

Literature Review

**CHARACTERISTICS OF TRAUMATIC BONE CYST IN THE
MANDIBLE IN RADIOGRAPHIC IMAGES**

THESIS

*Submitted To Complete One of The Conditions
Achieving a Bachelor's Degree in Dentistry*

M. FADLAN FAISAL T. SYARKAWI

J011 19 1117



**DEPARTMENT OF RADIOLOGY
FACULTY OF DENTISTRY
HASANUDDIN UNIVERSITY
MAKASSAR**

2022

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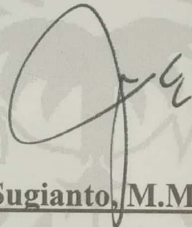
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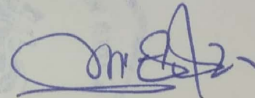
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FOREWORD

Assalamualaikum Warahmatullahi Wabarakatuh

Alhamdulillah, praise and gratitude to Allah SWT, the creator of science and knowledge, the most merciful, the most merciful. Alhamdulillah for all His grace and love so that the author can complete the preparation of the Thesis Literature Review with the title "Characteristics of Traumatic Bone Cyst in the Mandible in Radiographic Images". The writing of this thesis was submitted to fulfill one of the requirements for obtaining a bachelor's degree in dentistry at the Faculty of Dentistry, Hasanuddin University.

The completion of this thesis is not only due to the ability of the author, but also prayers, motivation, and guidance from several parties. Therefore, on this occasion, allow the author to express his deepest gratitude to:

1. The author's father and mother, **Faisal Tahir Syarkawi** and **Fausiah Djunaid Faisal**, who have supported, given infinite love to the author until this stage.
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10. For all parties whose names are not mentioned, thank you for contributing and supporting the preparation of this thesis.

The author realizes that in writing this Literature Review Thesis is still far from perfect because perfection only belongs to Allah SWT. Therefore, I apologize if there are errors in writing this thesis, the authors are happy to appreciate constructive criticism and suggestions. The author hopes that this article can be useful and add insight to the readers.

Makassar, Mei 2022

Author

ABSTRACT

Characteristics of Traumatic Bone Cyst in The Mandible in Radiographic Images

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Background: Radiology is a branch of medical science that is used to identify diseases in the body. In dentistry, radiology functions in establishing a diagnosis and determining treatment plans for various abnormalities and pathological conditions in the oromaxillofacial area. A cyst is defined as a pathological cavity filled with fluid and lined by epithelium. A traumatic bone cyst (TBC) is a benign pseudocyst that occurs in bone and is characterized by an empty or fluid-filled bone cavity. Traumatic bone cysts are rare in 0.2% to 0.9% of all cystic lesions of the jaw. The differential diagnosis of traumatic bone cyst includes apical periodontitis, odontogenic keratosis, central giant cell granuloma, ameloblastoma, odontogenic myxoma, central and neurogenic central neoplasm. In identifying the characteristics of a traumatic bone cyst and comparing it with other lesions, radiographic examinations such as panoramic radiography, CBCT, and CT scan can be used. **Objective:** To determine the characteristics of a traumatic bone cyst in the mandible on a radiograph. **Method:** Literature Review. The steps are problem identification, collecting information from several sources related to the topic of study, and Conducting a Literature Review using the information synthesis method from the literature/journal which is used as a reference and analysis of the results. **Results:** In this review of literature, several similarities were found based on their location, most of which were in the body of the mandible, ramus and anterior area of the mandible. Another similarity is that more cases of unilocular lesions are found than multilocular. Another equation states that Traumatic Bone Cyst usually appears as a radiolucent lesion, well-defined, surrounded by irregular or scalloped borders. The difference found was the size of the traumatic bone cyst. **Conclusion:** Traumatic bone cysts in the mandible when viewed on a radiographic picture occur mostly in the body of the mandible with characteristics that show unilocular lesions. Traumatic bone cysts usually present as radiolucent lesions, well-defined, surrounded by irregular or scalloped borders. Traumatic bone cysts in most cases range in size from 1.5 to 8 cm, with an average of 3.5 cm.

Keywords: traumatic bone cyst, mandible, radiography.

