REVIEW

Diagnostic Dilemmas: Anatomical Masquerades in Dental Radiographs: A Mini Review

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Abstract

Dental radiographs are an essential component in routine dental practice. They serve multiple purposes such as aiding in the diagnosis, and exclusion of disease monitoring the progression or healing of lesions and observing the natural development of the dentition. Furthermore, they play a considerable role in medico-legal documentation. Dental radiographs are usually taken within the dental clinic and are not routinely reported by the radiologists. Instead, dental surgeons themselves use them for diagnostic purposes.

Intra Oral Periapical radiographs, Upper Standard Occlusal radiographs, and Dental Panoramic Tomographs are frequently taken in dental practice despite their inherent limitations. Although there are better imaging techniques propitious in clinical practice, increased radiation exposure and higher cost, make them less utilized as a primary tool in day-to-day practice. Therefore, it is imperative to have a better knowledge of natural structures that are superimposed in dental radiographs. Instituting other investigations with thorough clinical assessment is highly recommended in doubtful cases.

This mini review presents a series of radiographs where normal anatomical counterparts simulate pathology in them. All the presented cases were taken in Sri Lanka under the purview of the authors.

Keywords: Dental radiographs, Diagnostic dilemmas, Anatomical variations

DOI: https://doi.org/10.4038/slaj.v8i2.247

Sri Lanka Anatomy Journal 2024; 8(II): 5–17

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Introduction

Dental radiographs are essential tools for diagnosis and monitoring of dental diseases. The human body contains various features that can mimic actual pathological conditions. Soft tissues that are found around and within bones and variations in the density of the hard tissues can mimic pathology and lead to inaccurate diagnoses. It is noted that radiographic findings in the oral and maxillofacial regions often confuse radiologists (1). To prevent misinterpretation and unnecessary additional imaging or interventions, it is crucial to be familiar with the structures that are frequently found in the region.

There has been a marked improvement in the field of dental radiography with the introduction of digital radiographs offering enhanced clarity and ease in storage and sharing. However, dental radiographs have some inherent disadvantages some of which are common to all other plain radiographs. There are special radiographs taken to visualize the whole dentition. One such radiograph is the Dental Panoramic Tomograph (DPT) which is taken in a special technique, where the radiation source rotates. Thus, these radiographs have many overlapping structures hinting at abnormalities in a healthy individual. Since these radiographs only provide a two-dimensional representation of anatomical structures, clinicians must be cautious when interpreting any abnormality.

Dental professionals must be aware of these findings in dental radiographs (2). Otherwise, it might lead to wrong interpretations and unnecessary interventions. In instances where medico-legal matters are involved, the conclusions may lead to erroneous judgments (3). Furthermore, they should be aware of ways to exclude/confirm the doubts (4). The correlation of radiographic findings with clinical evaluations and other investigation results is of prime importance for diagnosis and treatment planning (5,6).

Challenges in plain radiography in Oral and Maxillo-Facial Region

Intra-oral and panoramic radiography have a high spatial resolution which is ideal for imaging tiny structures like teeth and remain the two most often employed techniques in clinical practice (7). Intra Oral Peri Apical radiographs (IOPA), Upper Standard Occlusal radiographs (USO), and DPT are the commonest. However, all the above-mentioned techniques can only capture 2D (2-dimensional) images. Thus, clinicians and radiologists may get confused by overlapping structures, displacement of tomographic layers on 2D pictures, and numerous obstacle shadows and virtual images (8).

Common mimics

The list of commonly misdirected structures classified according to the jaw and the type of radiograph is shown in Table 1.

Table 1: List of commonly misdirected structures in radiographs

Periapical radiographs of Maxilla

Radiolucent structures	Radio-dense structures
1. Incisive foramen	1. Zygomatic arch
2. Incisive fossa	2. Coronoid process
3. Intermaxillary suture	3. Soft tissue outlines of the nose
4. Maxillary sinus	4. Floor of the nasal cavity
5. Cervical burnout	
6. Nasal cavity	

Periapical radiographs of Mandible

Radiolucent structures	Radio-dense structures
1. Mental forâmen	1. Mylohyoid ridge
2. Inferior alveolar canal	2. Mental Ridge
3. Lingual forâmen	3. External oblique ridge
4. Nutrient canals	
5. Cervical burnout	

Upper standard occlusal radiograph

Radiolucent structures	Radio-dense structures
1. Nasal cavity	1. Floor of the nasal cavity
2. Incisive fossa	2. Inferior nasal concha
3. Intermaxillary suture	3. Y line of Ennis (Inverted Y)
4. Maxillary sinus	

Dental Panoramic Tomogram

Radiolucent Structures	Radio-dense structures
1. Mental forâmen	1. Mental Ridge
2. Inferior alveolar canal	2. Mylohyoid ridge
3. Submandibular fossa	3. External oblique ridge
4. Stafne's bone concavity	4. Soft tissue shadow of the nose
5. Maxillary sinus	5. Coronoid process
6. Air shadow above the tongue	6. Hyoid ghosting
	7. Auricles

Incisive foramen / Incisive Fossa

The incisive foramen is located in between the upper central incisors at the midline of the maxilla and can resemble disease if not correctly identified (9). It manifests as a periapical radiolucency or a radiolucent region that resembles a cyst. However, the nasopalatine nerve and blood vessels flow through it, making it a typical anatomical structure (Figure 1).

