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Pictorial Essay: Cysts and Cyst-like Lesions of the Jaws

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Introduction

The diverse spectrum of pathologies that can manifest as cystic jaw lesions can present a challenge even for experienced radiologists. Part of the difficulty is that some lesions, particularly those commonly detected on dental radiography, are more familiar to dental radiologists. However, it is not uncommon for medical radiologists to be confronted with these lesions when cross-sectional imaging is performed. This review summarizes the clinical, radiologic, and histopathologic features of selected cystic jaw lesions, including both odontogenic and nonodontogenic diseases. Although not exhaustive, the lesions discussed cover a range of cysts and cyst-like lesions likely to be encountered by the radiologist.

Imaging Characteristics

Imaging modalities used in the evaluation of cystic jaw lesions include conventional radiography (including specialized views, eg, periapical and occlusal films), panoramic radiography, and cross-sectional imaging (computed tomography [CT] and magnetic resonance [MR]). Cross-sectional imaging is usually performed to better characterize or provide more complete evaluation of the extent of disease. CT provides superior delineation of osseous anatomy and is sensitive to mineralization, whereas MR provides superior soft-tissue detail.

Location

The location or epicenter is the geographic center of the lesion, when assuming equal growth in all directions, which has greater validity with smaller lesions [1]. Odontogenic cysts are cysts composed of odontogenic epithelium. They typically are located superior to the inferior alveolar nerve canal within the mandible and may have a pericoronal position relative to an impacted tooth. In the maxilla, odontogenic cysts can be differentiated from cysts intrinsic to the maxillary sinus by the presence of a cortical boundary between the cyst and the internal structure of the sinus, which indicates an origin outside the sinus (Figure 1).

Shape

Cysts can be identified by their external shape, which is circular or oval, ie, hydraulic (fluid filled). Some cysts may be expansile. This rounded aspect is always present unless the cyst has decompressed and collapses. Some cysts, specifically odontogenic keratocysts (OKC) and simple bone cysts (SBC), may have a scalloped border analogous to a series of contiguous arcs (Figure 2).

Periphery

Cysts that originate in bone usually have a well-defined corticated border characterized by a thin radiopaque line (“inert” margins). However, if there has been secondary infection, then this border may become thicker, sclerotic, or ill defined.

Internal Structure

Most cysts have a radiolucent center. When bone is trapped within multicystic lesions composed of small cysts, such as some OKCs or cystic ameloblastomas (AB), the bone remodels into internal septa and creates a multilocular appearance. Cysts may also develop ill-defined internal dystrophic calcifications.

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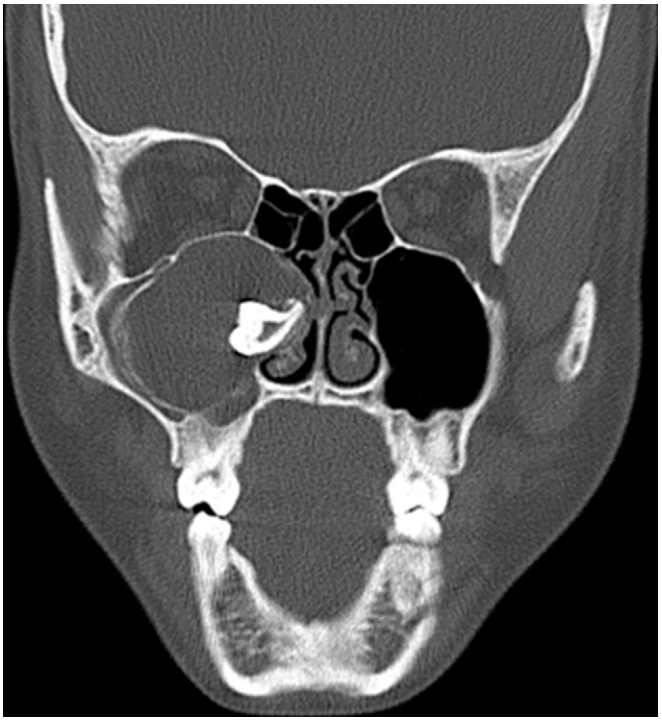

Figure 1. Coronal computed tomography image of a dentigerous cyst in the right maxillary antrum. Note the thin rim of bone along the inner margin of the true maxillary antral wall. This indicates that the lesion has its origin outside of the antrum.

