CASE REPORT

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Imaging analysis 3D cone-beam computed tomography of a suspected infected radicular cyst in the mandible

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ABSTRACT

Objectives: This article is aimed to report the use of cone-beam computed tomography (CBCT) imaging analysis on a radiolucent lesion case.

Case Report: A 24-year-old female patient was referred to dentomaxillofacial radiology installation, at Universitas Padjadjaran Dental Hospital for a CBCT examination of a lower jaw lesion. The CBCT result demonstrated a large radiolucent lesion at the periapical of tooth 37 with a mostly diffuse border that extended posteriorly to the ramus. There was a cortical thinning on the lingual side alveolar bone. Density analysis revealed an average density of –22,9 grayscale.

Conclusion: CBCT 3D could analyze lesions from qualitative and quantitative approaches. Based on these approaches, the lesion of this case led to a suspect of infected radicular cyst.

Keywords: *Image analysis, periapical lesion, infected cyst, cone-beam computed tomography*

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INTRODUCTION

In dentistry, radiographic evaluation is crucial for diagnosis and treatment planning. The specific inherent limits of 2D imaging (such as magnification, distortion, and superimposition) combined with the compression of the three-dimensional anatomy of the area being radiographed into a two-dimensional image cause misrepresentation of structures. Three-dimensional imaging (3D) developed in response to the requirements of sophisticated technologies in the delivery of therapy and was instrumental in the development of novel treatment modalities.[1]

CBCT 3D machine utilizes a cone-shaped beam and a reciprocating solid-state flat panel detector that rotates once around the patient 180–360 degrees, covering the defined anatomical. Due to its benefits, such as reduced patient radiation exposure, ease of access, higher image quality than medical CT, and cheaper cost, CBCT has gained popularity in the last 10 years as a substitute for medical CT in the imaging of hard tissue disorders in the craniofacial region. CBCT can yield 3D pictures that are helpful in many oral and maxillofacial conditions. These images can aid in the diagnosis and assessment of disease severity, the planning and administration of treatment, and follow-up procedures.[2]

The radicular cyst, which is a real cyst, is the most common odontogenic cystic lesion of inflammatory origin (60 %). Its cystic lining is made out of Malassez's leftover cells. It happens as a result of pulpal necrosis brought on by periodontal disease, trauma, or cavities. Except when secondary to infection, radicular cysts are slow to develop and asymptomatic. Although it can also be found on the lateral aspects of roots in relation to lateral accessory root canals, the radicular cyst is typically located in the apices of teeth that are affected. It primarily affects men and has a higher incidence in the third and fourth decades of life. Radicular cysts can develop in any of the jaw's tooth-bearing regions, but they are more common in the maxillary anterior region than in the mandibular region. Radicular cysts that are infected can grow and result in the resorption of bone.[3]

Histologically, radicular cysts can be divided into two subtypes there are apical true cysts and apical pocket cysts. Real radicular cysts are entirely encircled by epithelium, which is thought to have the ability to promote growth. The epithelium that surrounds periapical pocket cysts is exposed to the root canal, effectively treating a micro abscess that resembles a pocket. These cysts ongoing expansion results in a sluggish yet persistent surrounding bone has been destroyed.[4]

Radicular cyst radiographs which are two-dimensional, show unilocular round, pear-shaped, or ovoid are the most common kinds. radiolucency associated with the periapex of the offending tooth, outlined by a narrow radiopaque margin. The cyst may displace adjacent teeth or cause mild resorption.[5]

The availability of a non-invasive and reliable in-vivo technique in the differential diagnosis of apical granuloma and radicular cysts provide significant clinical advantages. The effectiveness of non-invasive approaches in the differential diagnosis of apical cysts and granulomas has been the subject of numerous recent research. These methods comprise CT and CBCT. The purpose of the current study was to examine the CBCT findings and grayscale values' effectiveness used in the suspected diagnosis using data from the CBCT radicular cyst.

CASE REPORT

A 24-year-old female patient was referred to Dentomaxillofacial Radiology installation, Universitas Padjadjaran Dental Hospital for a CBCT examination of a lower jaw lesion. Extraoral findings showed swelling in the lower left mandible which causes face asymmetric (Figure 1). Intraoral examination revealed caries with restoration on tooth 35, caries with a large cavity on tooth 36, and retained root on 37 (Figure 2). The patient was in orthodontic treatment and wearing orthodontic appliances.