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CHAPTER I

INTRODUCTION

1.1 Background

Radiology is a branch of medicine that is used to identify diseases in the body. In dentistry, radiology functions in establishing a diagnosis and determining treatment plans for various abnormalities and pathological conditions in the oromaxillofacial area.¹ The use of radiography in the field of radiology displays anatomical and pathological features that cannot be seen clinically, so that disease or abnormality can be detected earlier and more accurately. Radiography becomes a guideline or reference to maximize the results of the diagnosis seen from image interpretation.²

Radiographic examination in dentistry plays a role in displaying normal and non-abnormal conditions in the oral cavity, one of the abnormal conditions in the oral cavity is a cyst. A cyst is defined as a pathological cavity filled with fluid and lined by epithelium. Cysts consist of odontogenic cysts and non-odontogenic cysts. Several types of cysts are included in the odontogenic category, namely dentigerous cysts, eruption cysts and odontogenic keratocysts, while several types of cysts that are included in the non-odontogenic category are aneurysmal bone cysts, Stafne's bone cysts and traumatic bone cysts.^{26,34}

Traumatic bone cyst (TBC) is a benign pseudocyst that occurs in bone and is characterized by an empty or fluid-filled bone cavity. Other terms for traumatic bone cyst are hemorrhagic bone cyst or simple bone cyst. Traumatic

bone cysts are rarely symptomatic, but some patients with these lesions may present with pain, swelling, or sensitivity to the tooth. Usually, the presence of a traumatic bone cyst is detected on routine radiographs. Traumatic bone cysts are rare in 0.2 to 0.9% of all cystic lesions of the jaw. This case is diagnosed more in patients aged less than 30 years with an estimated median age of 20 years. Predictions regarding the gender or the dominant sex of the disease are still controversial. Although some studies have not found a predisposition to this disease, there are studies that suggest that traumatic bone cysts are more likely to affect men.^{4,6,16,35}

In the classification of the World Health Organization (WHO), traumatic bone cyst is included in the group of lesions associated with bone, the statement is evidenced that traumatic bone cyst is commonly located in the jaw. Traumatic bone cyst is the result of trauma that causes an intraosseous hematoma to liquefy, resulting in a cystic defect. Any form of trauma, including tooth extraction, can cause a traumatic bone cyst. As many as 89% of cases of traumatic bone cyst occur in the lower jaw, especially in the body and mandibular symphysis and only a few cases occur in the condyle area. In the maxilla, traumatic bone cysts are rare and are usually located in the frontal aspect of the maxilla.^{3,6}

Suei *et al* suggested the differential diagnosis of traumatic bone cyst including apical periodontitis, odontogenic keratosis, central giant cell granuloma, ameloblastoma, odontogenic myxoma, central neoplasm and neurogenic. In identifying the characteristics of a traumatic bone cyst and

comparing it with other lesions, radiographic examinations such as panoramic radiography, CBCT, and CT scan can be used.⁶

Based on some of the descriptions listed above which state that traumatic bone cyst is a rare case and to know the difference between traumatic bone cyst and similar lesions so as to avoid misdiagnosis, the authors are interested in discussing and studying the characteristics of traumatic bone cyst in radiographic image.

1.2 Problem Statement

Based on the background that has been described previously, the formulation of the problem is: what are the characteristics of traumatic bone cyst in the mandible in radiographic images?

1.3 Writing Objective

The purpose of this literature review is to find out the characteristics of traumatic bone cyst in the mandible in radiographic images.

1.4 Writing Method

The literature sources in this writing plan mainly come from online that provide journal articles in PDF format (full text) such as PubMed, Google scholar, Science Direct with the keywords: traumatic bone cyst, mandible, radiography. Journal writing is available in English and Indonesian and the information used is mainly from literature collected over the last ten years (2012-2022).

1.5 Writing Management Procedures

To manage the writing of this literature review, the steps taken are as follows:

1. Problem Identification
2. Gather information from several sources related to the topic of study
3. Conducting a Literature Review using the method of synthesizing information from the literature/journals that serve as a reference
4. Analysis of Results

1.6 Writing Benefits

The except benefits of this research are as follow:

1. Theoretical Benefits

The results are expected to serve as a guideline to increase knowledge about characteristics of traumatic bone cyst in the mandible in radiographic images.

2. Benefits for Clinicians

The results of this study can provide information and a summary of the latest knowledge for clinicians regarding the characteristics of traumatic bone cysts on radiographs, because traumatic bone cysts are cases that are not often found.

3. Benefits for Educational Institutions

Can add references to libraries and become one of the references for further writing.

