CASE REPORT

Cone beam CT as an aid to diagnosing mixed radiopaque radiolucent lesions in the mandibular incisor region

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SUMMARY

We present two cases where the identities of mixed radiopaque radiolucent lesions in the lower incisor region were unclear, although the position of the lesions and positive pulp sensitivity tests were suggestive of periapical osseous dysplasia. In the first case, the lesion presented as a solitary round mixed radiopaque radiolucent periapical lesion, suggestive in some images as periapical osseous dysplasia. Cone beam CT (CBCT) provided clear images, which confirmed the diagnosis and, additionally, the images showed evidence of initial lesions associated with other anterior teeth and some destruction of the labial plate, not evident on the conventional radiographs. In the second case, radiopacities were identified within the lesion on conventional radiographs, but CBCT imaging also showed extensive and unexpected perforation of the lingual plate. Such destruction of cortical plates may be a feature of periapical osseous dysplasia, which is not visible in conventional radiography.

BACKGROUND

These case reports demonstrate that routine periapical radiographs may not demonstrate the actual extension of the periapical osseous dysplasia. The extension of these lesions in the buccolingual direction was not evident on the periapical radiograph. Cortical fenestrations may be a consistent feature of these lesions. Awareness about cortical involvement may help in ensuring meticulous oral hygiene, especially in those with concomitant periodontitis, to prevent infection of these lesions.

CASE PRESENTATION**Case 1**

A 28-year-old healthy woman of East Asian origin was referred for endodontic treatment on her mandibular right lateral incisor. The referring dentist noticed a radiolucent lesion on a panoramic film associated with the apex of mandibular right lateral incisor. The patient was asymptomatic with no signs of infection and could not recollect any history of trauma to the region. Clinical examination revealed excellent oral hygiene and no apparent discolouration or fracture of any of the mandibular incisor teeth. There was a unilateral mandibular torus on the right side in the canine premolar region (figure 1). An angled periapical radiograph given by the referring practitioner showed a circumscribed predominantly radiolucent periapical lesion associated with the apex of lower

right lateral incisor and a lateral radiolucency on the distal aspect at mid-root level (figure 2).

INVESTIGATIONS

All the mandibular anterior teeth responded normally to electric pulp testing (Vitality scanner, Sybron Endo, California, USA) and to refrigerant spray (Endo-ice, Coltene/Whaledent Inc, USA). A periapical radiograph taken with a parallel technique at the time of consultation revealed a well circumscribed radiopaque lesion with a radiolucent border (figure 3). The surrounding bone appeared sclerotic in relation to the lesion. The lamina dura of the mandibular right lateral incisor appeared intact and visible through the lesion. Considering the solitary nature of the mixed lesion, possible superimposition of torus and the difference in the radiodensity seen in the two periapical radiographs, a small field of view (50 mm diameter×37 mm height) cone beam CT (CBCT; Kodak 9000C 70 kVp, 8 mA, 10.8 s) was taken to help establish the diagnosis. The scan revealed a 6×5 mm oval-shaped radiopaque lesion near the apex of lower right lateral incisor with a partial radiolucent rim that surrounded the lesion except around the lingual aspect. At this location, the lesion was continuous with the lingual cortex without any expansion or destruction of the lingual cortex. The labial cortex appeared perforated in the region of the lesion, which was confirmed on axial, sagittal and coronal slices (figure 4). Coincidentally, erosion of the labial cortex was also apparent overlying the apices of the lower left central incisor teeth, which was not evident in the periapical radiographs (figure 5). Incipient areas of labial cortical erosion

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Figure 1 Mandibular occlusal view showing unilateral mandibular torus.

