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The effectivity of Cone Beam Computed Tomography (CBCT) in dentigerous cyst management: a literature review

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ABSTRACT

Objectives: This review aims to understand the effectiveness of Cone Beam Computed Tomography (CBCT) in the management of dentigerous cysts by looking at the advantages and disadvantages based on the quality of the resulting radiographic images.

Review: Based on the literature review that has been carried out on 10 journals were eliminated from 22 journals that had the criteria according to the topic but there was a duplication in the identification results of the initial 50 journals from Pubmed, Google Scholar, ScienceDirect, and EuropePMC, with a range of 2012-2022 using the Boolean Operator Strategy with inclusion criteria developed from PICOS framework, it was found that the CBCT radiographic method is the most widely used method in the management of dentigerous cysts because of the predominance of advantages over disadvantages. This radiographic method is able to produce three-dimensional radiographic images without overlapping structures, distortions, and amplifications at a low cost, although it has weaknesses.

Conclusion: CBCT 3D may assess dentigerous cyst lesions effectively by taking into account several considerations and the accuracy of the SOP in its use. This radiography method can provide clear radiographic images without structural overlap, distortion, and amplification at a low cost to confirm the diagnosis and determine the appropriate treatment plan despite the drawbacks as a new result of development technologies in dental radiography.

Keywords: *Dentigerous cyst, odontogenic cyst, radiographs, cone beam computed tomography*
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INTRODUCTION

Cyst is a pathological condition that refers to an abnormal lump on the underside of the skin that contains fluid, air, pus, to a substance such as hair. Cysts can be classified into three main groups which include cysts of the jaw, maxillary antrum, and soft tissues of the face, and neck.[19] Fluid that fills pathological cavities in bone can be of odontogenic or non odontogenic origin. Non odontogenic sources may be respiratory epithelium or epithelial remnants from tissue fusion processes. The growth of these cysts occurs due to the presence of epithelial remnants in large quantities in the gingiva on unerupted teeth so that they are at risk of developing into an abnormal condition in the form of cysts.

Odontogenic cysts are located in the mesial 75% of the first molar which can occur in the incisor and canine area. The margins vary, ranging from well-defined and corticated, to indistinct and irregular. The most common type of odontogenic cyst experienced by patients is dentigerous cyst. Dentigerous cyst is forms from the remnants of organ enamel that is still on top of the tooth crown that have finished and surrounds it. Dentigerous cysts usually develop on the crowns of unerupted teeth in the maxillofacial region. The prevalence shows that from 18,297 cases of odontogenic cysts affecting the community, Based on a study of the development of odontogenic cysts of the jaw in 245 cases over 10 years, Developmental odontogenic cysts occurred in 97 cases including: 44% dentigerous cysts, 36% odontogenic keratocysts, 9% primordial cysts, 2% gorlin cysts, 3% lateral periodontal cysts, 3% eruptive cysts, and 3% gingival cysts affect 1% of infants and 2% of adults.[26]

Called an odontogenic cyst because the epithelium that overlies it is called the odontogenic epithelium. This epithelial wall comes from the remnants of tooth-forming organs that are able to proliferate and have the potential to become tumors. Odontogenic in this term refers to infections affecting the teeth. The dentigerous type of odontogenic cyst often involves the third molars and second premolar of the mandibular and the maxillary molars and canines. This case often occurs in children and adolescents with mixed dentition. Then based on a study, it occurs more in white

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people than black people. If we look at gender, men have a higher number of cases than women. Although these cysts occur in unerupted teeth, they are rarely found in deciduous teeth.[10]

The development of science and technology in this digital era encourages the development of dental equipment, including in radiology. As a result, the CBCT X-ray technique has emerged with various advantages that are currently widely used, especially in dento-maxillofacial imaging, including in the case of dentigerous cysts. The effectiveness of using this X-ray method can be seen from the analysis of its advantages and disadvantages. According to Kıvanc Kamburoglu (2015), in the World Journal of Radiology, the advantages of CBCT compared to other medical CT, include the use of a lower effective radiation dose, low cost, less space required, easier image acquisition, interactive displays such as reconstruction, and multiplanar approach that can be applied to maxillofacial imaging. Apart from these advantages, CBCT also has disadvantages in its application to X-ray patients, ranging from the use of higher doses than the use of two-dimensional X-rays, its accuracy in the radiographic image of internal structure and lesions in soft tissue are still weak. These weaknesses include image noise and bad soft tissue contrast. Image noise can occur because the photo undergoes Compton interactions and produces scattered radiation. The contrast of the subject is reduced by X-ray photons through the addition of a background signal that is not representative of the anatomy and reduces image quality. Apart from that, the CBCT unit has little soft tissue contrast, and there are various image artifacts in the metal restoration.