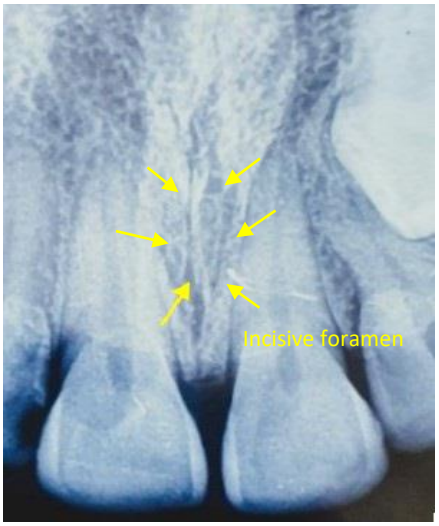

Figure 1: Incisive foramen

Intermaxillary suture

Intermaxillary suture represents the union line between 2 portions of the premaxilla and is found at the midline between the roots of maxillary central incisors as a radiolucent line which may sometimes give rise to confusion as a fracture line (Figure 2).

Figure 2: Intermaxillary suture

Nasal Foramen

Bound by bone, these are vertically oblong radiolucent structures. They are visible in IOPAs of maxillary incisors and canines and upper standard radiographs (10) (Figure 3).

Inferior Nasal Concha

The inferior nasal concha or the Turbinate bone projects to the lower part of the nasal fossa. These may sometimes appear in IOPAs of the upper incisors. This appears within the alveolar bone extending superiorly from the alveolar crest to the anterior nasal spine (Figure 3 & 18).

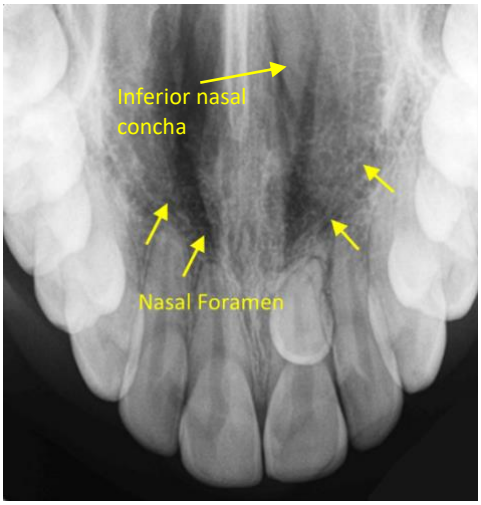

Figure 3: Nasal foramen and Inferior nasal concha

The floor of the Nasal Cavity

This represents the bony wall formed by the palatine processes of the maxillae and the horizontal plate of the palatine bone extending from the anterior nasal spine (Figure 4).

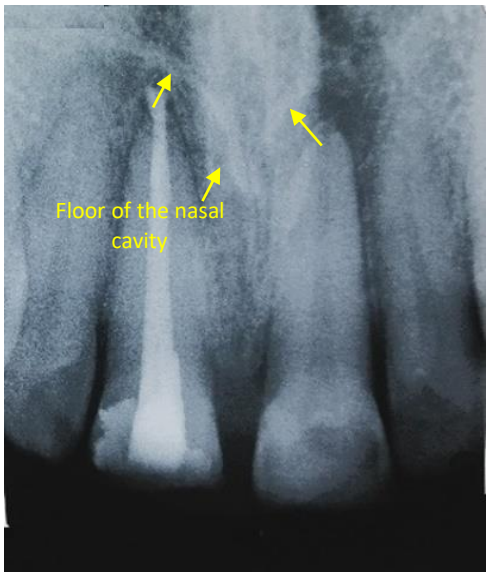

Figure 4: Floor of the nasal cavity

Soft Tissue Outline of the Nose

The nose may sometimes be seen as a soft tissue (radio-opaque) shadow in the vicinity of the roots of the maxillary incisor teeth. This may become visible both in IOPAs and USOs (Figure 5).

