramic X-ray, computed tomography [CT] or CBCT) included radiolucency around tooth roots (44%), lytic/sclerotic images (18%), widening of the periodontal ligaments (18%) and radiopacity (9%). The mean time from the beginning of symptoms to diagnosis was 14 weeks, ranging from 2 to 44 weeks, which shows the diagnostic difficulty of this rare disease of the jaws.

In the present report (the second case documented in the anterior maxilla in the past six years), the patient was a 25-year-old female with some discomfort and palpation tenderness in the anterior maxillary region, swelling, tooth mobility and a normal response to cold sensitivity testing. X-rays showed a periapical radiolucency and widening of the periodontal ligament. Upon clinical observation, all signs and symptoms were indicative of periapical pathology. However, a normal response to the pulp sensitivity testing ruled out pathology of endodontic origin. Cold pulp testing is considered a reliable pulp test

with a high sensitivity (0.867) and specificity (0.843) according to a recent systematic review (26), and only surpassed, in terms of reliability, by the vitality pulp tests such as laser Doppler flowmetry or pulse oximeter (26). The combination of periapical lesion associated with the positive pulp response clearly influenced the clinical diagnosis. A CBCT was then performed to further aid in diagnosis, but ultimately the incisional biopsy was required for a definitive diagnosis given the contradicting characteristics of the entity.

The radiographic appearance of osteosarcomas depends on the particular stage the tumour is at the time of diagnosis, ranging from sclerotic to completely radiolucent. These characteristics are also important in guiding the pathologist to a correct diagnosis, especially when combined with the clinical findings. The size and borders of the tumours are often difficult to determine due to unclear margins. A sunburst appearance, especially in occlusal radiographs, has been classically described and is conferred by the deposition of bone-like tissue on the lesions' surface. Early stages of the disease and tumour infiltration are associated with an enlargement of the periodontal ligament space. Although panoramic X-rays may be useful, the inherent image distortion and magnification render them diagnostically insufficient. Additional diagnostic imaging methods such as CBCT imaging or magnetic resonance imaging (MRI) are advised for better assessment of the characteristics of the lesion, as well as its extension. The CBCT scan of the present patient showed apparent radiolucent alterations in the apical area of tooth #12. Diagnosing OSJ is challenging and requires the combination of both clinical and radiographic findings, along with histopathological confirmation via biopsy. It is important to note, however, that up to 25% of biopsies are false negatives (27–30).

Practitioners must be aware that periapical lesions of non-endodontic origin may resemble periapical abscess and apical periodontitis, and care must be taken in differentiating these entities. A retrospective study assessed 1,521 biopsies clinically compatible with periapical lesions and found 52 cases (3.4%) with a diagnosis not compatible with a sequelae of pulpal necrosis, such as keratocystic odontogenic tumour (1.2%) and the glandular odontogenic cyst (0.7%) (31). Odontogenic tumours accounted for just 0.1% of cases, and only one case of metastatic carcinoma (0.06%) was observed (31). In the present report, all involved teeth presented with a normal response to the cold sensitivity testing. The decision was made to perform pre-emptive endodontic treatment on tooth #12, as it was assumed the exploratory diagnostic surgery and incisional biopsy would result in a severing of the periapical neurovascular bundle and pulpal devitalisation. Surgical resection of the lesion with clean margins, followed by chemotherapy, is associated with the best prognosis for OSJ (28,32,33), which appears to be in line with the plan defined by the specialised oncology medical team. Five-year survival rates are 68% with a 30% rate of recurrence (5). Additionally, and although the doubts of the correct present case report diagnosis were very much influenced by the combination of periapical lesion presence associated with a positive cold test response, it is important to notice that the reliability of the sensitivity test may not apply to cases of non-endodontic lesions (34). A previous study has reported that among 48 cases diagnosed with non-endodontic apical periodontitis lesions with pulp vitality test results available, 27 (56.5%) had positive response while 21 (43.5%) had a negative one (35). Other studies reporting central giant cell granuloma (36) and non-Hodgkin's lymphoma (34) also found nearby teeth to be unresponsive to cold testing. Considering that non-endodontic pathology has been found in teeth with periapical lesions exhibiting negative cold responses, all cases should be periodically monitored.