A CBCT result showed the focus area in mandibular sinistra from coronal, sagittal and axial views (Figure 3). Panorama view demonstrated a large radiolucent lesion from the apical of tooth 36 to the ramus sinistra with a mixed peripheral, from well-defined to diffuse border (Figure 4). The coronal view showed the lesion was associated with the apical of tooth 37 with the peripheral was mostly diffuse with some sharp border in some areas (Figure 5). The lesion was ± 238.91 mm^2 in area with an average density of -44.6 grayscale (minimum -439 and maximum 947). The. There was a cortical thinning on the lingual side. The distance between lesion margin to lingual cortical was ± 1,51 mm whi le the distance to buccal cortical was ± 1,69 mm. The mandibular canal appears to be in contact with the lesion. The sagittal view presented the loss of crown structure of tooth 37 leaving the root retained with the lytic of periodontal membrane and lamina dura (Figure 6). The peripheral was also seen as diffuse. The area of the lesion was ± 532.30 mm^2 with average density -16 grayscale (min -542 and max 1322). The lesion looked as if conjugated with the mandibular canal. The axial view as in figure 7, showed the lesion was in ± 220.56 mm^2 in area with an average density -22.9 grayscale (min -256 and max 225). It looked as if there is no border between the mandibular canal

Figure 1. Extraoral examination

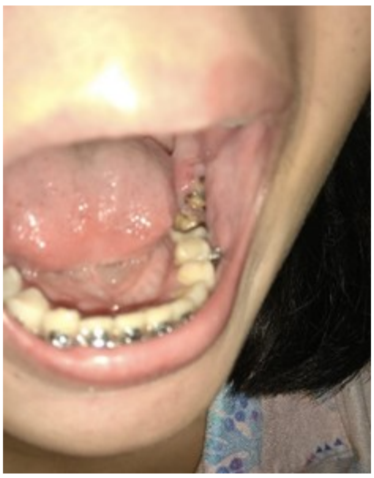


Figure 2. Intraoral examination

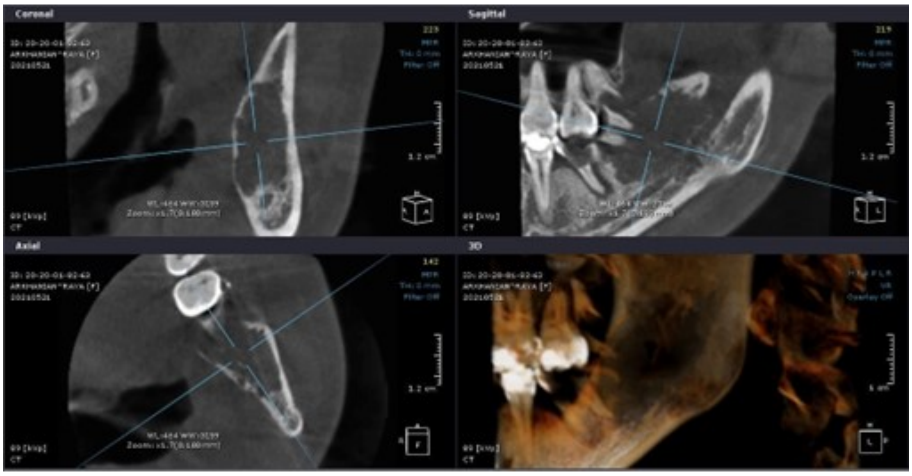


Figure 3. Multiplanar (MPR) view of the lesion on left mandible

Figure 4. Panorama view of the lesion on left mandible

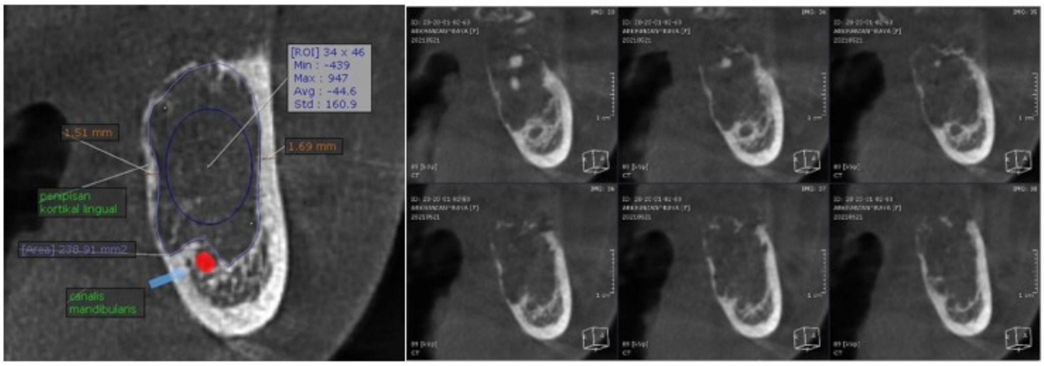


Figure 5. Coronal view (left) and coronal slicing view (right) of the lesion

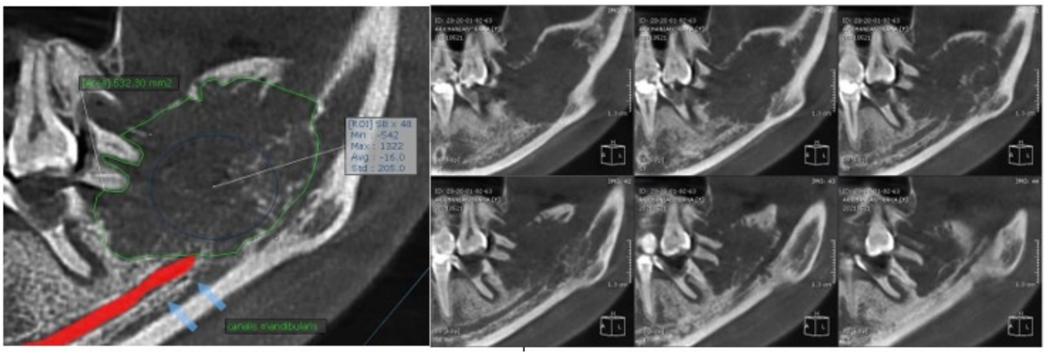


Figure 6. Sagittal view (left) and sagittal slicing view (right) of the lesion

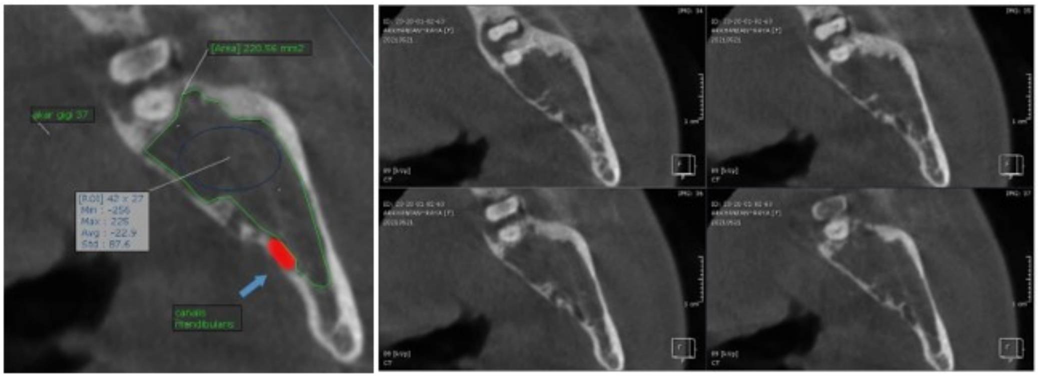
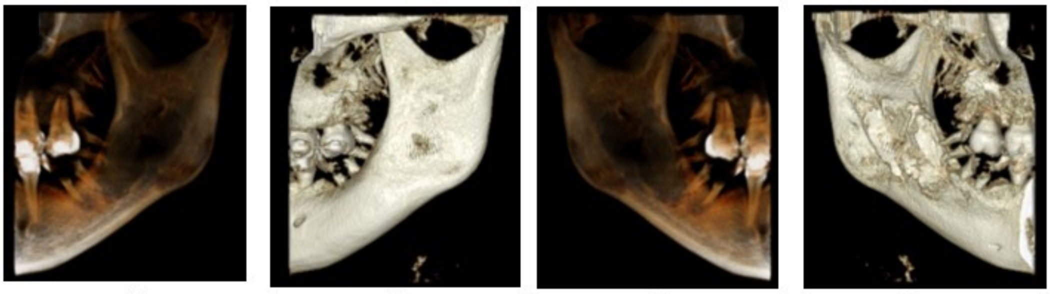


Figure 7. Axial view (left) and axial slicing view (right) of the lesion



(a) (b) (c) (d)

Figure 8. Three-dimensional (3D) reconstruction of CBCT, (a) buccal teeth view with (b) bone view, and (c) 3D lingual teeth view with (d) bone view

and the lesion. The three-dimensional view demonstrated the extent of the lesion to the bony damage in the buccal and lingual aspects (Figure 8). From all detailed information, a radiodiagnosis of an infected radicular cyst tooth 37 was suspected. The differential radiodiagnosis for this case includes odontogenic keratocyst and ameloblastoma.

