

# Keratocystic odontogenic tumor: role of cone beam computed tomography and magnetic resonance imaging

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Keratocystic odontogenic tumors (KCOTs) are known for unique and varied behavior, high recurrence rates, and distinctive histopathologic findings. Differential diagnosis and management of KCOTs may be challenging because other jaw lesions may present similar characteristics. Careful interpretation of cone beam computed tomograms and magnetic resonance images has great significance for precise assessment of KCOTs and their relationships to adjacent anatomic structures as well as for treatment planning. This case report describes

a KCOT that developed in the left angle and mandibular ramus in association with a semierupted third molar.

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The keratocystic odontogenic tumor (KCOT), previously designated by the term *odontogenic keratocyst*, is one of the most common odontogenic lesions.<sup>1</sup> According to the World Health Organization (WHO), it is widely accepted that KCOT originates from odontogenic epithelium, the chief sources of which are remnants of dental lamina and basal cells of the oral epithelium.<sup>1,2</sup> The WHO reclassified KCOT as a benign developmental odontogenic neoplasia in 2005.<sup>2</sup> This new designation reflects its aggressive clinical

behavior and high local recurrence, which are associated with high cellular proliferation rate and increased expression of anti-apoptosis genes in the basal layer.<sup>2,3</sup>

Despite their destructive potential, a substantial number of KCOTs are found incidentally during routine radiographic examination, where they may appear as a unilocular radiolucency with well-defined sclerotic margins or a multilocular radiolucent lesion with scalloped borders.<sup>3-5</sup> Clinically, most KCOTs involve no signs and symptoms until they cause bone

displacement, cortical disruption, pain, and drainage (if infection is present).<sup>2,3,6</sup> KCOTs affect a wide range of ages and present a male predilection; posterior portions of mandible are the most frequently involved areas.<sup>2,3,6</sup> This lesion can mimic other odontogenic and nonodontogenic lesions.<sup>2,3,6</sup>

Conventional radiographs are usually adequate for initial assessment of the position and size of KCOTs.<sup>7</sup> However, digital imaging modalities have been used for more accurate diagnosis of odontogenic tumors, including KCOT.<sup>8</sup> Cone beam computed

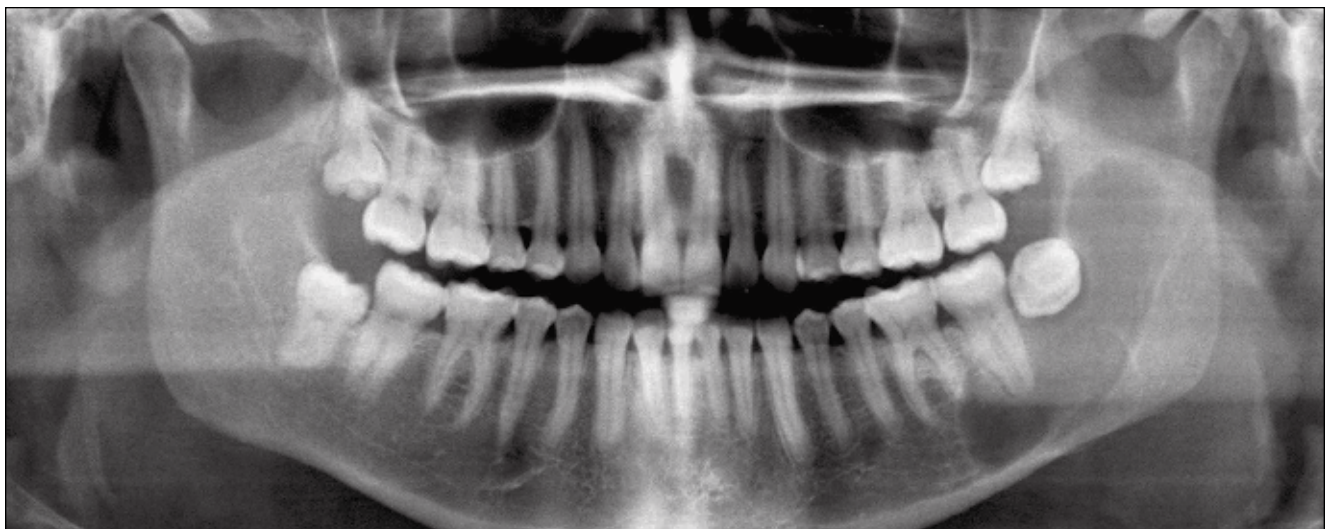


Fig 1. Panoramic radiograph showing the radiolucent unilocular lesion and its relationship to the semierupted transverse mandibular left third molar.

tomography (CBCT) and magnetic resonance imaging (MRI) are valuable complementary examinations for assessment of additional information, such as borders of large lesions, bone expansion, cortical perforation, contents, heterogeneity, intratumoral vascularity, and soft tissue involvement.<sup>2,6,8</sup>

The aim of the present report is to describe a case of KCOT and provide an overview of CBCT and MRI findings to assist dentists in performing accurate analysis of these tumors.