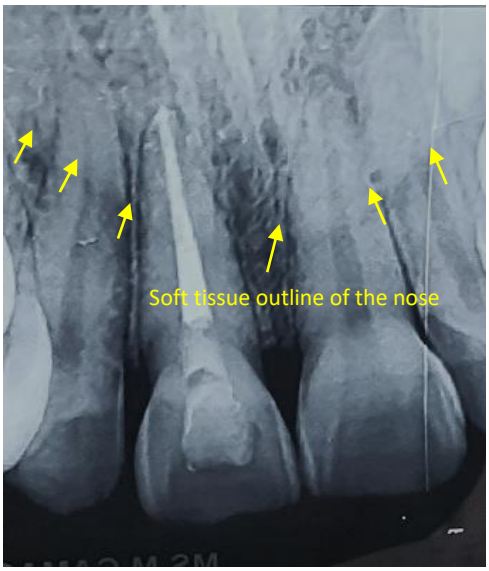

Figure 5: Soft tissue outline of the nose

Y of Ennis (Inverted Y)

This is sometimes visible in the IOPAs and DPTs of the upper canine region. The Y line is created by the lateral wall of the nasal fossa and the anterior border of the maxillary sinus (Figure 6).

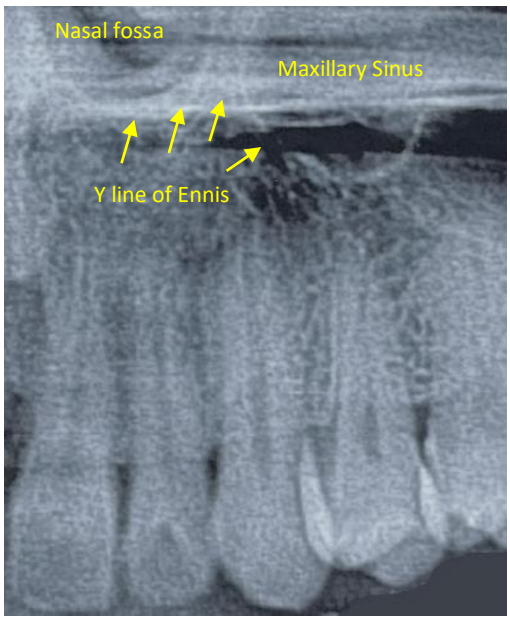

Figure 6: Y line of Ennis

Cervical burnout

On dental radiographs, the cemento-enamel junction (CEJ) exhibits cervical burnout as an optical phantom. It is a radiolucent shadow resembling a carious lesion or cervical root resorption.(8) Due to the morphologic properties of the tooth and the differences in radiography attenuation between the tooth and periodontal tissues, this phenomenon (cervical burnout) appears as a radiolucent patch on the cervical region. By being aware of this phenomenon, unnecessary testing or treatment can be avoided.

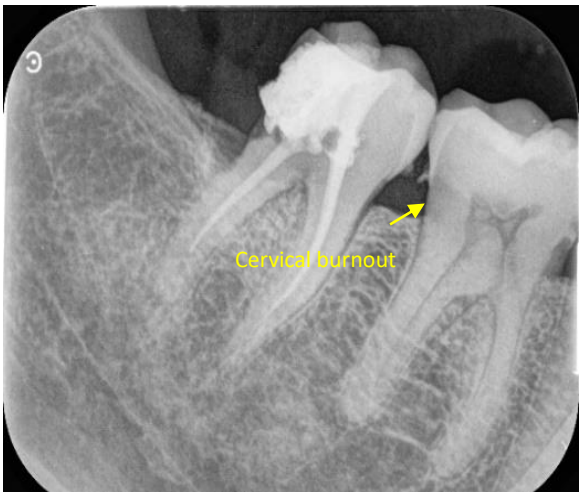

Figure 7: Cervical burnout

Other variations

Anatomical variations like tori (bony outgrowths), auxiliary canals (tiny additional channels inside the root), or even overlapping anatomical structures that produce superimpositions and provide the impression of disease are examples of other imitating features. Figure 8 shows an impacted canine overlapping the root of the first premolar.

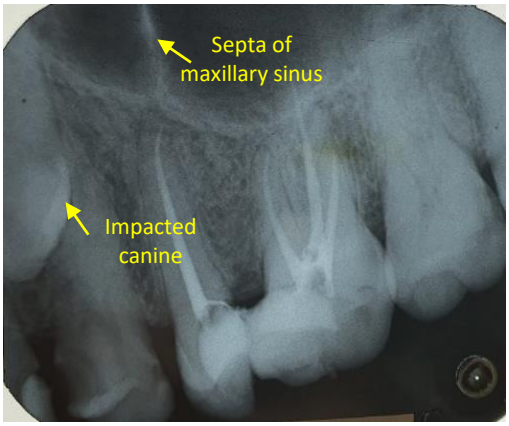

Figure 8: Impacted canine

Maxillary Sinus

The maxillary sinus can display several anatomical differences that might resemble a disease. These might be mucosal thickening, accessory ostia, or septa, which are bone partitions. These results could be mistaken for tumors, cysts, or sinus infections. Accurate diagnosis requires knowledge of these typical differences and how they relate to clinical symptoms. (Figure 8 & 9)