Figure 2 Radiographs from referral. (A) Panoramic radiograph showing circumscribed radiolucency associated with apex of lower right lateral incisor and obscure details. A well circumscribed solitary radiopaque lesion (arrow) is seen towards the lower border of mandible in mandibular left canine region. (B) Angled periapical radiograph showing a circumscribed predominantly radiolucent periapical lesion associated with the apex of lower right lateral incisor and a lateral radiolucency on the distal aspect at mid-root level.

were also seen away from the apex of lower left lateral incisor, which were not visible in the periapical radiographs (figure 6). The CBCT images also confirmed that the solitary radiopacity seen in the panoramic radiograph towards the lower border of the mandible in the left canine region was possibly the ghost image of the mandibular torus (figure 2).

CASE PRESENTATION

Case 2

A 40-year-old healthy Kuwaiti woman presented with sensitivity to cold in the upper right second molar region. On examination, she was found to have generalised yellowish-brown discoloration of her teeth suggestive of tetracycline staining, mild

generalised periodontitis and deep caries on her upper right second molar.

INVESTIGATIONS

As the woman was a new patient, a dental panoramic tomography (figure 7) was taken for general assessment of the dentition and crestal bone loss, as per guidelines suggested by the Food and Drug Administration and American Dental Association.¹ It revealed irregular shaped radiodense lesions with radiolucent borders in the periapical region of the lower anterior teeth. A periapical radiograph (figure 7) of the mandibular anterior region showed slight widening of the apical periodontal ligament space and mild crestal bone loss and confirmed the presence of a mixed radiopaque/radiolucent lesion extending from the distal aspect of mandibular right lateral incisor to distal of left lateral incisor. On further questioning, the patient stated that she did occasionally experience mild discomfort in the lower anterior region. A small field of view (50 mm diameter × 37 mm height) CBCT (Kodak 9000C, 70 kVp, 8 mA, 10.8 s) of the lower anterior region showed destruction of the lingual cortex in the region of the lesion (figure 8). The overall mesiodistal extent of the lesion was 18 mm. Two radiodense irregularly shaped islands measuring 8 and 7 mm mesiodistally were present. In the coronal plane, the radiolucent periphery of the lesion extended between the roots of teeth with a maximum extension of 6 mm coronapically. All lower anterior teeth reacted normally to electric pulp testing (Vitality scanner, Sybron Endo) and to refrigerant spray (Endo-ice, Coltene/Whaledent Inc.).

DIFFERENTIAL DIAGNOSIS

The differential diagnoses of mixed radiodense/radiolucent lesions in the periapical region of the mandibular anterior teeth include mandibular tori, hypercementosis, cementoblastoma, idiopathic bone sclerosis, condensing osteitis, chronic sclerosing osteomyelitis, ossifying fibroma, odontoma, calcifying odontogenic cyst and tumour.^{2 3} Very rarely, malignancy such as osteosarcoma, chondrosarcoma and metastatic osteoblastic carcinoma can present as mixed radiopaque radiolucent lesions in the jaw; however, they are not necessarily associated with teeth.⁴ In diagnosing these cases it was considered that malignancy was unlikely due to absence of root resorption, root flaring, lymphadenopathy or expansile swellings.⁴

Superimposition of mandibular tori was ruled out with CBCT in the first case, although it was thought that the single torus present lingual to the right mandibular first premolar was likely responsible for the ghost image seen in the panoramic radiograph (figure 2). Hypercementosis and cementoblastoma were

Figure 3 Periapical radiograph taken with a parallel technique at the time of consultation revealing a well circumscribed radiopaque lesion with a radiolucent border apical to mandibular lateral incisor. The lamina dura appeared intact and visible through the lesion.