DISCUSSION

In dentistry, radiographic evaluation is crucial for diagnosis and treatment planning. In addition to compressing three-dimensional anatomy of the area being radiographed into a two-dimensional image, 2D imaging has particular limitations (such as superimposition, distortion, and magnification) resulting in inaccurate representation of structures. In evaluating cysts, a single intraoral radiograph may not fully record the superoinferior and mesiodistal dimensions of the lesion. The 3D pictures produced by CBCT are helpful for numerous oral and maxillofacial circumstances that can assist in disease diagnosis, severity evaluation and therapy delivery, as well as monitoring. This advanced modality produces a volumetric data set that software could interpret qualitatively and quantitatively. [6,7]

Dental CBCT should be performed when a diagnostic cannot be made using intraoral radiography or panoramic radiography. CBCT imaging in the practice includes the surgical extraction of third molars and impacted teeth, tracing of the inferior alveolar canals, implant planning, evaluation of cysts and tumors, fracture diagnosis, orthognathic surgical planning and follow -up, inflammatory conditions of the jaws and sinuses, evaluation of the temporomandibular joints, and as a tool to identify pain symptoms that are not related to a specific injury.[8,9]

Diagnosis of changes in bone density and hard tissues is important in radiographic images because changes outside the normal range may indicate disease, early diagnosis is important for the patients health. The diagnosis of density changes in all the common extraoral radiographic techniques is based on the darkness and brightness of images, expressed with Hounsfield Unit in CT scan and with gray scale in CBCT. The grayscale value (GSV) is a number that represents the amount of attenuation of the X-ray beam by the material contained in each voxel or structural unit of the tomographic volume similarly HU in computed tomography (CT) used in medical radiology. Although grayscale value is frequently represented as HU by CBCT manufacturers and software companies, it is important to emphasize that these measures are not actual HU. Many studies have been conducted to determine the link between CBCT grayscale values and CT HU. Eguren et al (2021) did a systematic review about converting gray value to HU which showed an unfavorable result. Due to lack of clinical studies with diagnostic capacity to justify its usage, GSV from CBCT cannot be converted to HU. However it is showed that in order to acquire pseudo Hounsfield values, three conversion steps-equipment calibration, prediction equation models, and a standard formula are required instead of only obtaining them from a regression or straight from the program.[10,11]

Manufacture of CBCT scanners provides viewer software that allows the user to open the CBCT dataset and to study the case. Conventionally, this software has the tools necessary for quantitatively. basic analyses such as multi-planar, dimension measurement, radiographic density calculation, and the calculation of the mean value of voxel gray values. CBCT gray values are considered approximate values and thus cannot be that expressed as HU as in case of conventional Ct scan.[12] Digital imaging, with pixel intensity (PI), holds the possibility of qualitative and quantitative analyses of bone density and architecture. Pixel intensity analysis is considered as a simple method that provide objective measures of radiographic density of alveolar bone. Its means measurement of blackness or whiteness in a 8-bit digital image on a scale from zero (totally black) to 255 (totally white). The number and size of the pixels, together with the number of shades of gray available in radiograph, decided the amount of information in an image. Most studies have reported that the gray values obtained by CBCT are higher than the HU values obtained by conventional CT of the same region. Typical values of different elements and tissue ranges from ?1000 to 3000 (air versus bone) which makes it possible to evaluate as either benign or malignant. Radiolucent lesion containing water or having attenuation corresponding to blood range from −1000 to +40 and radiopaque lesion having cancellous or dense bone may have attenuation ranging from +700 to 1000. [10,13]