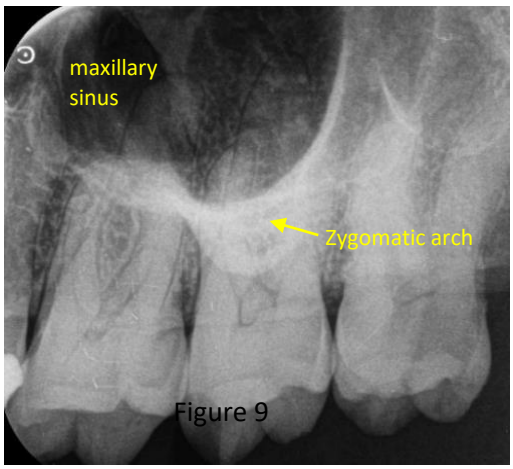

Figure 9: Zygomatic arch

Zygomatic arch

Zygomatic arch can present as a radio-opaque shadow on the maxillary molar area of a peri-apical radiograph (Figure 9).

Coronoid Process

The coronoid process of the mandible may appear in IOPAs of the maxillary posterior teeth which may be confused as an extra tooth (11). Careful examination and identification of the Trabecular pattern and the cortical bone may be useful in differentiating from a tooth structure (Figure 10).

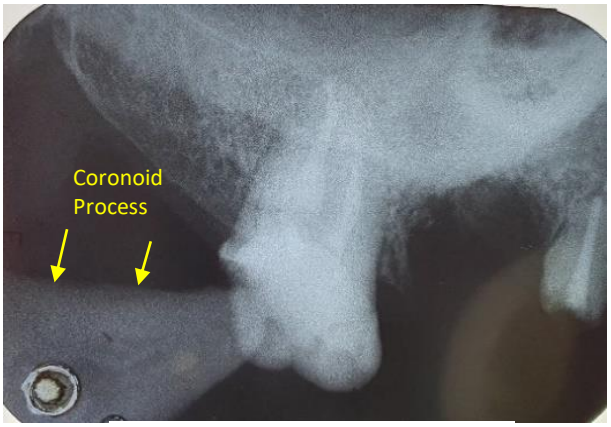

Figure 10: Coronoid process

Enamel pearls:

These tiny, spherical, or ovoid lumps of enamel are often located in the furcation regions of molars on the root surfaces of teeth. On dental radiographs, they might appear as radiopaque nodules that resemble calcified masses or even tumors. Understanding enamel pearls as a benign anatomical variation rather than a pathological lesion is imperative.

Certain anatomical landmarks or overlapping structures can produce shadows or superimpositions that may simulate disease. The palatal rugae, which are ridges on the palate, can occasionally be seen as radiopaque lines that resemble calcifications or dense formations.

Mental Ridge

The mental ridge is a prominence of bone on the labial surface of the anterior mandible. It may appear as an inverted V-shaped radio-opaque region extending medially from the canine region to the midline (Figure 11).

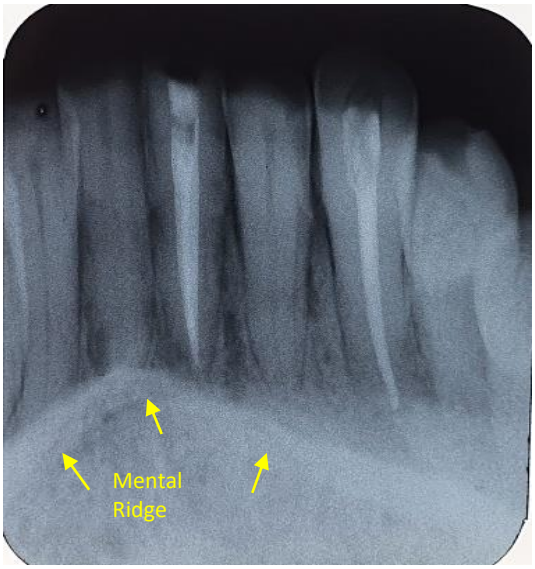

Figure 11: Mental ridge

External oblique ridge:

On the outer surface of the mandible a prominent bony ridge called the external oblique ridge exists which may appear as a radiopaque (light) line that resembles a fractured root or a thick bony lesion. The anatomical structure is normal and should not be confused with a pathological lesion. Figure 12 shows radio-opacity produced by the External oblique ridge over the roots of molars.