Figure 4 (A) Axial section near the apex of lower right lateral incisor revealing an oval-shaped radiopaque lesion with a partial radiolucent rim surrounding the lesion except around the lingual aspect. The labial cortex appeared perforated in the region of the lesion (arrow). (B) Coronal section through the same tooth showing the periodontal ligament space and that the lesion is not continuous with the root of the tooth. (C) Three-dimensional reconstruction of lower anterior region showing the overview of erosive darker areas and their relation with roots of the teeth. (D) The sagittal section through lower right lateral incisor showing a break in continuity of the labial cortex (arrow) associated with the lesion.

both excluded as the radiodensity is continuous with the roots of the tooth in both those conditions. Although there was an association between idiopathic osteosclerosis and dental fluorosis, the discolouration in the second case was considered to be due to tetracycline staining and therefore non-contributory of the lesion.⁵ Moreover, idiopathic osteosclerosis usually occurs as a localised region of abnormally dense bone without a

perilesional radiolucent halo and in the edentulous region of the mandibular jaw or in mandibular molar/premolar teeth with normal pulp.⁶ In contrast, condensing osteitis, which is reactionary high-density bone formation in the periradicular region in response to pulp disease, has distinctive features not shared with periapical osseous dysplasia—notably the lack of a radiolucent halo or loss of continuity of lamina dura and characteristic

Figure 5 Erosion of the labial cortex (arrows) is apparent overlying the apices of the mandibular left central. (A) Three-dimensional reconstructions with horizontal and vertical lines showing the plane of the section. (B) Corresponding axial section through apical region of mandibular left central incisor with arrow pointing towards the erosion of cortex.

Figure 6 (A) Three-dimensional reconstruction with horizontal and vertical lines showing plane of section 4–5 mm apical to lower left lateral incisor with dark erosive areas. (B) Axial section through the corresponding region showing early erosive changes (arrow). (C) Sagittal section through the same region showing the early erosive changes (arrow) away from the apex of the root of left lateral incisor.

presence of pulpal disease. Chronic sclerosing osteomyelitis can appear radiographically similar to osseous dysplasia, but is more often associated with the florid variety.⁷ Such patients are usually symptomatic, with concomitant pain, gingival swelling and pus discharge being the common symptoms. These latter two conditions were excluded based on the clinical and radiographic presentation, and by the presence of positive pulp sensitivity testing.

An important differential diagnosis in these lesions is ossifying fibroma, which is generally associated with swelling and deformation of the jaw in the mandibular premolar or molar region, with concentric buccolingual expansion and downward displacement of the lower border of mandible.⁸ Since there is considerable overlapping in the histological features of ossifying fibroma and osseous dysplasia, McCarthy⁹ suggested that radiographic and clinical findings are important differentiating elements. The anterior location of the presented cases along with lack of swelling or deformity helped us exclude ossifying fibroma.

In addition to its typical radiographic appearance, odontoma was ruled out as compound odontoma with its tooth-like structure is more common in the maxillary anterior region and complex odontoma with no resemblance to tooth structure is more common in the mandibular posterior region.¹⁰ Calcifying odontogenic cyst and tumour may include a spectrum of clinical behaviour and histopathological features with cystic, solid and aggressive (malignant) variants.^{11 12} They may present as unilocular or multilocular radiolucency with calcified flecks and a predilection for the maxillary canine–premolar region.¹² They are also often associated with root resorption and divergence.¹¹ Thus on the basis of the location of these lesion, positive pulp

sensitivity and radiographic findings, a clinical diagnosis of periapical osseous dysplasia was made in both cases.

TREATMENT

No treatment was undertaken specifically for periapical osseous dysplasia in either of the cases. Both patients were given written details about the diagnosis. Their general dental practitioners were informed about the diagnosis so that unnecessary surgical exploration or root canal treatments were not initiated.

