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Radiolucent lesions that may resemble inflammatory periapical lesions: A review article

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ABSTRACT

Non-endodontic lesions (NEL) closely resemble lesions of endodontic origin. Its etiology can be odontogenic, non-odontogenic, neoplastic, or anatomic variations that can resemble inflammatory periapical lesions in the periapical area. Inflammatory periapical lesions are caused by pulpal pathoses and require endodontic treatment. Since numerous NEL may resemble inflammatory periapical lesions, they can lead to misdiagnosis and inappropriate management. Thus, a detailed review of the patients' medical and dental histories with clinical examination, including radiographic findings, is essential for the proper assessment of periapical lesions. Numerous cases of misdiagnoses of NEL have been reported in literature. Thus, this review aimed to strengthen the awareness of clinicians on periapical radiolucency, which may resemble inflammatory periapical lesions.

1. Introduction

Radiolucent lesions are commonly observed on dental radiographs. Inflammatory periapical lesions, cysts, tumors, and trauma may also cause these lesions. Most periapical radiolucent lesions are caused by the necrosis of the tooth pulp (Bilodeau and Collins, 2017; Huang et al., 2017). However, non-endodontic lesions can also occur in the jaw and may lead to the misdiagnosis of periapical lesions of endodontic origin, particularly when these lesions are located in the periapical region of the teeth, with or without endodontic treatment. Reviewing the patient's medical history, clinical examination, and radiographic findings may aid in the differential diagnosis of radiolucent lesions. Additional diagnostic procedures, such as biopsy or computed tomography (CT), may be necessary to confirm the diagnosis (Avril et al., 2014). When the clinical diagnosis is uncertain, periapical lesions may also be histopathologically examined (Omoregie et al., 2009). The literature shows that the prevalence of non-endodontic lesions varies between 0.7 % and 5.0 % in all periapical biopsies (Bhaskar SN, 1966; Weisman, 1975; Kuc et al., 2000). A recent retrospective study reported that 4.22 % of periapical lesions were of non-endodontic origin, with 34.9 % of the lesions being odontogenic keratocysts (OKC), 15.6 % being dentigerous cysts, and 9.15 % being nasopalatine duct cysts. Notably, the prevalence of non-endodontic lesions in the periapical area varies depending on the population studied (Vieira et al., 2020). This study aimed to expand the awareness of clinicians on the various radiolucencies that may resemble inflammatory periapical lesions. This will allow clinicians to reduce the possibility of misdiagnosis, while providing appropriate treatment.

2. Review

2.1. Cemento-osseous dysplasia (COD)

COD is a self-limiting condition classified as a "benign fibro-osseous lesion" (Shamala Ravikumar et al., 2020). It is also the most prevalent benign fibro-osseous lesion (Nam et al., 2022). It has three categories: periapical, focal, and florid (Shamala Ravikumar et al., 2020). The periapical type typically occurs around the apex of the anterior mandibular teeth, and the focal type occurs in the mandibular molar region (Shamala Ravikumar et al., 2020). The florid type refers to more widespread and multilocular forms that affect the maxilla and mandible or develop bilaterally in the jaw (Salvi et al., 2020). In the first stages of COD, the lesions often exhibit radiolucency and then transition to a more radiopaque appearance as the condition advances (Lin et al., 2010; Fenerty et al., 2017). Since COD is typically self-limiting, it is often

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diagnosed incidentally during routine dental examinations and does not require any treatment (Shamala Ravikumar et al., 2020). However, it may become symptomatic and necessitate intervention if it becomes secondarily infected due to improper endodontic treatment, tooth extraction, or any other cause (Min et al., 2018). Owing to radiographic similarities specially in the early stage, it iscommon for COD to be misdiagnosed as an inflammatory periapical lesion (Delai et al., 2015). Previous dental history and pulp sensitivity tests are essential for distinguishing between COD and inflammatory periapical lesions (Huh and Shin, 2013). Advanced radiographic modalities, such as cone beam CT, are also beneficial for diagnosing this lesion (Fenerty et al., 2017) (Table 1).