4. Benefits for Writers

Can be used as input and learning materials that are useful for scientific development when making literature reviews.

CHAPTER II

LITERATURE REVIEW

2.1 Cyst

Cyst is one of the most common pathological conditions found in the mouth and jaw area. Cysts, usually referred to as follicles, are cavities surrounded by connective tissue and may or may not be lined by an epithelial layer or not and the outer layer is lined with connective tissue and blood vessels. Inside the cavity usually contains liquid or semi-fluid. Substances in the cavity cause high osmotic pressure, which leads to the growth of the cyst. It is a disease that requires prompt diagnosis and treatment because it can damage adjacent bone and soft tissue. The cyst will be painful and uncomfortable if accompanied by an acute infection, at the time of radiographic examination there will be a radiolucent appearance.^{29,7,8}

Jaw cysts are not a new lesion, in this case the mandible and maxilla are the most common anatomical locations of cysts. In some cases, the jaw cyst becomes very large and its removal causes facial asymmetry, adjacent neurovascular damage, and permanent damage to peripheral nerve function.²⁹

2.1.1 Classification of Cysts

In general, cysts can be classified into several parts because it varies greatly based on the presence or absence of the epithelium lining the cyst, which are commonly known as epithelial cysts and non-epithelial cysts. Epithelial lined cysts in bone are seen in the jaws. Apart from a few cysts that may result from

epithelial inclusions along the embryonic fusion line, most jaw cysts are lined by epithelium of odontogenic origin.^{8,28}

Epithelial cysts are divided into:

A. developmental cysts

Developmental cysts are of unknown origin, but do not appear to be the result of an inflammatory reaction. Developmental cysts are usually asymptomatic, but have the potential to become very large and cause cortical expansion and erosion. Some cysts can be aggressive, crushing the jaw or can recur frequently. Developmental cysts are divided into odontogenic cysts and non-odontogenic cysts.^{28,30}

Odontogenic cysts include:

- Gingival cyst of infant
- Odontogenic keratocyst
- Dentigerous cyst
- Eruption cyst
- Gingival cyst of adults
- Developmental lateral periodontal cyst
- Botyroid odontogenic cyst
- Glandular odontogenic cyst
- Calcifying odontogenic cyst

Non-odontogenic cysts include:

- Mildpalatal raphe cyst

- Nasopalatine duct cyst
- Nasolabial cyst

B. inflammatory cyst

Inflammatory cysts are cysts resulting from inflammation, which include:

- Radicular cyst
- Apical lateral cyst
- Residual cyst
- Paradental cyst
- Juvenile paradental cyst
- Inflammatory collateral cyst

Non-epithelial cysts are divided into:

- A. Solitary bone cyst
- B. Aneurysmal bone cyst
- C. Traumatic bone cyst

2.2 Traumatic Bone Cyst

The term Traumatic Bone Cyst (TBC) is the term most often used today. These lesions are diagnosed mostly in young patients during the second decade of life with a male predilection.⁹

In general, traumatic bone cysts are asymptomatic but pain may be present in 10-30% of patients who develop such cases. Rare clinical signs and symptoms include pain, swelling, tooth sensitivity, paresthesias, fistulas,

delayed eruption of permanent teeth, and pathological fractures of the mandibular permanent teeth.¹⁵

Based on the classification of the World Health Organization (WHO), traumatic bone cysts (Figure 2.1) are included in the group of bone-related lesions including bone lesions such as aneurysmal bone cysts, fibrous dysplasia, ossifying fibroma, central giant cell granuloma, osseous dysplasia, and cherubism.⁶



Figure 2. 1 Traumatic bone cyst pre-operative orthopantomography

(Source: Madan R, Sharma S. Balani A, Rethod, Hathgain P, Sharma M. Traumatic bone cyst of the mandible: a case report and brief review of the literature. 2018; 6(2): P.118)

2.2.2 Etiology of Traumatic Bone Cyst

The most common cause in the formation of Traumatic Bone Cyst (TB) is trauma. The mandibular symphysis region is more common than the maxilla.