Mylohyoid Ridge

Mylohyoid Ridge may appear as a radio-opaque line in both IOPAs and DPTs (Figure 13 & 16).

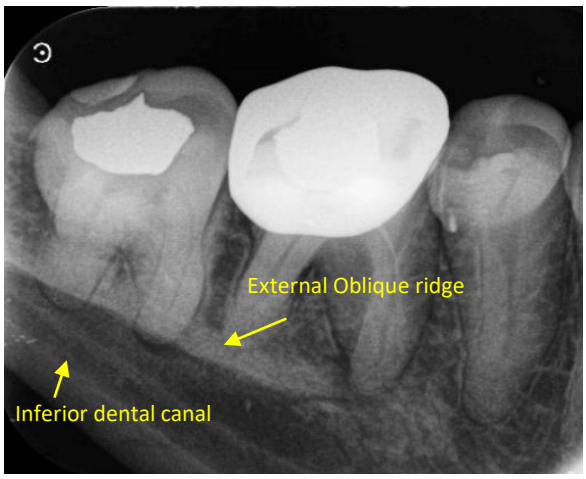

Figure 12: External oblique ridge

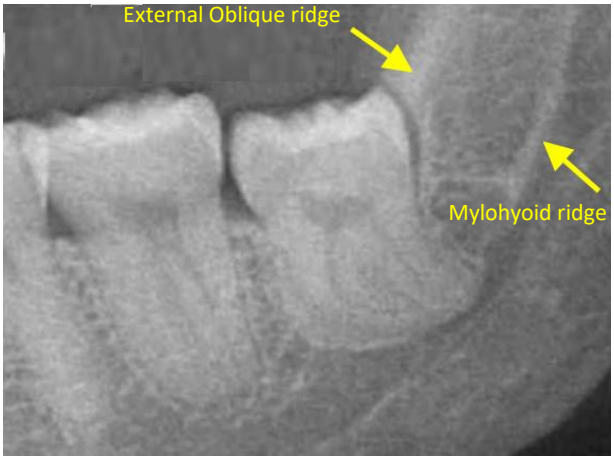

Figure 13: Mylohyoid ridge

Nutrient canals

The nutrient canal is another specific imitating structure. Small tubes called nutrient canals carry blood vessels and nerves and sustain the bones. On dental radiographs, they appear as linear radiolucent lines resembling fracture lines. These may sometimes have a radio-dense bony margin. Figure 14 shows a nutrient canal in an IOPA which mimics a fracture in the mental region.

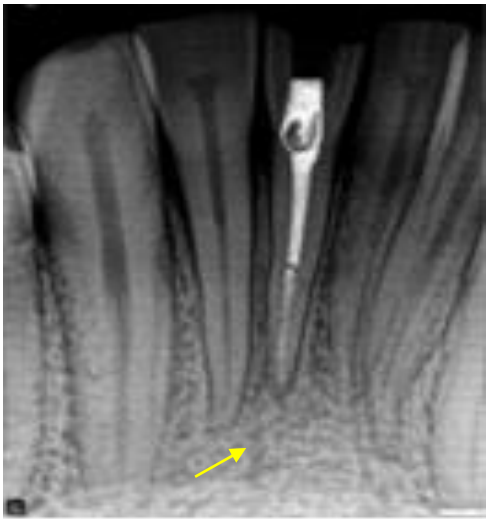

Figure 14: Nutrient canal

Developing Dental follicle

The developing tooth germ appears to be cystic. By the age of three years, most tooth germs begin to calcify and only rarely undergo imaging. The third molar tooth germs are an exception; they begin to calcify around the age of 10 years. The tooth germs exhibit cyst-like imaging results before calcification, and they may need to be distinguished from odontogenic cysts (9). Figure 15 depicts the initial calcification of the tooth bud of 38 in a young patient.

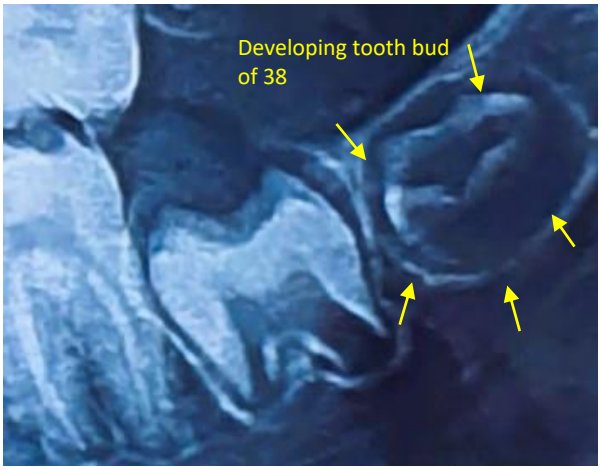

Figure 15: Dental follicle

Inferior Dental Canal

The inferior dental canal is a bony canal starting at the mandibular foramen and continues mesially. It contains Inferior dental nerve and blood vessels (12). Accurate identification is imperative to prevent complications, especially during third molar removal surgeries as sometimes the nerve and blood vessels have very close association with the roots of the mandibular third molars. This close association can be identified as the narrowing of the canal, deviation of the canal, or darkening of the roots of the third molar. (Figures 16 & 18)