### Case report

A 30-year-old white woman presented with the chief complaint of pain, halitosis, and oral drainage that had lasted for 1 week. Her past medical history did not reveal any preexisting major disease, and the results of the extraoral examination were unremarkable. Intraoral examination revealed a semierupted mandibular left third molar that was partially covered by erythematous and edematous tissue. A fetid odor, drainage, and trismus completed the intraoral findings, and a clinical diagnosis of pericoronitis was suggested.

However, panoramic radiography disclosed an extensive radiolucent unilocular lesion with sclerotic borders. The lesion involved the mandibular left first and second molars up to the inferior mandible cortical and extended to the left ascending ramus of the mandible (Fig 1). There was no radiographic sign of root resorption of the first and second molars. The mandibular left third molar was in a transalveolar position, and the mandibular canal was surrounded by the lesion. Due to the lesion location, presence of a semierupted tooth, and age of the patient, dentigerous cyst and KCOT were the first differential diagnoses, but unicystic ameloblastoma was not ruled out. Because of the emergency clinical situation, the mandibular left third molar was extracted after administration of local anesthesia. Prophylactic antibiotic therapy was provided before surgery, and an amoxicillin regimen (500 mg, 3 times a day) was continued for 1 week.

The patient returned for her 1-week recall appointment with a complaint of pain. A CBCT scan was performed, and the multiplanar axial and coronal reconstructed images showed a dense soft tissue lesion and expansion and thinning of the lingual cortex in the region of the posterior

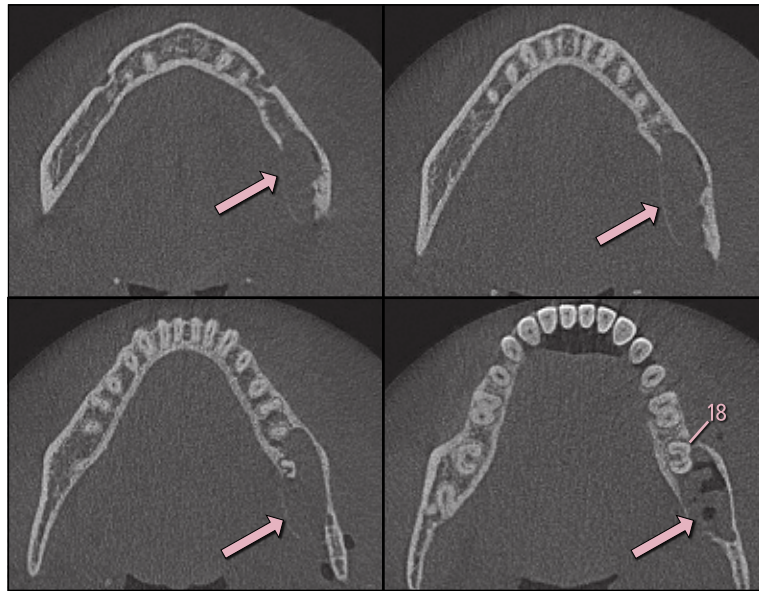


Fig 2. Inferosuperior axial cone beam computed tomograms (CBCTs) providing evidence of the expansion, thinning, and disruption of the lingual cortex (arrows).

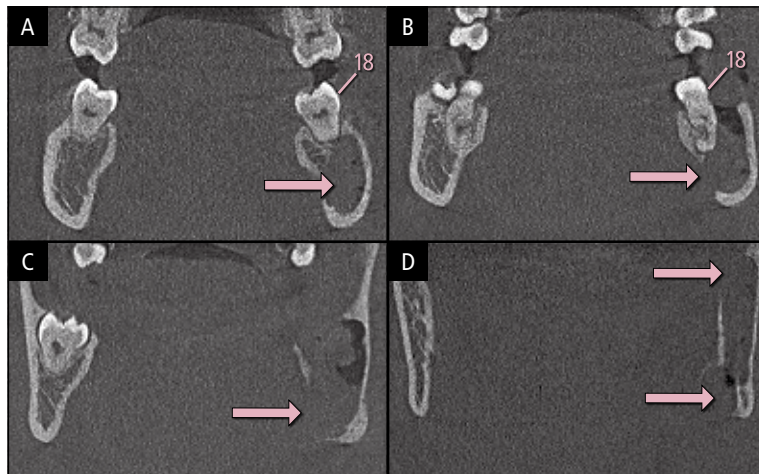


Fig 3. Anteroposterior coronal CBCTs. A and B. Area of expansion (arrows). C. Hypodense area inside the lesion (arrow). D. Disruption of the lingual cortex (arrows).