Based on that, a literature study on the effectiveness of using CBCT is important in optimizing the results of radiographic images in dental practice, so as to determine the right diagnosis and treatment plan. The literature review entitled "The Effectivity of Cone Beam Computed Tomography (CBCT) in Dentigerous Cyst Management: A Literature Review" is summarized based on the results of data searches from Pubmed, Google Scholar, ScienceDirect, and EuropePMC, with a range of 2012-2022. Article searches were carried out using a Boolean Operator Strategy to get specific and structured results with the main keywords "Dentigerous Cyst" and/or "CBCT (Cone Beam Computed Tomography)". Inclusion criteria were developed using the PICOS framework. A total of 50 journals were obtained during research and 22 journals with titles that matched the criteria. Duplicate journals are eliminated so that the remaining 10 main reference journals are included in the bibliography. The outcome that makes the effectiveness of using CBCT in radiographic examination carried out in each case is by looking at the quality of the radiographic image using several indicators, such as density, contrast, sharpness, and detail.

REVIEW

ODONTOGENIC CYST

Common people think that cysts and tumors are the same thing, but they are not. Indeed, basically these two conditions are either tumors or cysts that originate from the remnants of the tissue of the tooth-forming apparatus or the remnants of inflammation. However, in contrast to tumors in cysts, which may or may not be covered by epithelium. According to the World Health Organization (WHO), cysts can be categorized into two, namely odontogenic and non-odontogenic cysts.[4]

Odontogenic cysts are commonly found in dental practice. WHO classifies odontogenic cysts into two types based on their pathogenesis, inflammatory cysts including radicular cysts and developmental cysts including dentigerous cysts and keratocysts. This type of cyst has a tendency to expand and shows slow growth. Biologically, these cysts are benign, but if not diagnosed and treated on time, they can reach large sizes.[23] Radiographs as a form of supporting examination in an effort to establish the diagnosis of odontogenic cysts show unilocular or multilocular radiolucent lesions with clear boundaries.[16]

DENTIGEROUS CYST

Dentigerous cysts is an odontogenic cyst that generally occurs by partial eruption, expansion, or impaction. These cysts are generally formed from the remnants of the enamel organ that is still on the crown of the tooth by surrounding the crown. It is asymptomatic in the jaw, unless the cyst is inflamed to the point of swelling, CEJ of the tooth is attached by the lower end of the cyst, potentially blocking the eruption of the tooth, and it can increase the size of the dental follicle. If the size of this cyst is very large, it can absorb the roots of other teeth next to it and can also turn into a neoplasm (ameloblastoma). Of all possible cysts that can affect the jaw in general, 24% of them are this type of cyst. A dentigerous cyst is defined as the development of an odontogenic epithelial layer due to the accumulation of reduced enamel epithelium fluid and an unerupted tooth crown. This group of cysts often occurs in children, especially in the first and third decades of life.[1]

When viewed based on size, there are differences in methods and results of radiographic images of large and small cysts. Radiographically, the presence of a dentigerous cyst is characterized by a well-defined and corticated, multilocular radiolucent area indicating the presence of multilocular dentigerous, pericoronal radiolucency and crowns of unerupted teeth with sclerotic margins around them starting at the cervical margins. If there are cases with small cysts, routine radiographic examinations may be performed to determine the cause of failed tooth eruption, which may be asymptomatic or asymptomatic. Meanwhile, for large cysts, there is persistence of trabecular bone so that it looks radiolucent and multilocular.[10]

DENTIGEROUS CYST ETIOLOGY

Dentigerous cysts are lined by odontogenic epithelium consisting of the Epithelial Cell Rest of Serres, the Epithelial Cell Rest of Malassez (ERM), and the Reduced Enamel Epithelium (REE). The developing tooth crown is surrounded by REE. In the sixth week of embryonic development, the degenerating remnants of the dental lamina carry out the formation of teeth which become the remains of Serres Epithelial Cells. Root formation is initiated by ERM in the form of residual cells resulting from the disintegration of Hertwig's epithelial root sheath. Then, these remnants accumulate as a whole and are trapped in the alveolar bone and the maxillary and mandibular gingiva. The appearance of dentigerous cysts begins with a developmental process that can widen the dental follicle due to fluid buildup between the tooth crown and the enamel epithelium. This in turn can inhibit tooth eruption.[16]