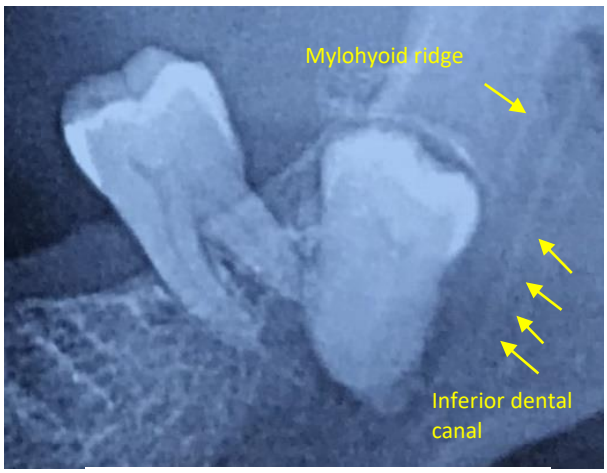

Figure 16: Inferior dental canal

Mental foramen

Dental radiographs may show the mental foramen as a radiolucent (black), ovoid-shaped structure resembling a radiolucency usually found between roots of lower premolars. It is a typical anatomical feature and does not portend any disease (13). Figure 17A shows the mental foramen located very close to the root of the mandibular second premolar mimicking peri apical pathology while 17B shows it overlapping the root mimicking root resorption.