Howe reported that 17%-70% of cases reported a history of trauma. Pommer revealed that trauma is the origin of intraosseous hematoma formation and destruction of adjacent bone occurs due to enzymatic activity that causes clot thawing in the blood. According to Blum and Thoma, a history of previous trauma can lead to traumatic bone cysts. Thoma explains that the trauma triggers a subperiosteal hematoma, resulting in impaired blood supply and bone resorption in the area. Apart from trauma, other theories proposed by Olech et al regarding the etiology of traumatic bone cysts:¹⁰

- Bone marrow infection
- Loss of blood supply to the hemangioma or lymphoma
- Cystic degeneration from an existing bone tumor
- Altered and decreased osteogenic activity
- Impaired calcium metabolism due to systemic disease (parathyroid disease)
- Fatty bone marrow ischemic necrosis
- Low-grade chronic infection
- Imbalance between osteoclastic and osteoblast activity due to trauma
- Developmental defects
- Failure of mesenchymal tissue to form bone and cartilage, and to become immature as a synovial cavity.

The exact etiopathogenesis of traumatic bone cyst remains unclear. The most consensual etiology among all the theories that explain the beginning of the formation of this cyst is local trauma that occurred earlier. Based on this

theory, it may be concluded that trauma causes intraosseous hematoma. The resulting blood clot activates an enzymatic response that initiates bone resorption. Although it is conceivable that microtrauma from occlusion of the teeth above the alveolar ridge could result in traumatic bone cysts.^{17, 18}

2.2.3 Histological Review of Traumatic Bone Cyst

Histology of traumatic bone cyst shows only a connective tissue membrane that lines the pathological cavity, characteristically classified as a pseudocyst. cholesterol crystals, hemorrhagic foci, and osteoclasts are also commonly encountered. Histologically this cyst is not considered a true cyst because it is covered by a thin and loose layer of connective tissue without an epithelial lining. The final diagnosis of traumatic bone cyst in almost all cases is determined at the surgical stage; Materials available from histology are generally sparse due to the difficulty of producing thin connective tissue membranes. Surgeons generally find an empty cavity, although blood or serum may be present.¹⁴

Histological examination of the traumatic bone cyst confirmed that the differential diagnosis of this cyst was a pseudocyst because of the lack of an epithelial lining and the presence of serum and blood. Odontogenic cysts, odontogenic keratocystic, ameloblastoma, odontogenic myxomas, aneurysmal bone cysts, central giant cell lesions can also be considered in the differential diagnosis of traumatic bone cyst.^{17,18}

2.2.4 Differential Diagnosis of Traumatic Bone Cyst

3.2.1.1 Odontogenic Keratocystic

Odontogenic keratocystic (KCOT) is a benign odontogenic tumor that arises from epithelial tissue. KCOT was first identified and described in 1876 and characterized by Philipsen in 1956. Pindborg and Hansen categorize histological criteria, which can be used to diagnose KCOT in 1962. Broadly speaking, KCOT originates from primordial cysts because the lesions originate from primordial teeth. In 1992, using the WHO Histological Criteria, found that KCOT belongs to the category of odontogenic tumors and named them odontogenic keratocysts (KCOT). KCOT is known for its high recurrence rate and aggressive behaviour and is associated with cancer nevoid cell syndrome.

On radiographs, both are radiation-permeable lesions located in the mandible and lesions and recurrences. On radiographs, KCOT appears as radiopaque tissue in irregular spaces, single or multiple, generally with a thin reactive scleral layer and smooth or jagged edges, invading destructive and adjacent bone (Figure 2.2).³⁶

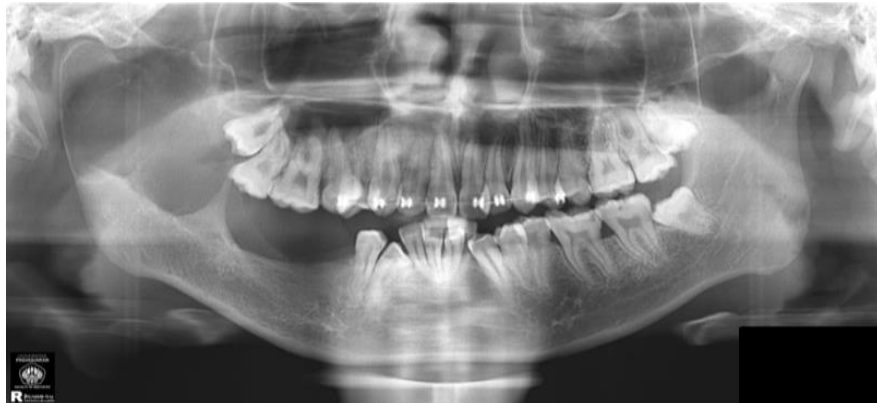


Figure 2. 2 Panoramic radiograph of the patient. It is seen that the mandibular posterior teeth disappeared after marsupialization therapy 6 years ago. A new mass was seen in the right STM area to the right mandibular ramus area