Attachment of the dentigerous cyst to the neck of the tooth and at the same time the expansion of the follicle to cover the crown of an unerupted tooth is due to the reduction of the enamel epithelium after amelogenesis. This is what then encourages the accumulation of fluid between the tooth and the epithelium. This case reaches 1.44 in every 100 teeth that do not erupt affecting more men than women. The teeth that commonly become attachments for dentigerous cysts are the third molars, first and second premolars, and canines.[20]

DENTIGEROUS CYST CLASSIFICATION

If we look at it in a broader scope, the dentigerous cyst is one part of the classification of developmental cysts as part of odontogenic cysts. Odontogenic cysts are divided into some types based on ICD 10 (K09.0, these are dentigerous, eruption, follicular, gingival, lateral periodontal, and primordial cyst.[16]

According to Pell and Gregory Classification, the classification of dentigerous cysts can be determined based on several differentiating grounds, including:

Relationship of Mandibular Third Molar with Mandibular Ramus and Second Molar: (i) Class I: the crown of the third molar with a certain mesiodistal diameter can be accommodated by the available space; (ii) Class II: the distal side and ramus of the second molar are spaced less than the mesiodistal diameter of the third molar; and (iii) Class III: All three are dominantly located on the ramus.

Relative Depth of Third Molar in Bone: (i) Position A: the highest part of the tooth is aligned to the occlusal line; (ii) Position B: the highest part of the tooth is above the cervical line of the second molar in the below the occlusal plane; and (iii) Position C: The highest part of the tooth lies below the cervical line of the inner second molar and is adjacent to the long axis of the impacted second molar.

In addition, dentigerous cysts can also be distinguished based on their radiological features which include: (i) Central: this central type is characterized by several characteristics, including a symmetrically encased crown, the tooth often moves apically due to pressure from the cystic contents, and the third mandible can be pushed toward the boundary or into the ramus; (ii) Lateral: usually seen in partially erupted teeth and dilated follicles seen on one side; and (iii) Circumferential Type: the entire tooth was pinched by the cyst.[26]

DENTIGEROUS CYST MANAGEMENT

The treatment commonly used in cases of dentigerous cysts is tooth extraction associated with curettage and enucleation. This treatment method in dentistry has been included in the surgical method. Literally, enucleation is defined as an action taken to completely remove one organ of the human body which in this case is a cyst. Then curettage, which is commonly known as a curette, can be interpreted as an organ wall to remove tissues remaining from physiological processes that occur in the body.[3]

This enucleation is applied to the connective tissue capsule and the epithelial layer as a whole. If this is not done properly according to the procedure, it can leave an epithelial layer that is at risk of causing residual cysts to form more invasively. This process begins with a gingival sulcus incision in the form of triangular or trapezoidal. After elevation of the mucoperiosteal flap, an anterior vertical side is provided for optimal visualization. The use of scissors for sharp dissection was performed superficially to separate the mucoperiosteal flap from the cyst wall with undiminished integrity. The cyst is enucleated and sent to the pathology department during surgery. The curettage process is closely related to the treatment of the bone cavity. In this procedure, the cyst is completely scraped off, then left in the cavity with normal saline and the cavity gently aspirated using a plunger at 3000r/min. Next, the residual defect left by the cystic lesion is filled with xenograft bone immersed in sterile normal saline and covered with an absorbable collagen membrane.[6]

DENTIGEROUS CYST PROGNOSIS

Based on the discussion in the previous point that dentigerous cysts can be removed by enucleation, if there are several teeth that are interconnected with the cyst, then tooth extraction is carried out followed by treatment or orthodontics. For cysts with a larger size, marsupialization can be done because there is a high possibility of damage to nerves and blood vessels in the teeth and the surrounding anatomical structures. Marsupialization of the cyst or exteriorization that promotes decompression or reduction of air pressure and difference in the lesion, thereby reducing the area to be operated on. This shows a good prognosis for dentigerous cysts without treatment, especially if the cyst treatment process is carried out according to the procedure.[11]