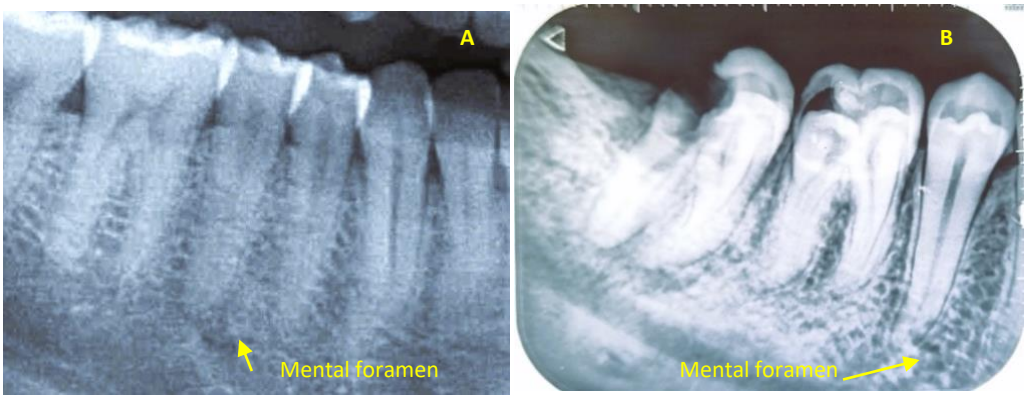

Figure 17: Mental foramen

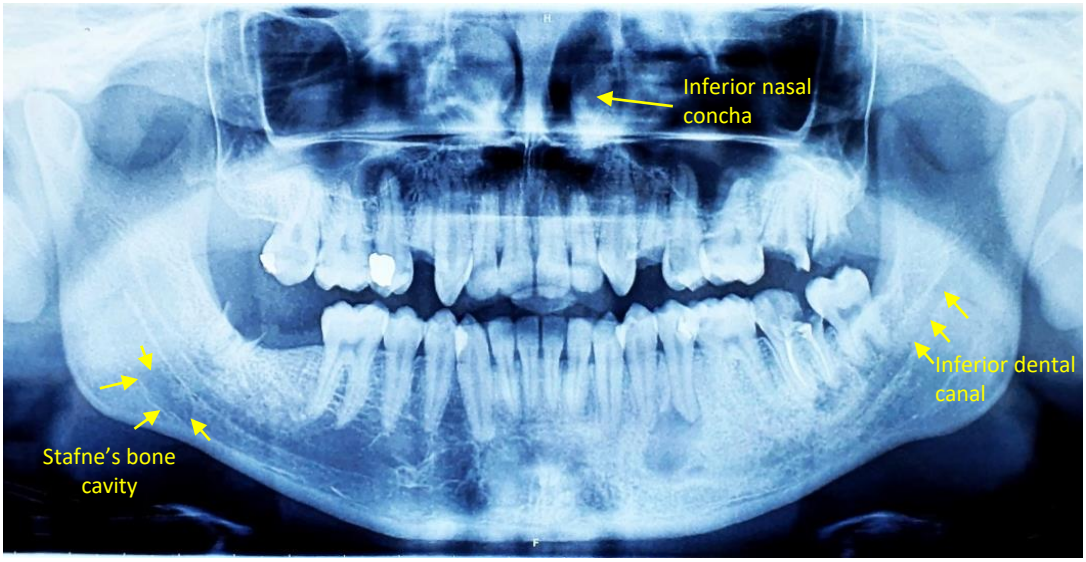

Figure 18: Stafne's bone cavity

Stafne's Bone cavities

These are rare asymptomatic unilateral oval-shaped radiolucent areas in the posterior region of the mandible below the inferior alveolar canal (10). They are described in DPTs. (Figure 18)

Hyoid Ghosting

The hyoid bone may show as a radio-opaque mass with a ghosting effect with poor margins in DPT. Figure 19 presents hyoid bone superimposing on the lower border of the mandible.

Airway - In DPTs where the teeth and jaws are shown in a single view, most other head and neck components are also represented in the image (14). These overlapping hard and soft tissues and airways frequently produce perplexing shadows and could mimic pathological lesions that make interpretation difficult (15). Figure 19 shows the airway mimicking a fracture at the angle of the mandible and Figure 20 shows an airway that simulates a cyst or a tumor.

Auricle

Auricles are not a common finding in dental radiographs. However, due to changes in exposure level during radiograph taking, auricles can be seen bilaterally in DPTs as radio-dense structures. (Figure 21)