2.2. Nasopalatine duct cysts

The most frequent non-odontogenic developmental cyst is the nasopalatine duct cyst (Cecchetti et al., 2012). It develops from the epithelial remnants of the nasopalatine duct between the growing fetus's nasal cavity and anterior maxilla (Barros et al., 2018; Nelson and Linfesty, 2010). It is predominately well-defined and apical to the central incisors on radiographs and has the appearance of a radiolucent shaped heart due to the superimposition of the anterior nasal spine (Fig. 1) (Nelson and Linfesty, 2010). Clinically, it is mostly asymptomatic and located in the anterior part of the palate (Cecchetti et al., 2012). From a histological perspective, it is bordered with stratified squamous epithelium, either by itself or in conjunction with other forms of epithelium (Nelson and Linfesty, 2010). To differentiate this cyst from inflammatory periapical lesions and other cysts in the anterior maxillary region, vitality testing should be performed and correlated with radiographic findings; however, the final diagnosis can only be made after histological examination (Cecchetti et al., 2012) (Table 1).

Table 1
Summary of Most common non-endodontic lesionS that could resemble inflammatory periapical lesions.

Disease	How it resembles inflammatory periapical lesions	How to differentiate
Cemento-osseous dysplasia	It has the potential to manifest around the teeth apices.	- Dental history - Vitality tests - Advanced radiographic modalities
Nasopalatine duct cyst	Radiographically occurs around the apex of maxillary central incisors.	- Dental history - Vitality tests - Advanced radiographic modalities - Histological examination
Median palatine cyst	Radiographically occurs around the apex of maxillary central incisors.	- Dental history - Vitality tests - Advanced radiographic modalities - Histological examination
Odontogenic keratocyte	Radiolucency in the teeth bearing area.	- Dental history - Vitality tests - Advanced radiographic modalities - Histological examination
Lateral periodontal cyst	Circumscribed radiolucency between the roots.	- Dental history - Vitality tests - Advanced radiographic modalities - Histological examination
Pseudocysts of the jaws	May manifest as a radiolucency around mandibular posterior teeth.	- Dental history - Vitality tests - Advanced radiographic modalities

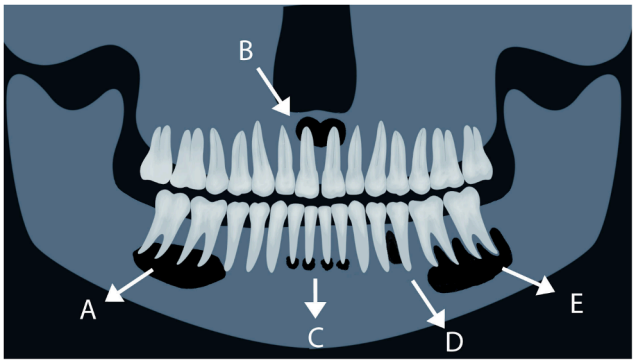

Fig. 1. An illustration showing the various changes that can occur on panoramic radiograph. (a) Odontogenic keratocyst, (B) Nasopalatine duct cysts, Cemento-osseous dysplasia, (D) Lateral periodontal cyst, and (E) Aneurysmal bone cyst. Panoramic radiographs are not diagnostic; nonetheless, they can aid in the identification of potential abnormalities.

2.3. Median palatine cysts

Median palatine cysts are considered non-odontogenic fissural cysts that can arise in the middle of the hard palate and do not involve the incisive nerve, as in the case of a nasopalatine cyst (Allmendinger et al., 2009), which originates from the entrapment of the epithelium during the fusion of the two lateral maxillary processes that form the hard palate (Queiroz et al., 2011). Radiographically, it can be clearly differentiated using CT, with the lesion being radiolucent, well defined, and centered along the median palatine suture, with no contact between the cyst and incisive foramen (Allmendinger et al., 2009). Clinically, the cyst is present in the middle of the median palatine suture, fluctuant, and asymptomatic (Allmendinger et al., 2009). Histologically, the cyst was lined with stratified squamous epithelium (Queiroz et al., 2011). To differentiate it from inflammatory periapical lesions, the vitality of the teeth around the area must be assessed (Allmendinger et al., 2009; Queiroz et al., 2011). Moreover, the palatal swelling associated with inflammatory periapical lesions will most likely be ill-defined and located lateral to the median palatine suture, rather than centered (White and Pharoah, 2014) (Table 1).