Figure 2. Axial computed tomography image of an odontogenic keratocyst of the mandible, demonstrating a scalloped appearing border.

Effects on Surrounding Structures

Cysts are slow growing and can displace adjacent structures, such as teeth, the inferior alveolar canal, the floor of the maxillary sinus, and the outer cortical boundaries. The cysts tend to preserve cortical margins, with the exception of OKCs and cystic ABs in which it is not unusual to observe breaks in the expanded cortex. Some cysts may resorb the roots of adjacent teeth (Figure 3).

Specific Lesion Overview

The specific lesions addressed in this review article and a simplified classification are summarized in Table 1.

Odontogenic Keratocyst (OKC)

OKCs are cysts that contain keratinized epithelium, thought to arise from the dental lamina and other sources of odontogenic epithelium. They represent 3%–11% of all jaw cysts and are most commonly found during the second to fourth decade. A slight male predominance was reported [2]. The mandible is affected twice as frequently as the maxilla. OKCs are commonly seen in the posterior body or ramus.

The cyst margins are usually well corticated and may have a scalloped contour (Figures 2 and 4). They often remodel and/or displace the mandibular canal. They are more often unilocular than multilocular. On MR, OKCs may be heterogeneous or homogeneously hyperintense on T2W images and are usually heterogeneous on T1W sequences, because of the cyst contents generated by the epithelial lining. Areas of T1 shortening because of cholesterol content or hemorrhagic products can be seen. Wall enhancement correlates with focal inflammatory ulceration of the cyst lining [3,4]. OKCs tend to be aligned along the body of the mandible and often only cause minimal bone expansion [1]. They can displace or resorb tooth roots. Cortical dehiscence (Figure 5) and extension into adjacent soft tissues can occur.

OKCs with no bone expansion and scalloped borders can mimic SBCs, whereas those in a pericoronal location can resemble dentigerous cysts (DC). Less commonly, OKCs can be multiseptated and resemble ABs [5], however, the mixed solid and cystic appearance and enhancing papillary projections associated with the latter usually permit their distinction. Management can include resection, curettage, or marsupialization to reduce the size of large cysts before removal. Attention has been focused on complete removal of the cyst wall to reduce recurrence. Periodic imaging follow-up is required.

Multiple OKCs can be associated with the basal cell nevus (Gorlin-Goltz) syndrome, an autosomal dominant syndrome with variable expressivity [3]. The syndrome includes multiple basal cell skin carcinomas and multiple OKCs. Falx/dural calcification, skeletal abnormalities (bifid ribs, scoliosis, polydactyly), and an increased incidence of certain neoplasms (ovarian fibroma, medulloblastoma) is seen.