Radiologic evaluation qualitatively, a visual assessment can be carried out which usually uses the 4 SBCA principle (*site*, *size*, *shape*, *symmetry*, *border*, *content*, *association*). The following describes a series of steps which assists in the identification of the important radiologic features, highlighting the behaviour and nature of a lesion. Pathogenesis of radicular cysts is a complicated procedure that has been hypothesized to incorporate elements of the abscess theory, the osmotic pressure theory, and intricate epithelial-stromal interactions. It's unclear how common radicular cysts really are, most likely because a significant portion of these lesions did not receive a standard biopsy. The standard radiography appearance of radicular cysts is that of a radiolucent object with well defined, expansile, corticated edges (surrounded by a narrow radio-opaque margin, which extends from Lamina Dura of involved tooth), seem hydraulic or round, with a size of lesion more than 2 cm in diameter, root resorption is rare but may occur.[5,14]

Radiologic presentation of Radicular Cyst is given in detail as follows periphery usually has a well defined cortical border. The outline of radicular cyst usually is curved or circular unless it is influenced by surrounding structures such as cortical boundaries. In most cases, internal structure of radicular cyst is radiolucent. If a radicular cyst is large, displacement and resorption of roots of adjacent teeth may occur. The resorption pattern may have a curved outline. In rare cases, the cyst may resorb the roots of related non-vital teeth. The cyst may invaginate the antrum, but there should be evidence of a cortical boundary between contents of cyst and internal structure of antrum. The outer cortical plates of maxilla and mandible may expand in a curved or circular shape. Cyst may displace the mandibular alveolar nerve canal in an inferior direction. If Cyst is secondarily infected, the inflammatory reaction of surrounding bone may result in loss of this cortex or alteration of cortex into more sclerotic border.[4,15]

An infected cyst is commonly characterized by an inflamed swelling with pain. On radiograph, the border of the lesion plays important role in defining whether or not the cyst is infected. In an infected cyst, the radiopaque margin may not be present due to the cyst's rapid growth. Adjacent root resorption is usually present. If the lesion is extensive and involves nearby teeth, vitality may be lost. The present case reported a suspect mandible cyst based on clinical examination and showed a mostly diffused border radiolucent lesion on the radiograph qualitatively. This absent corticated peripheral leads to an infected cyst. The average density of this lesion ±30 grayscale which is grossly equivalent to fat if it is HU. Theoretically, cyst content is nodules of opaque yellow material representing cholesterol, a type of fat. These findings based on radiograph feature and density analysis could refer to a suspect of an infected radicular cyst.[16]

Ameloblastoma and perimandibular abscess have been chosen as the differential diagnosis for this case. The radiograph features of these lesions are particularly similar. Ameloblastoma is a radiolucent lesion with aggressive nature with a mostly well-defined border and shows bubble soap, honeycomb, or spider web appearance particularly. In this case, a well-defined border is still found in this case yet mostly diffuse. Nonetheless, ameloblastomas are the second most common odontogenic tumor in jaw. Perimandibular abscess is a localized collection of pus within the mandible caused by infected tooth pulp that spread to the bony mandibular. The radiographic feature of this lesion is as same as the other abscess, a diffuse border with a radiolucent internal structure, comparable with the current reported case.[17]

In addition, the diagnosis of radicular cyst confirmed not only from radiographic examination, but also from clinical examination and histological examination. Patient with radicular cyst sometimes have no symptoms (asymptomatic) unless there is acute inflammatory exacerbation and incidentally found with radiographs. Mild sensitivity and swelling may be seen as the cyst grows larger in size and painful if infected. Movement and mobility of adjacent teeth are seen as the cyst enlarges.[18, 19] Jose (2016) explained histopathological, the cyst is lined by stratified squamous non keratinized epithelium of variable thickness, and if they are near to maxillary sinus can be lined with respiratory epithelium. Epithelium show spongiosis and inflammatory cell infiltration. Cystic lumen is filled with fluid containing cholesterol crystals. Connective tissue capsule adjacent to lining epithelium is delicate with dense inflammatory infiltrate containing lymphocytes variably intermixed with neutrophils, plasma cells, histocytes,and rarely mast cells and eosinophills. In radicular cyst sometimes mucus producing epithelium lining is seen either in maxillary or mandibular locations as a result of metaplastic transformation of epithelial rests of Malassez which are pluripotential.[20]

CONCLUSION

A large radiolucent lesion, in this case, was assessed qualitatively and quantitatively. A suspect of an infected radicular cyst was made based on radiograph feature and density analysis. Software in CBCT simplifies dentomaxillofacial radiologists to narrow the differential radiodiagnosis as well as determine the radiodiagnosis.

FOOTNOTES

All authors have no potential conflict of interest to declare for this article. Informed consent was obtained from the patient for being included in this case report.

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