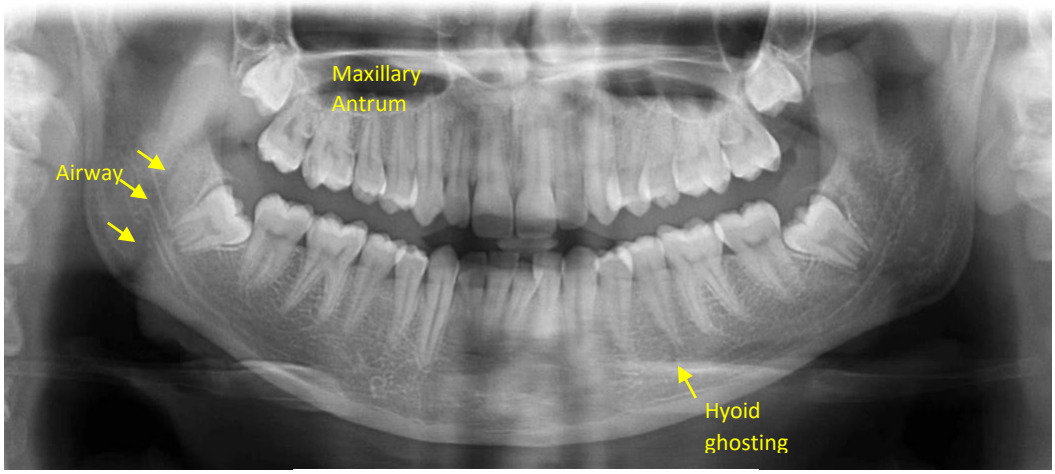

Figure 19: Hyoid ghosting

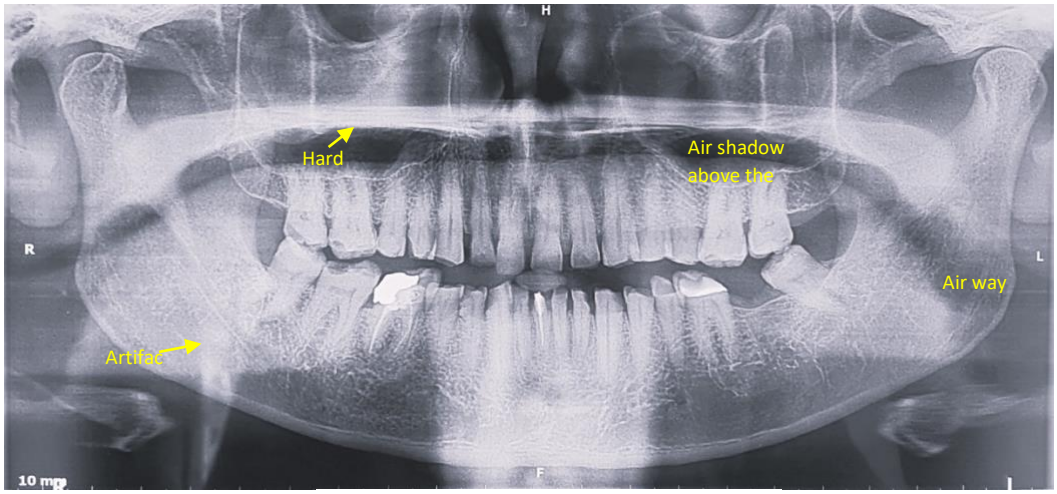

Figure 20: Airway

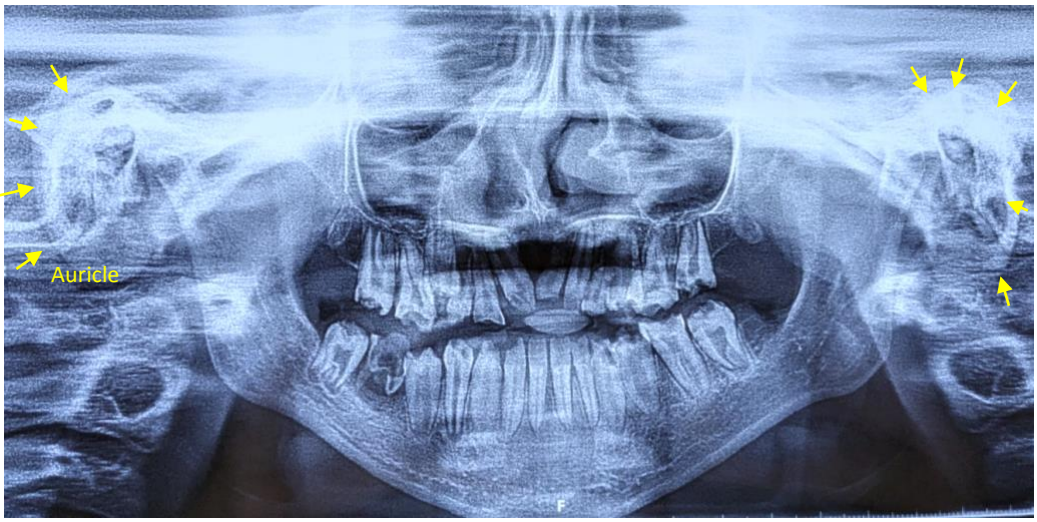

Figure 21: Auricle

Pseudo-lesions

On dental radiographs, pseudo-lesions are artifacts or superimpositions that might resemble a disease. (Figure 20) For instance, radiolucent or radiopaque regions that mimic periapical lesions or fractures might be produced by an overlapping root or a metallic repair. These fictitious lesions may be distinguished from actual pathological disorders with the assistance of a careful examination and interpretation of the clinical symptoms and history.

Exostoses and Hyperostosis

Exostoses are benign bone growths that can develop on the jaw's surface, usually on the buccal or lingual side. As radiopaque lumps that resemble bone tumors or abnormalities, they can sometimes be seen. Like osteoporosis, hyperostosis is characterized by excessive bone thickening and can manifest as regions of elevated radiopacity. To prevent unnecessary procedures, it is imperative to recognize these abnormalities as natural anatomical variances. (Figure 22)

Figure 22: Bony exostoses

Clinical Significance

Dental practitioners must maintain a high level of expertise in radiographic interpretation to distinguish between structures that resemble disease and actual pathological findings (16). Cone-beam Computed Tomography (CBCT), among other sophisticated imaging methods, can help to improve diagnostic precision and reduce the need for faulty/ unindicated procedures.

Since the anatomy may be substantially different from that of mature adults, it is crucial to comprehend the maxillofacial region's typical development when interpreting maxillofacial imaging in children or young adults (17).

It is crucial to understand how the jawbone marrow changes and how quickly each tissue grows. For diagnostic imaging of the maxillofacial region, it is also important to determine when the tooth germ starts to calcify and when the tooth erupts (1).

In the maxillofacial region, certain normal variations resemble pathologic conditions (15). Pseudo-lesions are additionally brought on by numerous imaging artifacts. To develop a differential diagnosis and to make an accurate diagnosis, the radiologist needs to have a solid grasp of normal variations and familiarity with imaging artifacts (1).

Conclusion

There are numerous presentations that might cause concern for the dental clinician in reading the dental radiographs. The dentist must be aware of common radiographic variations presented with normal anatomical structures. Dental surgeons also should be able to relate them to clinical scenarios. In addition, the clinician should be able to exclude doubts by performing alternative investigations.

Developing dentitions can occasionally be confused with pathological disorders. For instance, radiolucency that resembles cysts or tumors may be seen with growing permanent teeth or tooth buds that are present close to deciduous teeth. When evaluating these results, it is crucial to consider the patient's age and stage of dental development.

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