body, angle, and ramus of the mandible on the left side. Disruption of the lingual cortex was observed in some areas of the mandibular body and ramus. These images also revealed inferior displacement of the left mandibular canal by the lesion. There were some hypodense areas in the middle of the lesion, corresponding to postsurgical trauma from mandibular third molar extraction (Fig 2 and 3). Unfortunately, it was not possible to distinguish the true

borders of the lesion because soft tissue definition is limited in CBCTs.

To establish the true limits of the lesion and its relationship with the surrounding tissues and thus determine the best treatment approach, MRI examinations were performed with T1-weighted image (T1WI) and T2-weighted image (T2WI) sequences. Axial T1WIs revealed an intermediate signal image occupying the entire mandibular left body and ramus, rupture

of the lingual cortical bone, and extension of the mass into the floor of the mouth. It was possible to observe well-defined borders of the lesion with no invasion of muscle tissue. The T2WIs showed the same aspects as the T1WIs and evidence of hypersignal areas inside the lesion that corresponded to the location of acute secondary infection (pericoronitis) before third molar extraction (Fig 4 and 5).

An incisional biopsy was performed, and the microscopic examination of the surgical specimen revealed a parakeratinized KCOT with an epithelial lining, 6 to 8 cells thick, associated with the hyperchromatic palisaded basal cell layer and corrugated parakeratotic surface. The patient was referred to a maxillofacial surgeon; because of the extent of the lesion, a marsupialization was performed. A continuous follow-up schedule was established to confirm complete enucleation of the cyst.

## Discussion

Radiologic diagnosis of a lesion depends on association of many criteria, including the location, demarcation, cortical involvement, periosteal and soft tissue alterations, and density, in relation to the adjacent structures within the jaw.<sup>9</sup> Although panoramic radiography is the primary choice of radiologic examination for dentists, superimposition of craniofacial structures generates images with limitations, distortions, and magnifications.<sup>10</sup> In contrast, CBCT generates images that are both dimensionally faithful and anatomically accurate for diagnosis of oral and maxillofacial pathoses, such as KCOT.<sup>10</sup> Moreover, the risk of injury to adjacent anatomic structures, such as teeth and lingual nerves, and the risk of mandibular fracture are clearly identified through CBCT images.<sup>7,11,12</sup> Another advantage of CBCT examination is the reduced radiation dose compared to fan beam computed tomography (FBCT), associated with the high spatial resolution of osseous structures.<sup>7,11,12</sup> Therefore, accurate 3-dimensional information about the extent, borders, and exact measurements of KCOTs can be obtained.<sup>11</sup> In the present case, CBCTs revealed disruption of lingual cortical bone and mandibular canal involvement, contributing to the selection of initial conservative treatment through marsupialization.

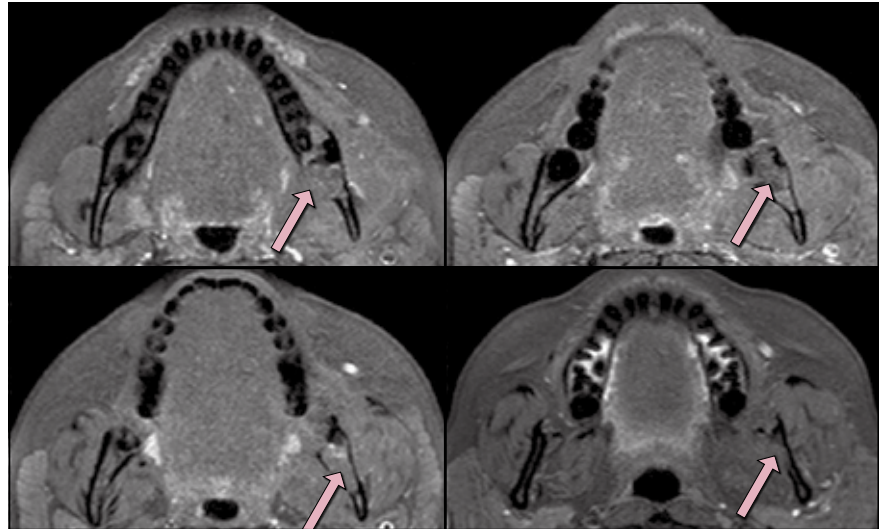


Fig 4. Inferosuperior axial T1-weighted magnetic resonance images (MRIs) showing the intermediate signal intensity of the lesion (arrows) and its real limits.