Conclusion

Periapical radiolucency is usually associated with root canal infection; however, the differential diagnosis of such lesions should not neglect to include conditions associated with non-odontogenic pathology. Osteosarcomas of the jaws are rare, difficult to diagnose and may present with varying signs and symptoms. The present case report discussed an osteosarcoma of the maxilla, which closely mimicked symptomatic periapical pathology of endodontic origin.

Authorship Declaration

All authors have contributed significantly to the present manuscript, and all have agreed in its final version.

Acknowledgements

Nothing to declare.

Disclosure Statement

The authors declare no conflict of interests.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2018; 68: 394–424.

2. Gatta G, Botta L, Sanchez MJ *et al.* Prognoses and improvement for head and neck cancers diagnosed in Europe in early 2000s: The EUROCARE-5 population-based study. Eur J Cancer 2000; 51: 2130–43.
3. Bidra AS, Hofstede TM, Skoracki RJ, Jacob RF. Maxillofacial rehabilitation of a 7-year-old boy with osteosarcoma of the mandible using a free fibula flap and implant-supported prosthesis: a clinical report. J Prosthet Dent 2009; 102: 348–53.
4. Nissanka EH, Amaratunge EA, Tilakaratne WM. Clinicopathological analysis of osteosarcoma of jaw bones. Oral Dis 2007; 13: 82–7.
5. Granowski-LeCornu M, Chuang SK, Kaban LB, August M. Osteosarcoma of the jaws: factors influencing prognosis. J Oral Maxillofac Surg 2011; 69: 2368–75.
6. Laskar S, Basu A, Muckaden MA *et al.* Osteosarcoma of the head and neck region: lessons learned from a single-institution experience of 50 patients. Head Neck 2008; 30: 1020–6.
7. Bennett JH, Thomas G, Evans AW, Speight PM. Osteosarcoma of the jaws: a 30-year retrospective review. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000; 90: 323–32.
8. Utyuzh AS, Yumashev AV, Lang HW, Zekiy AO, Lushkov RM. Comprehensive treatment and rehabilitation of patients with osteosarcoma of the mandible. Implant Dent 2018; 27: 332–41.
9. Soares RC, Soares AF, Souza LB, Santos AL, Pinto LP. Osteosarcoma of mandible initially resembling lesion of dental periapex: a case report. Braz J Otorhinolaryngol 2005; 71: 242–5.
10. Baumhoer D, Brunner P, Eppenberger-Castori S, Smida J, Nathrath M, Jundt G. Osteosarcomas of the jaws differ from their peripheral counterparts and require a distinct treatment approach. Experiences from the DOESAK Registry. Oral Oncol 2014; 50: 147–53.
11. Ferrari D, Codecà C, Battisti N *et al.* Multimodality treatment of osteosarcoma of the jaw: a single institution experience. Med Oncol 2014; 31: 171.
12. Kämmerer PW, Shabazfar N, Vorkhshori Makoie N, Moergel M, Al-Nawas B. Clinical, therapeutic and prognostic features of osteosarcoma of the jaws - experience of 36 cases. J Craniomaxillofac Surg 2012; 40: 541–8.
13. Wang S, Shi H, Yu Q. Osteosarcoma of the jaws: demographic and CT imaging features. Dentomaxillofac Radiol 2012; 41: 37–42.
14. Mendenhall WM, Fernandes R, Werning JW, Vaysberg M, Malyapa RS, Mendenhall NP. Head and neck osteosarcoma. Am J Otolaryngol 2011; 32: 597–600.
15. Agrawal R, Bhavthankar J, Mandale M, Patil P. Osteosarcoma of jaw with varying histomorphologic patterns: case report. J Orthopaedic Case Rep 2017; 7: 61–4.
16. Tomar D, Dhillon M, Nishad M, Thayath M, Zaidi I, Singh S. Central telangiectatic osteosarcoma of the mandible in a paediatric patient: a rarity. J Clin Diagn Res 2016; 10: XD01-XD03.