(Source: Epsilawati L, Et al. Keratocyst odontogenic tumor sebagai diagnosis banding unicystic ameloblastoma. Makassar Dent J. 2018; 7(3): 115-8)

3.2.1.2 Ameloblastoma

Ameloblastoma is an invasive neoplasm that results from the dental ridge and the debris of the enamel organ (dental epithelium). Synonyms for ameloblastoma are adamantinoma, adamant blastoma, and epithelial odontoma. Ameloblastoma is an odontogenic tumor, the most common true epithelial odontogenic tumor, but occupies only one of all tumors and cysts in the jaw. Most cases of ameloblastoma occur in the mandibular molars and mandibular region, with characteristics of aggressive but benign growth and characteristically slow but locally invasive growth. It is a locally invasive

tumor with the highest incidence reported in the ages of 30 and 40 years and is rare in childhood.

Ameloblastoma are usually radiation permeable on radiographs and are single-chambered or multi-chambered with a septum, honeycomb, soap bubble, and tennis racket pattern. In some cases, cortical plate widening and root resorption occur.

The appearance of ameloblastoma generally shows a localized cortical appearance, radiation permeable, from the molars to the ramus, and is multilocular or single-chambered and the internal structure is permeable to radiation and looks like a honeycomb or foam. Effects on the surrounding tissue cause root resorption, tooth displacement, and widening of the cortical bone (Figure 2.3). Maxillary lesions may extend to the sinuses, orbits, or skull base.³⁷

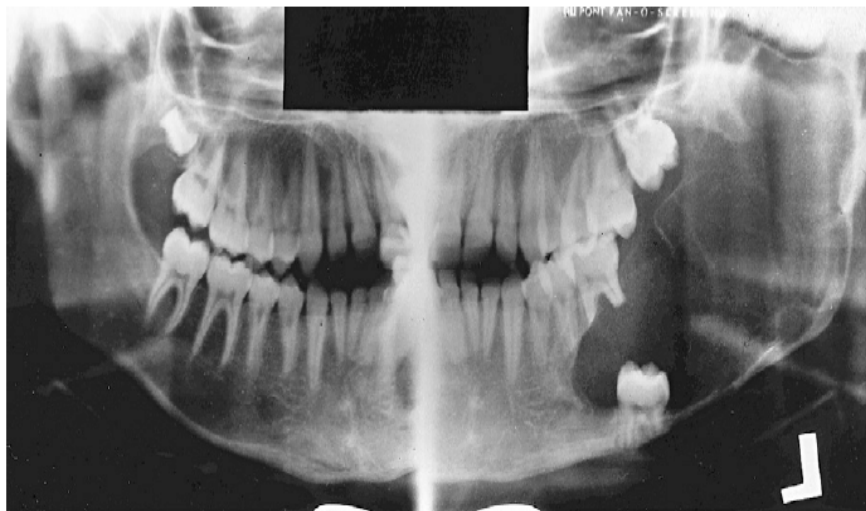


Figure 2. 3 Unicycstic ameloblastoma from occlusal to the left mandibular M2 causing mandibular and ramus expansion to the sigmoid notch and condylar

neck as well as inferior displacement of the mandibular M2 and resorption of the left lower M1 root

(Source: Ferasari AAIA, Epsilawati L, Pramanik F. Fitur radiografis ameloblastoma pada CBCT dan panoramik. J ked gigi universitas padjadjaran. 2020; 32(1): 48-50)

3.2.1.3 Odontogenic Myxoma

myxoma Odontogenic myxoma is a benign oral tumor originating from mesenchymal tissue such as dental follicles, papillae, or periodontal ligament. Clinically, odontogenic myxoma can be divided into two types: central and peripheral. Central myxoma is a bone lesion that grows slowly, compresses, and eventually invades the bony cortex. Peripheral myxoma is limited to soft tissues.

