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Image Analysis of a Dentigerous Cyst by Cone Beam Computed Tomography: A Case Report and Literature Review on Its Immunological Expression

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Abstract

A dentigerous cyst is a developmental odontogenic cyst. Mostly asymptomatic, radiographic examination is the only way to discover dentigerous cysts. A dentigerous cyst, when infected, causes pain, swelling, and facial asymmetry. This cyst forms around or lateral to the crown of impacted or supernumerary teeth and prevents tooth eruption. If you have a dentigerous cyst in the maxillary canine or third molar area, the teeth will move into the maxillary sinus or the ramus or condyle if it's in the mandibular molars. The current case study discusses the radiographic features of a dentigerous cyst on cone beam computed tomography in a 19-year-old female, as well as its etiology, clinical features, and management.

Categories: Oral Medicine, Dentistry
Keywords: cone-beam computed tomography (cbct), dentigerous cyst (dc), endoscopic approach, impacted teeth, supernumerary teeth

Introduction

The word cyst stems from the Greek word kýstis, which can indicate "bladder," "bag," or "pouch. Cysts are diseased cavities that contain fluid, semi-fluid, or gaseous substances [1]. A dentigerous cyst develops around the crown of an unerupted or supernumerary tooth [1]. About 5% of dentigerous cysts occur around supernumerary teeth [1,2]. After the completion of enamel formation, a cystic change in the dental follicle of an unerupted tooth forms a dentigerous cyst [1,2]. It is still unknown what triggers cystic alterations in the oral follicle [1,2]. The theory states that the pressure an impacted tooth applies during its eruption attempt could block the venous outflow from the squeezed follicle and result in serum transudation into the follicular space [1,2]. Later, changes in inflammation lead to exudation, and when epithelial cells break down into osmotically active particles, this raises the intraacystic osmotic pressure. This keeps happening until the expansion stops being dependent on it [2-4].

A dentigerous cyst encircles the crown and attaches itself near the neck of an unerupted tooth [3]. Dentigerous cysts can push maxillary third molars into the maxillary sinus and mandibular molars into the ramus or near the condyle [2,3]. Usually, it is a cystic enlargement of the dental follicle, hence the term 'follicular cyst'. Dentigerous cysts are almost more common in men during the second to fourth decades than in women [2,3]. Usually, routine radiography discovers these asymptomatic cysts. Radiographically, dentigerous cysts have a curved or circular outline [2,3]. Pain and swelling occur only in cases of secondary infections [3,4].

Case Presentation

A 19-year-old female reported to our Department of Oral Medicine and Radiology for a routine radiographic evaluation. Her medical history was non-contributory. The reconstructed panoramic cone beam computed tomographic image revealed a well-defined, unilocular radiolucency between the right mandibular second premolar and first molar, as well as impacted supernumerary teeth (Figure *1*).

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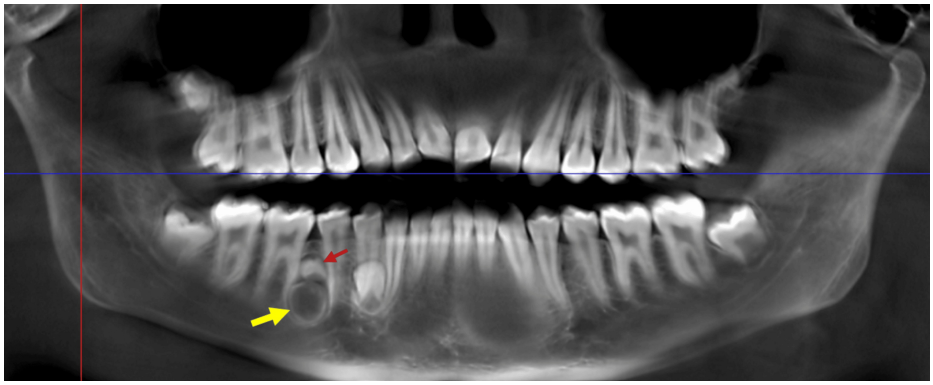


FIGURE 1: Reconstructed panoramic image revealed a unilocular well-defined radiolucency (yellow arrow) and impacted supernumerary tooth (red arrow)

The sagittal section of cone beam computed tomography (CBCT) revealed a well-defined radiolucency measuring about 11.56 mm x 8.59 mm between the right mandibular second premolar, the mandibular first molar, and two impacted supernumerary teeth (Figure *2*).