2.4. Odontogenic keratocyst (OKC)

OKCs are odontogenic cysts lined with keratinized stratified squamous epithelium and have a high risk of recurrence (Polak et al., 2019). Solitary OKC can appear anywhere in the jaw, but mostly arise in the posterior mandible, especially in the tooth-bearing area (Fig. 1) (Stoelinga, 2022). It originates from either hamartia in the submucosa or epithelial residue of the dental lamina located in the gingiva or periodontium (Stoelinga, 2022). Radiographically, it presents as unilocular with smooth or scalloped borders or multilocular radiolucency (Bilodeau and Collins, 2017). The lesion may enlarge and take on a fusiform shape because of bucco-lingual bone expansion (MacDonald-Jankowski and Li, 2010). It rarely results in root resorption or tooth displacement and tends to be associated with impacted teeth (Kitisubkanchana et al., 2021). Inflammatory periapical lesions are associated with non-vital teeth, and some can be well defined and might resemble OKC in that manner; thus, testing for the vitality of the teeth associated with the lesion is important to differentiate it(Lin et al., 2009) (Table 1).

2.5. Lateral periodontal cyst (LPC)

LPCs are relatively rare odontogenic cysts that originate in the periodontal ligaments adjacent to the roots of certain teeth (Siponen et al., 2011; Ramalingam et al., 2019). This is an uncommon finding in dental practice, representing approximately 0.4 % of all odontogenic cysts (Carvalho et al., 2010; Ramalingam et al., 2019). The most typical locations of this cyst are the mandibular canine and premolar areas, followed by the anterior maxilla (Carvalho et al., 2010; Bilodeau and Collins, 2017). As this cyst seldom manifests with symptoms, it is almost always discovered accidentally (Carvalho et al., 2010; Siponen et al., 2011; Ramalingam et al., 2019). They appear as a well-defined radiolucency with a sclerotic margin on radiographs in the alveolar process between the roots of vital teeth (Fig. 1) (Bilodeau and Collins, 2017; Ramalingam et al., 2019). LPC can be identified based on its characteristic teardrop shape (Bilodeau and Collins, 2017; Ramalingam et al., 2019). Similar to the cysts discussed in this article, LPC is typically associated with asymptomatic vital teeth, making it easily distinguishable from periapical inflammatory lesions (Carvalho et al., 2010; Ramalingam et al., 2019) (Table 1).

2.6. Pseudocysts of the jaw

Aneurysmal bone cyst (ABC) is a radiolucent lesion that can affect the jaw (Richardson et al., 2022). It is a blood-filled benign lesion that most commonly affects long bones, such as the cervical spine (Richardson et al., 2022). Its presence in the head and neck region is uncommon, since it only occurs in 2–3 % of ABCs (Richardson et al., 2022). Its most plausible location of origin in the jaw is the posterior mandible (Fig. 1) (Baumhoer, 2017). Females are more likely to be affected than males (Richardson et al., 2022). Clinically, it manifests as swelling of areas affected by pain and in relation to vital teeth that are occasionally mobile (Baumhoer, 2017). Radiographs show either a single or multilocular radiolucent lesion (Baumhoer, 2017).

Simple bone cyst (SBC) is an intraosseous cavity that lacks an epithelial lining, that can be either vacant or filled with a liquid and has an unclear cause (Lima et al., 2020). SBC is often seen on x-ray imaging during routine examination, it is mostly asymptomatic and manifests as a unilocular radiolucency with well-defined borders that has a characteristic scalloping pattern (Lima et al., 2020). It is mostly found in the mandible and a lining of a vascular fibrous connective tissue may be seen histologically (Suomalainen et al., 2009).