Odontogenic myxoma has a similar septum, but usually has one or two of the thin, sharp, straight septum that are characteristic of myxoma (Fig. 2.4). Myxoma is not as extensive as ameloblastoma and tends to grow along the bone. The ossified septal fibroma is usually wide, granular, indistinct, and often has a small irregular trabecular pattern.^{37,38}



Figure 2. 4 There is a soft tissue mass in the gingiva around tooth 27, without destruction of the surrounding bone

(Source: Khoiriyah A, Widastuti MG, Hasan CY. Penatalaksanaan Miksoma Odontogenik Periferal Maksila Sinistra pada Penderita Geriatri Pasca Stroke Non Hemoragik dengan Anestesi Umum. MKGK. 2015; 1(2): 127-9)

3.2.1.4 Aneurysmal Bone Cysts

Aneurysmal bone cyst (ABC) according WHO are expansive osteolytic lesions consisting of blood-filled spaces separated by connective tissue septa containing osteoid material and multinucleated giant cells. ABC is a relatively rare lesion. Most cases of ABC involve long bones such as the femur or tibia and only about 12% affect the head and neck region of which 2% occur in the jaw. The etiopathogenesis of ABC is uncertain. Several theories have been put forward such as post-traumatic, reactive malformations, genetic predisposition, local vascular tissue dilatation due to increased venous pressure caused by local circulation disorders.

Radiographically, radiolucent lesions are almost as common as mixed radiolucent-radiopaque features. Unilocular lesions (Figure 2.5) were mostly observed. Several other features such as association with impacted teeth, root resorption and alveolar bone were also observed. Ballooning expansion of the cortex was noted in two cases.³⁹



Figure 2. 5 Panoramic view showing a well-defined, unilocular radiolucent lesion with extension to the inferior border of the mandible

(Source: Urs AB, Augustine J, Chawla H. Aneurysmal Bone Cyst of the Jaws: Clinicopathological Study. J maxillofacial oral surg. 2014; 13(4): 458-60)

3.2.1.5 Central Giant Cell Lesions

Central Giant Cell Granuloma (CGCG) was first defined by Jaffe in 1953 as a giant cell granuloma of the jawbone repair. In a subsequent article, CGCG was characterized as an abnormal benign bony lesion of the mandible or maxilla, accounting for approximately 7% of all benign tumors

of the jaw. The etiology of CGCG is unknown, but the lesion is thought to be a local repair reaction of bone resulting from trauma, inflammation, or bleeding.

CGCG is found in the mandible, mainly affecting the anterior surface of the mandibular first molar. They often cross the halfway line. The clinical features of CGCG are asymptomatic, non-aggressive, slow growth, painless swelling with facial symptoms, painful cortical bone destruction, root resorption, and post-healing recurrence. This can range from aggressive lesions associated with it.

The radiographic appearance of CGCG (Fig. 2.6) was not pathological. They are usually single or multi-bundle radiopaque and clear lesions resulting in perforation and dilatation of cortical bone. Because of this radiographic appearance, CGCG should be separated from other jaw lesions. B. Brown tumor in hyperparathyroidism, fibrous dysplasia, bone cysts such as aneurysms, giant cell tumors, fibrous lesions, and other malignant tumors of the jawbone.⁴⁰



Figure 2. 6 Panoramic view of central giant cell lesions

(Source: Etoz M, Asantogrol F, Akyol R. Central giant cell granulomas of the jaws: retrospective radiographic analysis of 13 patients. Springer. 2020: 60)

2.3 Radiographic examination of Traumatic Bone Cyst

Radiography in the field of dentistry is one of the diagnostic measures that assist dentists in seeing structures that cannot be seen on clinical examination. Radiographic examination can also be used to see caries in teeth, bone damage to teeth and jawbones, as well as when a doctor detects the presence of cysts and tumors (both benign and malignant) in the mouth. Radiographic examination can not only show images of the patient's teeth, but it can also produce images of the soft tissue structures and jawbones.¹¹

On radiological examination, traumatic bone cysts generally appear as unilocular radiolucent areas with irregular borders but well demarcated with or without a sclerotic layer around the edges of the lesion.^{9,16} The characteristic

shape of a traumatic bone cyst can be seen in the posterior mandible, showing a circular shape.¹⁷

Most traumatic bone cysts are identified during routine radiographic examination. Traumatic bone cysts occur in the mandible, especially in the posterior region, usually extending from the canine region to the third molar region. Radiographic features are important for the diagnosis of traumatic bone cyst. Several imaging modalities that can be used to identify traumatic bone cysts include panoramic radiography, CBCT, CT.^{19,20,24}