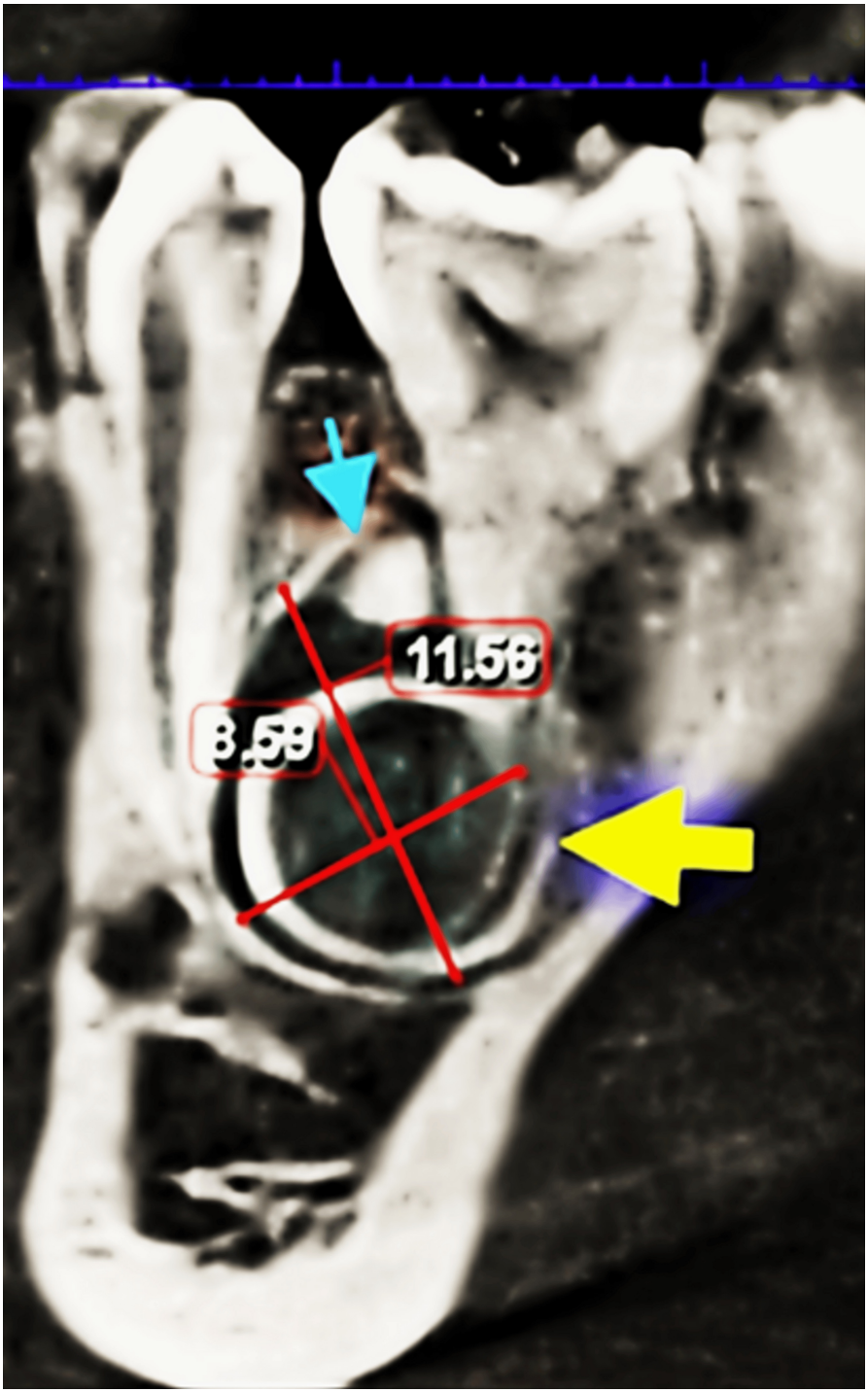


FIGURE 2: The sagittal section of cone beam computed tomography (CBCT) revealed a unilocular, well-defined radiolucency measuring about 11.56 mm x 8.59 mm between the right mandibular second premolar and first molar (yellow arrow) and impacted supernumerary teeth (blue arrow)

The axial section of the CBCT image showed a clear radiolucency that was about 5.12 mm x 7.47 mm, with enhancements around the edges and an impacted extra tooth (Figures *3A*, *3B*).