17. Jeong H, Lee M, Nam W, Cha I, Kim H. Osteosarcoma of the jaws in Koreans: analysis of 26 cases. J Korean Assoc Oral Maxillofac Surg 2017; 43: 312–7.
18. Tahmasbi-Arashlow M, Barnts KL, Nair MK, Cheng Y-SL, Reddy LV. Radiographic manifestations of fibroblastic osteosarcoma: a diagnostic challenge. Imaging Sci Dent 2019; 49: 235–40.
19. Wagh A, Kokane G, Jendi S, Khatib S, Mistry J, Vaidya K. Early diagnosis: a seeming misfortune for osteosarcoma of mandible - rare case report. Indian J Otolaryngol Head Neck Surg 2019; 71: 748–51.
20. Ahmad I, Bhatt CP, Bashir I, Rathour S. High-grade osteosarcoma of the mandible: a rare tumor successfully treated with surgery and image-guided volumetric modulated arc therapy. BMJ Case Rep 2018; 30: 2018.
21. Brauner E, Quarato A, De Angelis F *et al.* Prosthetic rehabilitation involving the use of implants following a fibula free flap reconstruction in the treatment of osteosarcoma of the maxilla: a case report. Clin Ter 2017; 168: e392–e396.
22. Li BB, Zhang JY, Gao Y. Chondroblastic osteosarcoma arising in the maxilla mimicking the radiographic and histological characteristics of cemento-osseous lesions: a case report. Mol Clin Oncol 2017; 6: 733–6.
23. Yamamoto-Silva FP, Silva BSF, Batista AC, Mendonça EF, Pinto-Júnior DDS, Estrela C. Chondroblastic osteosarcoma mimicking periapical abscess. J Appl Oral Sci 2017; 25: 455–61.
24. Fang Z, Jin S, Zhang C, Wang L, He Y. Misdiagnosis of osteosarcoma as cementoblastoma from an atypical mandibular swelling: a case report. Oncol Lett 2016; 11: 3761–5.
25. Pardhe ND, Jamdade A, Bajpai M, Kashyap N, Mathur N. Giant osteosarcoma of the mandible. J Coll Physicians Surg Pak 2017; 27: S117–S119.
26. Mainkar A, Kim S. Diagnostic accuracy of 5 dental pulp tests: a systematic review and meta-analysis. J Endod 2018; 44: 694–702.
27. Altuwairgi O, Papageorge MB, Karp DD. Maxillary chondroblastic sarcoma: presentation of two cases and a literature review. J Oral Maxillofac Surg 1996; 54: 1357–64.
28. Neville BW, Damm DD, Allen CM, Bouquot JE. Oral maxillofacial pathology. 3rd ed. Philadelphia: Elsevier; 2009.
29. Ogunlewe MO, Ajayi OF, Adeyemo WL, Ladeinde AL, James O. Osteogenic sarcoma of the jaw bones: a single institutional experience over a 21-year period. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101: 76–81.
30. Nakayama E, Sugiura K, Ishibashi H, Oobu K, Kobayashi I, Yoshiura K. The clinical and diagnostic imaging findings of osteosarcoma of the jaw. Dentomaxillofac Radiol 2005; 34: 182–8.

31. Kontogiannis T, Tosios K, Kerezoudis N, Krithinakis S, Christopoulos P, Sklavounou A. Periapical lesions are not always a sequelae of pulpal necrosis: a retrospective study of 1521 biopsies. Int Endod J 2015; 48: 68–73.
32. Lukschal LF, Barbosa RM, Alvarenga RL, Horta MC. Osteosarcoma in the maxila: case report. Rev Port Estomatol Med Dent Cir Maxilofac 2013; 54: 48–52.
33. Saito K, Unni KK. Malignant tumours of bone and cartilage. In: Barnes L, Eveson JW, Reichart P, Sidransky D, eds. World health organization classification of tumours pathology and genetics of head and neck tumours. Lyon: IARC Press; 2005
34. Shilkofski J, Khan O, Salib N. Non-Hodgkin's lymphoma of anterior maxilla mimicking a chronic apical abscess. J Endod 2020; 46: 1330–6.
35. Pontes F, Fonseca F, Jesus A *et al*. Nonedodontic lesions misdiagnosed as apical periodontitis lesions: series of case reports and review of literature. J Endod 2014; 40: 16–27.
36. Sykaras S. Central giant cell granuloma: report of a case. Int Endod J 1981; 14: 185–7.