OUTCOME AND FOLLOW-UP

Summerlin and Tomich¹³ recommended follow-up of these lesions as two of their cases progressed to the florid variety.⁵ However, Kawai *et al.*,¹⁴ with a mean follow-up of 9 years, reported that the existing lesions do not tend to change in size but new lesions can appear. Although there is no clear cut information on the frequency, clinical and radiographic follow-up is recommended for osseous dysplasia of the jaw.²

Both these patients have been placed on annual follow-up and plaque control measures are undertaken to ensure the second case with concomitant periodontitis and cortical destruction does not develop into a symptomatic variety. The one year review periapical radiograph of the first case showed that the solitary circumscribed radiopacity has lost its radiolucent halo and extended to mandibular right central incisor while remaining asymptomatic (figure 9). As mentioned earlier, this is in contradiction to what was reported by Kawai *et al.*¹⁴ Hence it appears that these lesions may have variable behaviour. Although periapical radiographs provide limited information, follow-up CBCT cannot be recommended currently due to radiation hazard. However, a very recent introduction of 'low dose

Figure 7 (A) Dental panoramic tomographic image revealing irregular shaped radiodense lesions with radiolucent borders in the periapical region of the lower anterior teeth. (B) Periapical radiograph of mandibular incisor region showing presence of a mixed radiopaque/radiolucent lesion extending from the distal aspect of mandibular right lateral incisor to distal of left lateral incisor.

Figure 8 (A) Lingual view of three-dimensional reconstructed CBCT image of the anterior mandible showing destruction of the lingual cortex in the region of the mandibular incisor region. Break in continuity of the lingual cortex (arrow) seen in axial (B) and sagittal slices (C). Coronal section (D) showing radiolucent border and dense calcified islands that are not continuous with the roots of the teeth.

mode CBCT' appears promising, with as little as 3 μ Sv of effective dose for a 5 cm $\times$ 5 cm scan.¹⁵

DISCUSSION

Conventionally, periapical osseous dysplasia is thought to be an endosteal lesion.³ Reports on CBCT imaging of these lesions, though rare, do not seem to support this view.¹⁶ The question of whether osseous dysplasia can produce expansion of bone is controversial, depending on whether the evaluation is based on pathology on or occlusal radiography.² Although studies using occlusal radiographs have shown intact (but thinning) expansion of at least one cortex, the lesions are usually described in the literature as non-expansile.² This may also be due to the lack of sensitivity of two-dimensional imaging in identifying early cortical changes. However, one earlier CT study on the florid variety has described expansion as well as destruction of buccal and lingual cortices in areas with cystic change.¹⁷ An association between a simple bone cyst with periapical osseous dysplasia has also been reported with an incidence of 8.5%.² Simple bone cysts associated with osseous dysplasia usually display loss of lamina dura, endosteal tooth root scalloping, expansion and cortical destruction, and are usually located in the mandibular premolar and molar location.¹⁸ This is an important consideration in our second case, though lack of cortical expansion and its anterior location make it unlikely to be associated with cyst formation; however, further follow-up would be necessary to evaluate the behaviour of this lesion.¹⁹ Also, the presence of concomitant periodontitis in this case and the likelihood of

secondary infection as reported in two-thirds of Kawai *et al*'s¹⁴ study are of concern. Secondary infection may not respond to antibiotics and surgical intervention may be required.¹⁴

An interesting association between periapical osseous dysplasia and women with neurofibromatosis type 1 has been reported recently by Visnapuu *et al*.²⁰ In their study, 34% of the women with neurofibromatosis and 14% of all patients with neurofibromatosis had concomitant periapical osseous dysplasia. This supports the hypothesis proposed by Kawai *et al*¹⁴ that these dysplastic changes happen due to hormonal imbalance affecting bone remodelling in women. In addition, 85% of the total patients with neurofibromatosis also had enlargement of the mandibular foramen and inferior alveolar nerve canal. This may be because the common site in the mandible for neurofibromatosis is the mandibular canal and/or foramen.²⁰ Neither of our patients had enlarged inferior alveolar canals or neurofibromatosis. However, further studies on this association may shed light on the pathogenesis of periapical osseous dysplasia.