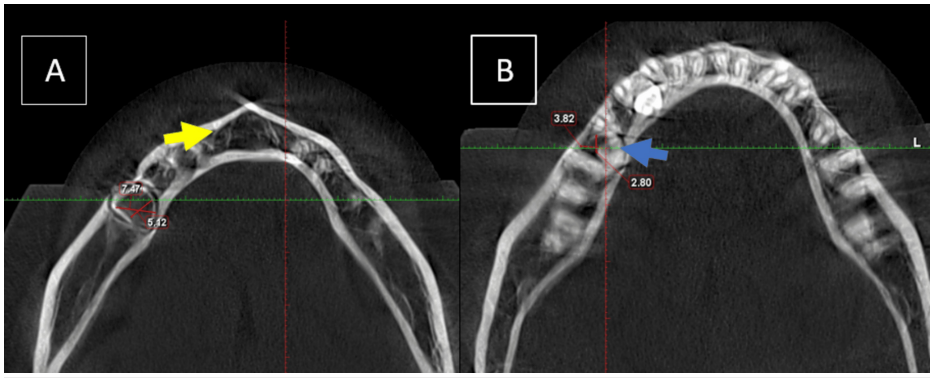


FIGURE 3: A. The axial section cone beam computed tomography (CBCT) revealed a well-defined radiolucency with peripheral enhancement (yellow arrow), and B. impacted supernumerary teeth (blue arrow)

The coronal section of the CBCT revealed a well-defined radiolucency measuring about 9.57 mm x 7.87 mm and impacted supernumerary teeth about the right mandibular second premolar (Figure *4*).