The usual treatment compromises of surgical exploration and curettage and is considered the gold standard (Lima et al., 2020; Suomalainen et al., 2009). Even though SBC and ABC are extremely similar, ABC tends to be more aggressive than SBC and knowledge of their presentation can be very helpful (Flores et al., 2017). The vitality of the teeth is a distinguishing feature between inflammatory periapical lesions and Pseudocysts of the jaws (Baumhoer, 2017; Richardson et al., 2022) (Table 1).

2.7. Misdiagnosed cases reported in the literature

Numerous cases of misdiagnosed radiolucent lesions have been reported in literature. For instance, in the case of a 20-year-old white male patient who was in good condition and had a sinus tract, periapical radiography revealed an apical radiolucency associated with the maxillary central incisors, a palatal sinus tract with gutta-percha was traced to the apex of a previously treated left maxillary central incisor. The lesion was initially diagnosed as a chronic apical abscess. However, following retreatment of the tooth and the lack of healing, it was determined that the tooth had a root fracture and was extracted. Due to lesion persistence after extraction, the patient was referred to specialists for endodontic/periodontal evaluation; cone beam CT was performed, and the specialists correctly diagnosed the lesion as a nasopalatine duct cyst (Hilfer et al., 2013).

In another case report, a 42-year-old male patient presented to a specialist center with a fluctuant, painless soft tissue swelling on the palatal side. The periapical radiograph revealed the presence of a well-defined, oval-shaped radiolucent lesion located between the roots of the maxillary central incisors. The provisional diagnosis of the lesion was a nasopalatine duct cyst, and the patient was booked for a surgical excision procedure. However, due to the patient's fear of surgery, he visited a general practitioner who performed endodontic treatment on both maxillary central incisors. The patient returned to the specialist center complaining of pain around the endodontically treated roots. Periapical radiography revealed inadequate root canal filling with no changes in the lesion. The two central incisors were retreated, followed by excision of the lesion (Onanasekhar et al., 1995).

In another instance, a general dental practitioner referred a 46-year-old female Taiwanese patient to Chang Gung Memorial Hospital in Taipei for treatment of apical periodontitis of the right mandibular second molar. Oral examination revealed a missing right mandibular first molar and a three-unit fixed partial denture on teeth #45 and 47. With the exception of moderate pain on palpation of tooth #47, no percussion, biting pain, or alveolar bone expansion were observed in the region. The right mandibular second molar's periapical radiograph revealed radiolucent and radiopaque lesions. The lesion was initially identified as apical periodontitis, and root canal treatment was scheduled for the affected tooth. However, once the fixed partial denture was removed, there were no caries, and the teeth were healthy. Similar lesions were observed in the region of the left second mandibular molar, and both lesions displayed a symmetrical pattern. The two mixed lesions were diagnosed as florid COD based on their symmetrical distribution, lack of alveolar bone expansion, and positive vitality test for tooth #47 (Lin et al., 2010).

3. Conclusion

Inflammatory periapical lesions can resemble several diseases and conditions radiographically. Although most radiolucent lesions are related to inflammatory periapical lesions, clinicians must pay great attention to the different radiographic presentations that can arise from each condition and correlate the radiographic and clinical presentations of every case to differentiate between various diseases. Published research on the knowledge, attitudes, and practices of dental practitioners regarding non-endodontic lesions are lacking. Increasing the awareness of non-endodontic lesions among dental practitioners may help prevent misdiagnosis and improper treatment.

Ethical approval

This article does not include any studies involving human participants or animals performed by the author.

An exemption letter was provided by the Institutional Review Board (IRB) (No. 23/0615).

CRediT authorship contribution statement

Hamad Albagieh: Conceptualization, Project administration, Resources, Supervision, Validation. **Mohammed Aldosari:** Investigation, Writing – original draft, Writing – review & editing, Project administration, Supervision, Resources, Validation, Visualization, Methodology. **Abdulmajeed Alkhathlan:** Investigation, Resources, Visualization, Writing – original draft, Writing – review & editing. **Nawaf Alfawaz:** Resources, Writing – review & editing, Writing – original draft. **Mohammed Almutairi:** Resources, Writing – review & editing, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

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