DIAGNOSIS OF DENTIGEROUS CYST BY RADIOGRAPHY

Dentigerous cysts are usually associated with delayed eruption or partial eruption which is often known as the occurrence of impacted teeth. Evaluations carried out by radiography are generally asymptomatic unless inflammation is present. The radiograph was well demarcated and showed a corticated unilocular radiolucency at the cementoenamel junction of the tooth, as well as looks similar to ameloblastoma. More severe cysts act aggressively until movement is characterized by radiolucency exceeding 4 mm.[16]

The radiographic appearance is derived from the development of cysts caused by the accumulation of fluid between the epithelial layers and tooth enamel resulting in the widening of the follicles, which in turn can inhibit the eruption of the teeth. Histologically, dentigerous cysts have a non-keratinized stratified squamous epithelium lining the rete ridges. Apart from that it also shows ciliated mucus and sebaceous cells. Radiographically, these dentigerous cysts can be identified at the coronal epicenter of the tooth, usually the maxillary third molars or canines. The margins surrounding the teeth are well demarcated and corticated (radiopaque line), starting at the cementoenamel junction with internal structures that appear radiolucent. The occurrence of dentigerous cysts also has a tendency to affect the surrounding tissue which is characterized by displacement and resorption of neighboring teeth, as well as compression of the nerves.[16]

RADIOGRAPHIC IMAGE QUALITY INDICATORS

Lesions/diseases in the oral cavity have a wide variety and high complexity. Several studies show consistency and conformity in the reading and interpretation of radiographic images between 60-70%. An important factor in interpreting the radiographic appearance of lesions in the oral cavity including dentigerous cysts is the development of these lesions. This results in changes in the bone structure that give the radiograph certain characteristics. Radiolucent images will be shown from disease conditions that deform normal trabecular architecture in bone, while radiopaque images are obtained from lesions that produce calcified material.[25]

Radiographic interpretation can be done only if the resulting radiographic image is of good quality as seen from several indicators. The first indicator is a visual characteristic which includes detail, contrast, and density, then the next indicator is a geometric characteristic consisting of magnification/unsharpness and distortion. The main factors that play an important role in determining image quality are contrast, blur, noise, artifacts, and distortion. Contrast refers to the difference in density in a radiographic image that makes objects visible and facilitates differentiation between adjacent organs and tissues. Image contrast sensitivity is the level of contrast used to visualize a particular object. An imaging system with very low sensitivity will detect objects that contrast only and the opposite. The effect of blurring or burs on the radiographic image will limit the operator's search for minor pathologies that may decrease the significance of the diagnosis. Noise gives a grainy appearance to the radiographic image giving random variations in image brightness. Next are artifacts which are image features that do exist but do not appear due to abnormalities of the imaging modality. The last is distortion which refers to interpretation factors or inaccuracies in the structure of the radiographed target.[13]

The use of CBCT radiographs can produce precise images for interpretation. This is supported by several things related to this radiographic method, including being able to produce a higher radiation dose compared to other radiographic methods. Currently, the use of conventional CT is limited in dentistry. This occurs for several reasons, including poor resolution, longer scan times, and difficulty in interpretation. Some of these problems can be solved by the use of CBCT which can provide a number of potential advantages for oral & maxillofacial imaging.[28]

CONE BEAM COMPUTED TOMOGRAPHY

Cone Beam Computed Tomography (CBCT) is a radiographic imaging system that enables significant and accurate Three-Dimensional (3D) imaging. It is characterized by its ability to produce sub-millimetre (2-line pairs/mm) resolution radiographs with a short scan time (60 seconds), but with high diagnostic quality. The radiation exposure dose of CBCT is 10 times smaller than that of conventional CT scan during maxillofacial exposure (68 µSv compared to 600 µSv Conventional CT) accompanied by a large dimensional accuracy of 2% magnification.[21]

The CBCT machine uses a conical beam and a solid-state panel detector that rotates 180-360 degrees around the patient, covering a defined anatomical volume (complete tooth/maxillofacial volume) compared to section-by-section imaging on conventional CT. This single scan will capture data unlike stacked axial sections on CT, further reducing the absorbed X-ray dose compared to CT from 6 to 15.[28]

THE EFFECTIVITY OF CONE BEAM COMPUTED TOMOGRAPHY (CBCT) IN DENTIGEROUS CYST MANAGEMENT

Radiographic evaluation is a crucial diagnostic procedure in dental practice. This is done by operators for several purposes, including:

(i) Detects the extent of a large lesion; (ii) Anatomical relationships; (iiii) Assess the periphery of the lesion to confirm the presence of infiltrative growths suggestive of aggressive development.