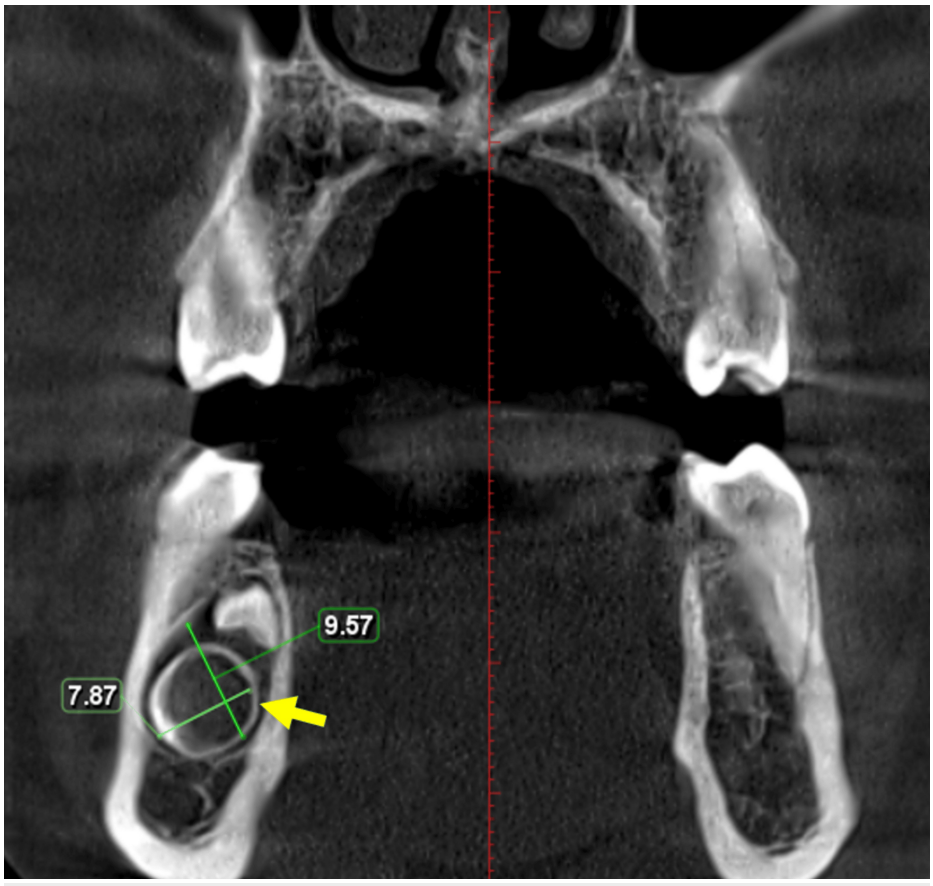


FIGURE 4: The coronal section of cone beam computed tomography (CBCT) revealed a well-defined radiolucency measuring about 9.57 mm x 7.87 mm and impacted supernumerary teeth (yellow arrow)

The differential diagnosis includes hyperplastic dental follicles, radicular cysts, and eruption cysts. The hyperplastic dental follicle occurs as a radiolucency surrounding the crown of a diameter greater than the normal follicular space of about 2-3 mm. The radicular cyst that arises in a primary tooth can mimic a dentigerous cyst. In such cases, a large, extensive, carious lesion or restoration is usually present in the

crown of primary teeth. Dentigerous cysts do not have carious lesions or extensive restoration. The treatment focuses on surgically removing impacted supernumerary teeth, followed by deroofing, marsupialization, and drainage of the cystic lesion. The prognosis is good and the recurrence rate is rare.

The main limitation in this case study was the patient's lack of attendance for follow-up evaluation and further analysis to elicit immunological expression of the cyst through immunohistochemical evaluation. This was due to the patient's fear of undergoing a surgical procedure.

Discussion

Immunological expression

A dentigerous cyst (DC) typically develops around an impacted supernumerary tooth [1]. It occurs when fluid builds up between the crown of an unerupted tooth and the reduced enamel epithelium [1]. Acquired dentigerous cyst walls may give birth to squamous cell carcinomas, mucoepidermoid carcinomas, or ameloblastomas [1]. Molecular profiling results show that dentigerous cyst linings can develop into benign odontogenic tumors [1]. MUC5AC and MUC2 only showed immunoexpression and immunoreactivity in the epithelial lining in dentigerous cyst mucus metaplasia, and they were the least positive [2]. Higher expression of minichromosome maintenance (MCM-3) and a high labeling index (LI) occur in dentigerous cysts [3]. The amount of tenascin present at the boundary between epithelial and mesenchymal cells was lower in dentigerous cysts as compared to odontogenic keratocysts and ameloblastomas [4]. Due to increased hypoxia in these lesions, dentigerous cysts had higher expressions of HIF1A antisense RNA 1(HIF1A-AS1) and hypoxia-inducible factor 1 alpha (HIF1A) determined by quantitative polymerase chain reaction PCR [5]. DCs exhibit stages of bone quiescence and healing, and the positive connection between Noggin and Bone Morphogenic Protein (BMP-2) in dentigerous cysts suggests a more significant function for both markers in bone production and remodeling [6]. DCs had increased expression of chemokines CXCL12 in the fibrous capsule and CXCR4 in the epithelium [7].

An acid phosphatase metalloprotein enzyme associated with bone resorption, tartrate-resistant acid phosphatase (TRAP), is expressed in osteoclasts. In the DC lining, the epithelium is negative for TRAP; the dentigerous cyst has slow osteoclastic function and gradually resorbs and destroys the alveolar bone [8]. There was no expression of PEA3 in dentigerous cysts [9]. Dentigerous cysts have the fewest myofibroblasts [10]. Dentigerous cysts contain amyloid [11].

Images of diffusion kurtosis, or apparent diffusion coefficient (ADC) mapping, were used to analyze 27 cystic lesions of the heads and neck using simple diffusion kurtosis imaging (SD). The results showed that the dentigerous cyst (DC) had an ADC of 1364 × 10−6 mm2/s mean kurtosis (MK) of 0.74, higher than the other cysts (odontogenic keratocyst (OKC): 0.86 and ranula 0.13 [11]. If the lesion does not exhibit its characteristic appearance, diagnosing it as a dentigerous cyst would be difficult [12].