Although CBCT clarifies the lesion extent and provides details about osseous expansion and wall thinning, limitations of soft tissue identification restrict wide clinical application of CBCT; soft tissue boundaries are identified more consistently on FBCT than in CBCT.<sup>13</sup> In this scenario, MRI is a noninvasive method that offers superior images of the internal composition of a lesion, and its inherent soft tissue discrimination facilitates thin-section acquisitions showing involvement, intensity, and structure of the lesion.<sup>11,12</sup> Furthermore, electronic postprocessing software, such as image inversion, allows delineation of lesions, reducing or even eliminating the need for administration of contrast as was used in the present case.<sup>14</sup>

Investigation of lesion contents can be crucial for distinguishing KCOTs from other odontogenic lesions.<sup>15</sup> For example, in KCOTs, intermediate or high signal intensity on T1WI sequence and heterogeneous low to high signal intensity on T2WI sequence can reflect the presence of material in the cystic lumen that consists of desquamated keratin, cholesterol crystal, or components of secondary infection on microscopic examination.<sup>15,16</sup> Differences in keratin contents also are reflected in different MRI patterns among KCOTs and orthokeratinized odontogenic cysts, which are independent entities according to

WHO criteria.<sup>2-8</sup> Moreover, MRI is considered useful for differentiating between KCOT and other odontogenic lesions, such as dentigerous cyst, glandular odontogenic cyst, and radicular cyst, which tend to present homogenous intermediate signal intensity on T1WI and homogenous high signal intensity on T2WI sequence.<sup>16</sup> Finally, significant differences in signal intensity on T1WI and T2WI sequences and short TI (inversion time) inversion recovery images, caused by cystic components, provide characteristic findings that allow KCOT to be distinguished from ameloblastoma.

In the present case, findings on the MRIs were in accordance with aspects mentioned in the literature and demonstrated the soft tissue components associated with KCOT.<sup>8</sup> Moreover, the precise secondary extension of the lesion to the floor of the mouth only can be clearly visualized through MRI, because it provides high-definition contrast of the anatomical structures of adjacent soft tissue in relation to the lesion.<sup>17,18</sup> Nevertheless, detection of osseous abnormalities via MRI is limited, and CBCT is considered the standard examination for complete and reliable assessment of bone.<sup>19,20</sup> In the present case, both CBCT and MRI examinations played a key role in diagnostic imaging, enabling evaluation of soft and hard tissue aspects of the KCOT.

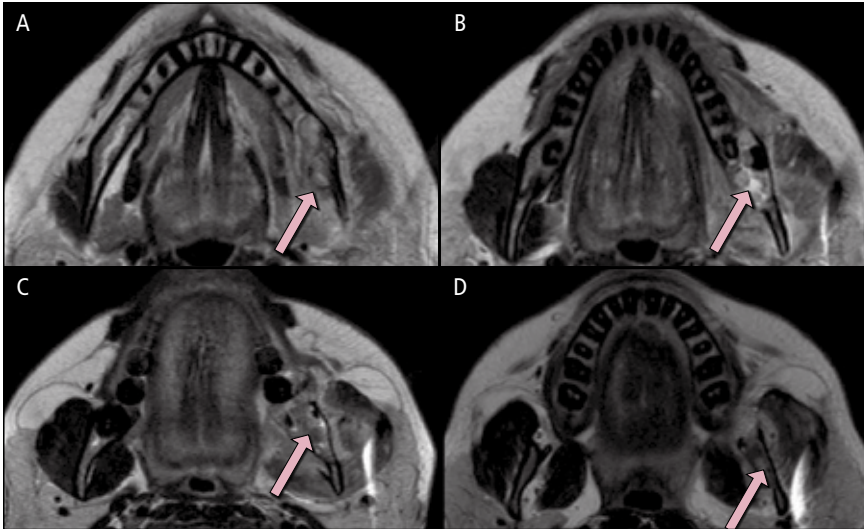


Fig 5. Inferosuperior axial T2-weighted MRIs. A, C, and D. Lesion (arrows). B. Hypersignal area of the lesion (arrow).

## Conclusion

Cone beam computed tomography and MRI represent complementary techniques to panoramic examination, revealing some unique pathologic aspects of KCOTs. Magnetic resonance imaging is less commonly applied in the dental field because of its high cost and limited access outside of hospitals and medical facilities. On the other hand, CBCT is widely available in dental offices. However, because diagnosis and treatment planning of odontogenic and nonodontogenic lesions should be based on analysis in 3 dimensions, and KCOT is a common jaw lesion, the combination of CBCT and MRI examinations should be used to facilitate assessment.

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