2.3.1 Panoramic Radiography

Panoramic radiography (orthopantomograph) is an extraoral radiographic technique for producing a single tomographic image of the facial structures that includes the maxillary and mandibular dental arches (Figure 2.7). Although dentists may only focus on the teeth and their supporting tissues when studying panoramic radiographs, they are also required to be able to identify all other structures that appear on the image. Other visible structures such as maxillary antrum, maxillary sinus, nasal fossa, temporomandibular joint, styloid process, as well as hyoid bone in one large film. Images on panoramic radiographs are not as clear or sharp as those seen on intraoral radiographs. Therefore, panoramic radiographs should not be used solely to evaluate and diagnose caries, periodontal disease or periapical lesions because in certain circumstances, intraoral radiographs are required.^{12,31}



Figure 2. 7 Panoramic Radiography

(Source: Mallya SM, Lam EWN. White and Pharoah's Oral Radiology Principles and Interpretation. 8th Ed. St. Louis: Elsevier. 2019. P. 421)

2.3.1.1 Indications of Panoramic Radiography

Panoramic Radiography is indicated especially at the first visit of patients who refer to the dentist as a routine visit and/or special needs such as pain, aesthetic problems, etc. The following are the indications for panoramic radiographs:¹²

- As a substitute for periapical radiographs for more extensive visualization
- To evaluate the development of children's teeth and mixed dentition
- To assist and assess patients during orthodontic treatment
- To determine the location and size of lesions such as cysts, tumors, and developmental anomalies of the body and ramus of the mandible

- Prior to surgical procedures such as extraction of impacted teeth, enucleation of cysts, etc.
- To detect fractures of the face and mandible after trauma
- For follow-up treatment, pathological development or postoperative bone healing
- Examination of temporomandibular joint dysfunction
- For the evaluation of the antrum, especially to study the floor of the antrum, the posterior and anterior walls of the antrum
- Periodontal disease, as a general description of the alveolar bone.

2.3.1.2 Advantage and Disadvantages of Panoramic Radiography

Advantage of panoramic radiography¹³:

- Covers widely the facial bones and teeth
- Low radiation dose
- Easy to operate panoramic radiography technique
- Can be used in patients with trismus or in patients who cannot tolerate intraoral radiographs
- Fast and convenient radiographic technique

Disadvantage of panoramic radiography¹³:

- Low resolution figures that do not provide the fine detail that intraoral radiography can show
- Magnification across figures is unequal, making linear measurements unreliable

- Figure are superimposed of real, multiple and imaginary figures and require careful visualization to decipher anatomical and pathological details
- Requires accurate patient positioning to avoid positioning errors and artifacts
- Difficult to define both jaws when the patient has severe maxillomandibular discrepancy

2.3.2 Cone Beam Computed Tomography

Cone beam computed tomography (CBCT) also known as digital volume tomography is a complete tomography technique specially designed for the field of dental, oral and maxillofacial radiology that is capable of provides optimal tomographic images (Figure 2.8) of the bony structures of the facial skeleton. CBCT is the most significant technological advance in maxillofacial imaging since the introduction of panoramic radiography. There are currently more than 50 commercially available maxillofacial CBCT devices specifically for dentistry, offering many different unit configurations. Operation of the maxillofacial CBCT device is technically simple and similar in many respects, to digital panoramic radiography. However, the CBCT units show a large difference in the available technical parameters.¹³

2.3.2.1 Indications for Cone Beam Computed Tomography

Indications for CBCT include³²:

- Examination of unerupted teeth
- Evaluation before implant placement

- Examination of pathological lesions affecting the jaw including cysts, tumors and bone dysplasia
- Examination of facial fractures where soft tissue detail is not required
- Orthognathic surgery planning to obtain a data set of craniofacial skeleton dimensions
- Examination of the bony elements of the temporomandibular joint
- Examination of the maxillary antrum bone wall

2.3.2.2 Advantages and Disadvantages of CBCT

Advantages CBCT include³²:

- Data manipulation allows anatomical/pathological conditions to be viewed in different planes
- Lower radiation dose than medical CT
- Geometrically accurate figures
- Excellent spatial resolution
- Fast scan time

Disadvantages CBCT include³²:

- The patient must remain still during the scan to avoid movement artifacts
- Equipment costs tend to be high
- Higher radiation dose than conventional radiography