These three things are important points in diagnosing dentigerous cysts on radiographic examination.[27]

The use of CBCT is considered effective in radiographic examination in this case of dentigerous cysts if carried out with the right procedure. If there are operator actions outside the established procedure, it will certainly pose a risk to

the quality of the resulting radiographic image. Good quality results from CBCT as part of high-resolution three-dimensional imaging in a lower dose than conventional multi-detector CT. The CBCT examination dose is between 30-1073 Sv for the large-field craniofacial view and the small-field dentoalveolar view which requires a dose of 11-674 Sv. In this case, the radiation dose received from conventional radiography is significantly better. Therefore, some considerations are needed before using CBCT radiology in supporting the diagnosis of dentigerous cysts.[2]

DISCUSSION

Dentigerous cyst are cystic lesions classified as odontogenic cysts that develop on the crowns of unerupted teeth in the maxillofacial region. Dentigerous cysts usually affect the mandibular

Table 1. Studies on dentigerous cyst management with CBCT 3D

Author's (Year)	Subject	Case (X-Ray)	Findings
Stieger-Vanegas and Hanna (2022)	The Role of Computed Tomography in Imaging Non-neurologic Disorders of the Head in Equine Patients (EuropePMC)	Non-neurologic Disorders (CT)	Radiographic examination is carried out using a CT scan which includes Multidetector Computed Tomography (MDCT) and Computed Beam Computed Tomography (CBCT). Both radiographs were of good quality, but MDCT showed greater accuracy than CBCT. This is due to artifacts, scattering level radiation, and lack of Hounsfield calibration.
Bergamini et al. (2021)	Unusual Multiple Dentigerous Cysts Evaluated by Cone Beam Computed Tomography, A Case Report on Non-Syndromic Patient (ScienceDirect)	Dentigerous Cysts (CBCT)	The imaging images produced by CBCT in this case can assist the dentist in diagnosing the patient. A comprehensive preoperative evaluation with an appropriate surgical approach selected based on radiographic results is required in the management of dentigerous cyst cases. Computed tomography on CBCT can demonstrate unilocular radiolucent lesions associated with unerupted teeth with well-defined sclerotic margins and accurately demonstrate the cystic nature of the lesions.
Prabhusankar et al. (2014)	CBCT Cyst Lesions Diagnosis Imaging Mandible Maxilla (Google Scholar)	Cyst Lesions (CBCT)	CBCT radiography provides advantages and benefits in both preoperative and postoperative dental evaluation with some challenges that may be experienced in its use. The claim will not completely fully record the super-inferior and mesiodistal of the lesion. However, multiplanar sections that include axial, coronal, and also sagittal sections are required if the cyst is located deep inside. Meanwhile, post-surgery CBCT can help provide a radiographic picture in case of recurrence. This is due to the imposition of a large network volume, image accuracy, and the absence of image distortion. The main challenge in its use is that most professional dentists are not familiar with this tool, which is a new technological development with the concept of multiplanar imaging.
Deana and Alves (2017)	Cone Beam CT in Diagnosis and Surgical Planning Dentigerous Cyst (Google Scholar)	Dentigerous Cyst (CBCT)	CBCT was finally chosen in this radiographic examination after several considerations compared to other radiographic methods although it still has some drawbacks. CBCT supports in-depth observations of a defined area, eliminating the overlap that is one of the main limitations of X-rays, radiation emission and cost, and a high degree of accuracy. However, this CBCT is not indicated for soft tissue analysis. Lack of CBCT is equipped with Magnetic Resonance Imaging (MRI) which can accurately distinguish odontogenic cysts, keratocystic odontogenic tumors, and ameloblastomas. The high quality of these MRI radiographs is accompanied by an increase in cost and therefore a higher price.
Mamatha et al. (2014)	Diagnostic CBCT in Dentigerous Cyst with Ectopic Third Molar in the Maxillary Sinus, A Case Report (Google Scholar)	Dentigerous Cyst (CBCT)	The cyst in this case report involved the maxillary sinus in which the role of CBCT is very important in this case to demarcate the hard tissue from the involved soft tissue. This is supported by the provision of multiplanar reforms with volume reconstruction and 3D images with low radiation doses. This radiographic method allows the surgeon to assess the extent of the lesion, its proximity to vital organs adjacent to these structures, and to visualize complete obliteration of the left maxillary sinus and elevated left orbital floor. In addition, even after surgery, CBCT can be useful due to its ability to visualize endosteal changes during healing at the surgical site.