The fractal analysis FA carried out using Image J Software (Ver 1.51, National Institute of Health Bethesda, Fiji) showed that dentigerous cysts had less bone damage than radicular cysts and odontogenic keratocysts [12]. The dentigerous cyst commonly occurs in the mandibular posterior region around unerupted mandibular third molars near the cementoenamel junction [13].

Fourier-transform infrared spectroscopy (FT-IR) is an alternative to histopathological examination of intraosseous lesions such as dentigerous cysts [14]. Clinically central mucoepidermoid carcinoma mimics dentigerous cysts [15]. Multiple dentigerous cysts are very rare and uncommon [16]. Goltz-Gorlin syndrome is characterized by the presence of multiple dentigerous cysts [16].

Murugesan I et al. (2024) studied the bone trabecular pattern in odontogenic cysts using fractal dimensions (FD) and fractal analysis (FA) in CBCT [17]. They found that the trabecular parameters change in different ways for each type of cyst [17]. These findings may influence the diagnosis, treatment, and prognosis of odontogenic cysts [17]. Trabecular pattern analysis has the potential to be a crucial component of the thorough evaluation of odontogenic cysts, with additional research and clinical validation. This could lead to an early, better diagnosis of odontogenic cysts and better patient outcomes [17].

Dentigerous cysts are asymptomatic, odontogenic cysts with a slow growth rate [17]. According to Permana H, they usually occur around the crowns of impacted teeth. They are not noticed until the tissues surrounding the teeth begin to suffer from them. Dentigerous cysts are associated with ectopic teeth. The treatment of dentigerous cysts associated with ectopic teeth includes either deroofing the cyst wall, marsupialization, or surgical enucleation [18]. The factors to be considered during minimally invasive endoscopic assisted surgery include the ectopic tooth site, the ease of access to the surgical site, instrumentation, and the extent of bone reduction [18]. Patients with dentigerous cysts during mixed dentition are often treated by the decompression technique, as younger patients with erupting teeth and an open apex exhibit remarkable tooth eruption potential and faster bone regeneration [19]. This approach involves the placement of a sterile tube, such as an acrylic stent or a trimmed disposable suction tube, following a cystectomy (surgical enucleation) or marsupialization procedure to maintain patency and communication between the cyst and the oral environment [19].

Dentigerous cysts are managed surgically by enucleating them; large cysts are removed by marsupialization [19]. By using endonasal endoscopic access and the Caldwell Luc approach, Romano A et al. (2024) treated a dentigerous cyst that was adherent to the orbital floor and soft tissues of the osteomeatal complex (OMC), restoring the maxillary sinus's physiological drainage [20].

Conclusions

Dentigerous cysts are very uncommon and rare developmental odontogenic cysts. Unless they are clinically evident to dentists, they usually grow silently and slowly around impacted canines, third molars, or unerupted extra teeth like mesiodens and supernumerary teeth occurring in maxillary or mandibular premolars. Dentigerous cysts often remain silent and asymptomatic. A large-sized dentigerous cyst can cause pain, discomfort, or swelling on the gingiva or even result in facial asymmetry. Dentigerous cysts involving ectopic maxillary canines or on the floor of the maxillary sinus can thicken the mucosa and block the maxillary sinus. The symptoms of recurrent nasal stuffiness in these patients often lead to confusion with maxillary sinusitis. Dentigerous cysts involving the orbital floor can cause epiphora and amblyopia. Routine radiographic examinations frequently uncover dentigerous cysts. The cyst gradually enlarges, causing pain, gingiva swelling, and facial asymmetry. A thorough knowledge of the radiological features of dentigerous cysts is essential for prompt diagnosis and treatment planning. The study of dentigerous cysts' immunological expression helps us understand how they behave biologically and evolve over time. It also helps us figure out how fractal analysis helps us understand the bone marrow changes caused by such cysts.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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