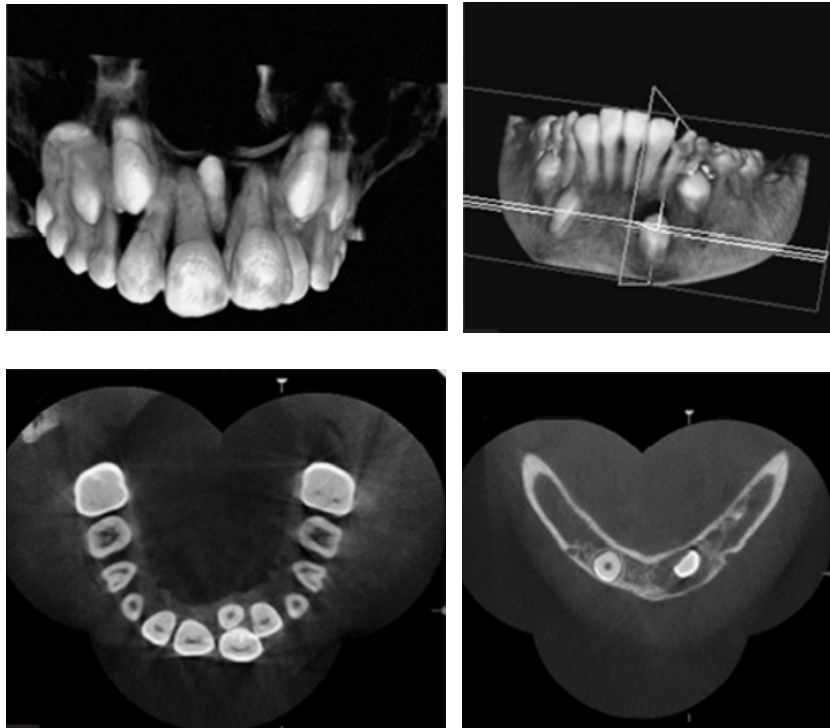


Figure 2. 8 Cone beam computed tomography

(Source: Karjodkar FR. Essentials of Oral & Maxillofacial Radiology. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 2014. P. 169)

2.3.3 Computed Tomography

Computed tomography (CT) is a fast, widely available and relatively inexpensive method of imaging the face and neck. CT is an imaging technique using ionizing radiation. The patient is in the supine position in the gantry, with the head in the supine position, so that the hard palate is perpendicular, on X-ray. This will provide excellent 2D and 3D reconstruction (Fig. 2.9), eliminating the need for a coronal scan with the patient in an uncomfortable prone position. Computed tomography (CT) is a form of radiography in which a pencil or fan shaped X-ray is directed at the patient from various angles. On the computer,

the signal is processed by a reconstruction algorithm to produce an anatomical image of the patient.³¹

2.3.3.1 Indication Computed Tomography

Indications CT scan include²⁸:

- Intracranial disease and trauma: To investigate intracranial diseases including tumors, hemorrhages, and infarctions
- Jaw malignancies: Helps in figuring the boundaries of tumors and cysts
- Infection: To assess the degree of infection in the maxillofacial area
- Salivary glands: Investigation of tumors, salivary stones and swelling
- Temporomandibular joint: Assists in the examination of the TMJ
- Implants: CT is useful in patients prior to endosseous implant placement, used to evaluate alveolar bone height
- Fractures: CT is very useful in identifying facial fractures, especially the assessment of middle facial injuries
- Foreign bodies: Foreign bodies can be easily detected due to the difference in density

2.3.3.2 Advantages and Disadvantages of Computed Tomography

Advantages of CT scan include³²:

- The structural relationship of hard and soft tissues can be observed directly
- Accurate linear and volumetric measurements can be made
- Eliminates superimposition of structure figures outside the desired area

Disadvantages of CT scan include³²:

- Since the measurements or pixels that make up the figure represent separate subdivisions of space, the effect of blurring is much greater than in conventional radiographic systems
- Detailed CT scan figures are not as smooth as those obtained on other radiographs
- Metallic objects such as patches produce scribble artifacts marked on CT figures
- The equipment is very expensive



Figure 2. 9 Computed tomography

(Source: Mallya SM, Lam EWN. White and Pharoah's Oral Radiology Principles and Interpretation. 8th Ed. St. Louis: Elsevier. 2019. P. 654)