(Cont.) Table 1. Studies on dentigerous cyst management with CBCT 3D

Author's (Year)	Subject	Case (X-Ray)	Findings
Cardoso et al. (2020)	Study Between Panoramic Radiography and Cone Beam-Computed Tomography in the Diagnosis of Ameloblastoma, odontogenic Keratocyst, and Dentigerous Cyst (PubMed)	Ameloblastoma, Odontogenic Keratocyst, and Dentigerous Cyst (Panoramic Radiography and CBCT)	CBCT has several advantages in its use when compared to panoramic radiography, CBCT allows visualization of three-dimensional images and the absence of overlapping structures, distortions, and amplifications. Nonetheless, panoramic radiography remains the main radiographic method in these cases due to the lack of studies related to the characteristic features of CBCT radiographs in the diagnosis especially to differentiate non-mineralized odontogenic lesions, ameloblastomas, odontogenic keratocysts, and dentigerous cysts.
Mahesh et al. (2017)	Role of Cone Beam Computed Tomography in Evaluation of Radicular Cyst Mimicking Dentigerous Cyst in a 7 Year Old Child, A Case Report and Literature Review (PubMed)	Radicular Cyst Mimicking Dentigerous Cyst (CBCT)	Besides being important in diagnosing dentigerous cysts, the CBCT radiography method is also useful for diagnosing radicular cysts, especially in this case located on the teeth on the maxillary primary central incisor because it generally occurs in secondary teeth. Compared to conventional radiographic methods that can provide two-dimensional radiographic images, CBCT can provide three-dimensional radiographic images from the sagittal, coronal, to axial directions without any overlap or deformation.
Dave et al. (2020)	The Use of Localized CBCT to Image Inflammatory Collateral Cysts- A Retrospective Case Series Demonstrating Clinical and Radiographic Features (PubMed)	Inflammatory Collateral Cysts (CBCT)	Occlusal radiography was tried in an effort to support the diagnosis in this case, but it has some shortcomings that can be complemented by the CBCT radiography method. The previously produced occlusal radiographs were inadequate and the images were not well exposed. On the other hand, the radiographic image produced by CBCT had good radiolucency above the LR6 furcation with a large (11.5 x 11.5 x 10.5 mm) radiolucent lesion with buccal expansion.
James R Allison and Grace Garlington (2017)	The Value of Cone Beam Computed Tomography in the Management of Dentigerous Cysts, A Review and Case Report (PubMed)	Dentigerous Cysts (CBCT)	Dentigerous Cyst treatment plan can be implemented if it has gone through several considerations with the benefits provided outweigh the risks. In determining the treatment plan, it is also necessary to have clear radiographic results for communication with patients regarding the risks of treatment that may be experienced. In this case, compared to radiographic techniques, CBCT can provide a three-dimensional radiographic image that can make it easier for the dentist to interpret the radiographic results as well as determine the appropriate treatment plan for the patient.
Vidya et al. (2013)	Cone-Beam Computed Tomography in the Management of Dentigerous Cyst of the Jaws, A Report of Two Cases (PubMed)	Dentigerous Cyst (CBCT)	Utilization of CBCT radiographs in odontogenic lesions including these dentigerous cysts, volumetric rendering of the radiographic images allows a better understanding of localization, cortical damage, and relationships to surrounding anatomic structures. In this case, CBCT can provide information about the margins and interior lesions in which an inflammatory impacted tooth is found.

third premolars, and maxillary canines which are lined by odontic epithelium consisting of the Epithelial Cell Rest of Serres, Epithelial Cell Rest of Malassez (ERM), and Reduced Enamel Epithelium (REE). Based on the results of 18 case studies related to dentigerous cysts, 33% of cases occurred in the maxilla and 67% in the mandible. Mandibular molars were the most common location for dentigerous cysts, especially in the third molars, then on the right side of the jaw 67% of cases were found and 33% of cases were found on the left side of the jaw. There was displacement of the involved tooth in 67%, dentigerous cyst surrounding the crown in 44% (lateral variety), and 56% surrounding the crown of the tooth (central variety).[29]