Notably, the only other case report describing the CBCT appearance of periapical osseous dysplasia also showed cortical destruction.¹⁶ Hence it is possible that cortical destruction is a consistent feature of periapical osseous dysplasia in the lower incisor region, undetected by conventional radiographic techniques. Additional CBCT-based studies of these lesions would be needed to confirm this. It has to be acknowledged that radio-density inconsistencies and artefacts are inherent in CBCT imaging due to a variety of reasons ranging from non-ideal geometry, scattered radiation, beam hardening, metal artefacts,

Figure 9 One year follow-up of case 1 showing the solitary radiopacity has lost its radiolucent border and extends to mandibular right central incisor.

partial reconstruction and exomass.²¹ Hence the presence of cortical destruction is better confirmed with CT. In the two cases reported here cortical erosion was also seen in multiple slices and in all three planes, and was specifically associated only with the lesion.

A lesser known fact is that some of the cases of osseous dysplasia could be symptomatic.²² Su *et al*,²³ in a comprehensive review of 316 cases, reported 38% of their cases to be symptomatic, whereas another recent study reported 27% of their 115 cases to be symptomatic.² The highest reported incidence of symptomatic cases of osseous dysplasia was in Japanese patients, where 59% of 54 patients with osseous dysplasia presented with symptoms.¹⁴ In all three studies, pain, swelling, tooth sensitivity and mobility, either alone or in combination, were the predominant symptoms. The CBCT images in our two cases provide valuable insight into the behaviour of osseous dysplasia and might explain why some of these lesions turn out to be symptomatic. It is our contention that the concomitant cortical erosion may act as a bacterial conduit, especially in cases associated with periodontitis, thus promoting secondary infection. However, this has to be verified by long-term follow-up studies.

Although it is tempting to recommend CBCT for imaging suspected cases of osseous dysplasia, higher radiation dose and cost are of concern. However, the use of small field of view CBCT is an effective strategy in reducing the radiation significantly.²⁴ A typical mandibular anterior scan with Kodak 9000 3D, as used in these cases, is equivalent to 21.7 μ Sv or 0.9 of a typical

digital panoramic film radiation dose.²⁵ In the first case, the inconsistent radiographic appearance and possible superimposition of mandibular torus were the reasons for requesting the additional imaging. In the second case, CBCT was essential to rule out possible presence of simple bone cyst, as reported by Chadwick and Alsufyani.^{2 18} Thus, judicious case selection is pivotal to implement the ALARA (as low as reasonably achievable) principle. Further, the use of CBCT for these cases are consistent with the guidelines in diagnosis of periapical osseous dysplasia and other non-endodontic periapical lesions as described in the Sedentext project²⁶ of the European Union and the position statements of the American Association of Endodontist and American Association of Oral and Maxillofacial Radiology.²⁷

Both our cases highlight the ability of CBCT, not only to confirm the diagnosis of periapical osseous dysplasia, but also to detect cortical erosions that are undetected in periapical radiographs. Of note is that the location of incipient areas of radiolucency can be away from the periodontal ligament space and within the adjacent bone. It has been proposed in recent years that the cells responsible for osseous dysplasia are of osseous origin rather than from the cementum or periodontal ligament. This, along with the intact periodontal ligament seen in most studies, supports the current terminology of osseous dysplasia instead of cemental dysplasia.^{9 28} The CBCT images of these cases seem to strengthen this hypothesis. However, future studies focused on alteration in bone metabolism in middle-aged women, along with genetic factors triggering neurofibromatosis, may unearth whether an alteration in neural control of bone metabolism is the likely cause of periapical osseous dysplasia.

Learning points

- ▶ Cortical erosion may be a consistent feature of periapical osseous dysplasia of the mandibular anterior region.
- ▶ Cone beam CT (CBCT) mapping of suspected cases of periapical osseous dysplasia may be useful in those with concomitant periodontitis to devise customised preventive care against infection of these lesions.
- ▶ CBCT detected early cortical erosion away from the root apex which suggests an osseous rather than cemental origin and is consistent with the recent change in terminology.

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Competing interests None.

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