In establishing the diagnosis of dentigerous cysts, one of the examinations carried out is a supporting examination in the form of radiographs. The development of science and technology in the field of dentistry has encouraged the development of tools and methods of dental practice, as well as radiography to produce two to three-dimensional images. In the radiographic examination of dentigerous cysts, a radiographic method is needed that can provide a three-dimensional image to be able to confirm the diagnosis and determine an appropriate treatment plan in this case. There are several three-dimensional radiographic methods, including Computed Tomography (CT), Cone Beam Computed Tomography (CBCT), Micro Computed Tomography (MCT), 3D Laser Scanning, Structured Light Technique, Stereophotogrammetry, 3D Facial Morphometry (3DFM), Tuned-Aperture Computed Tomography (TACT), and Magnetic Resonance

Imaging (MRI). Of all the 3D radiography methods, the most commonly used is the CBCT radiography method due to the advantages it provides to produce high-quality radiographic images.[15]

There are several advantages to using CBCT as a radiographic method, including: (i) Small size with lower cost compared to other computerized tomography, as well as maintenance costs. Image processing is also easier because it is limited to the head and face; (ii) Radiation dose limitation. Based on one study, CBCT devices are capable of emitting up to 98% less radiation with an average radiation dose of 36.9-50.3 micro-sievert (μSv); (iii) Scans are performed quickly. Scanning with CBCT can be done in one round, with a shorter time the patient's hospitalization can be reduced; (iv) Its dimensional reconstruction feature makes it possible to display and organize 3D data on a personal computer; (v) The drawings contain a comprehensive range of software that can be used for implant placement and orthodontic measurements.[15]

Apart from these advantages, the CBCT radiographic method also has several disadvantages, including: (i) Poor image quality if metal brackets and restorations are present on the teeth; (ii) The object's actual particular authentic skin color can't know; (iii) Unexpected patient mobility causes image distortion; (iv) Require more space and more expensive than conventional X-ray devices; (v) Image monitoring is disrupted due to radiation scattering.[15]

According to Cardoso (2020), the study offered suggests that there are several characteristics of the radiographic image produced through CBCT, including: (i) Location: if posterior to distal or in the area of the lower first molar becomes the center of the lesion, it is 1, while it is located in another area of the mandible, it is 0; (ii) Size: multiplanar reconstruction consisting of axial, coronal, and sagittal with showing their maximum extension was measured to get the largest diameter. (iii) Number of loci: multilocular lesion worth 1 and unilocular lesion worth 0; (iv) Bone Expansion: Mandibular lingual vestibular width as measured in axial reconstruction showing the greatest expansion lesion. In addition the calculation of the buccal-lingual width ratio was carried out from the affected side to the opposite side; (v) Cortical Bone Resorption: the value is 0 if the cortical bone appears intact, if it appears continuously the value is 1; (vi) Hyperdense area: presence or absence of high density in the intralesional area are identified. If there is a lesion in the hyperdense area, it is 1, but if it is not, it is 0; (vii) Tooth resorption: if the lesion shows root reabsorption close to 1, but otherwise it is 0; (viii) Impacted tooth: if the crown of the impacted tooth is not affected by the lesion, it is 0, but if it affects the crown of the impacted tooth, it is 1.[7]

Based on the analysis of ten literatures from the results in the form of case reports with cases of dentigerous cysts, it was shown that things were not much different regarding the advantages, disadvantages, and characteristics of the CBCT radiographic method in these ten cases. However, related to image quality, the main advantage of the CBCT radiography method is the ability to produce three-dimensional radiographic images without overlapping structures, distortion, and amplification at a low cost. While the main disadvantage is that it is one part of the development of science and technology in dental results so that there is not much literature that discusses the characteristics of the results of this CBCT radiography. So that the reference that can be used as a reference by dentists in carrying out this action is quite minimal.

CONCLUSION

CBCT 3D, as one of the science and technology development results in the field of radiology needs to be paid more attention and caution in its use by considering its advantages and disadvantages for optimal use. Its presence also provides many benefits from the results of a clear radiographic image without overlapping structures, distortion, and amplification at a low cost. So it is effectively used in the management of dentigerous cysts regardless of the drawbacks.

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FOOTNOTES

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