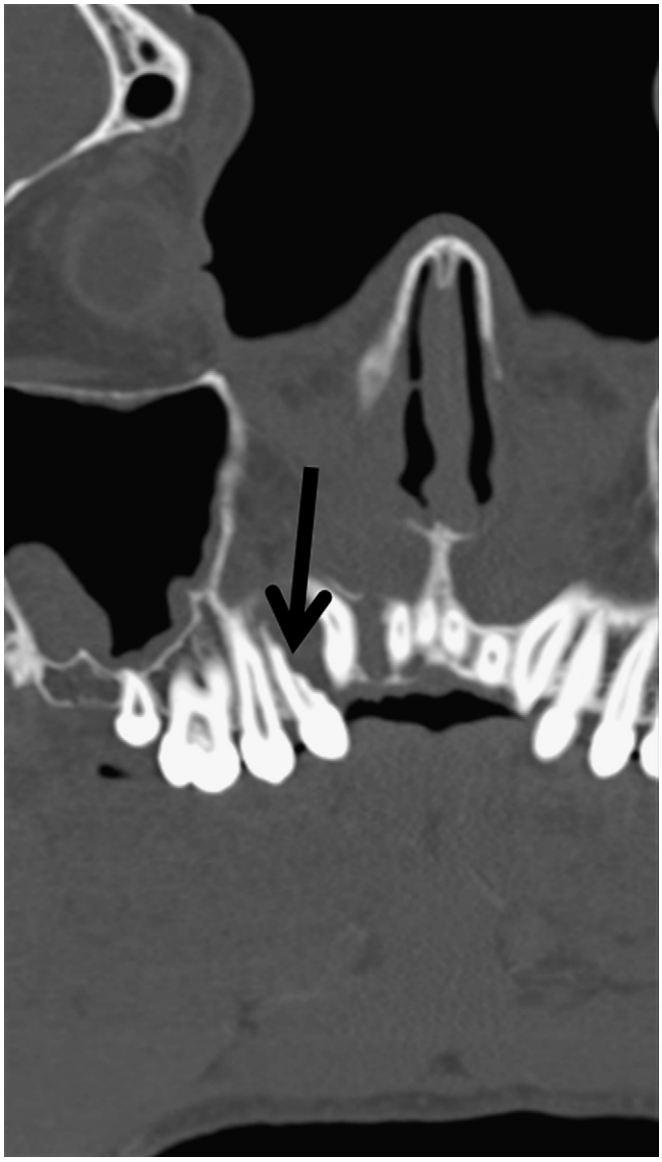

Figure 3. Coronal computed tomography image of an ameloblastoma of the maxilla that has caused smooth tooth erosion (arrow).

Table 1
Overview of cyst and cyst-like lesions of the jaws covered in this review

Odontogenic cysts	Odontogenic keratocyst (OKC)
	Dentigerous cyst (DC)
	Radicular cyst (RC)/residual cyst
	Buccal bifurcation cyst (BBC)
	Lateral periodontal cyst (LPC)
	Calcifying odontogenic cyst (COC)
Nonodontogenic cysts	Nasopalatine duct cyst (NC)
	Nasolabial cyst (NLC)
Cyst-like lesion	Simple bone cysts (SBC)
Cystic neoplasia	Ameloblastoma (AB)
	Aneurysmal bone cyst (ABC)

Dentigerous Cyst (DC)

DCs, also known as follicular cysts, develop around a fully formed crown of an unerupted tooth, most commonly the third mandibular and maxillary molars or maxillary cuspids; 75% are found in the mandible. They are usually evident by the third or fourth decade, with, possibly, a slight male predominance [2]. An enlarged asymmetric pericoronal space that measures larger than 2.5 mm is suspicious for DC. When larger, the wall of the cyst characteristically converges on the cemento-enamel junction of the tooth (Figure 6). DCs are unilocular, corticated, and may have undulating borders if large (Figure 7). They are radiolucent, with well-defined borders, and have a propensity to displace an involved tooth in an apical direction. The adjacent teeth may also be displaced, and resorption of their roots is more common than with other cysts. They can protrude into the maxillary antrum or infratemporal fossa (Figure 1). DCs typically show homogeneous isointensity on T1, homogeneous or heterogeneous hyperintensity on T2-weighted sequences, and may exhibit rim enhancement [4]. ABs can occasionally develop within the walls of DCs.

DCs form in the lining of the dental follicle when fluid accumulates between follicular epithelium and the crown of a developing tooth, which results in the characteristic relationship (Figure 8) [5]. Cyst lining is nonspecific, nonkeratinized, stratified squamous epithelium. Management is surgical resection. Recurrence is rare. Differential diagnoses for pericoronal lesions should include OKCs, small ABs, and ameloblastic fibromas (although these typically occur in a younger age group).

Radicular and Residual Cyst (RC)

RCs are also known as periodontal, periapical, or dental cysts. They arise from the periodontal ligament secondary to low-grade irritation and infection most commonly at the apices of nonvital teeth. RCs are associated with carious teeth with pulp necrosis. They may also be the result of trauma without caries. They can be asymptomatic, discovered incidentally on radiographs, or can cause swelling and pain if large. A residual cyst is a persistent RC after extraction of the involved tooth. RCs are the most common odontogenic cysts and also the most common cyst to be found in the jaw [1]. They occur at any age, mostly in the third-fifth decade, with no sex predominance.

The majority of RCs are centered at the apex of a nonviable tooth that has lost the adjacent lamina dura; 60% are found in the maxilla, and the incisors and canines are most commonly involved. RCs are radiolucent, unilocular, and have corticated (inert) margins, unless secondarily infected (Figure 9). They are typically homogeneously isointense on T1- and homogeneously hyperintense on T2-weighted sequences [4]. Maxillary lesions are commonly associated with the lateral incisor or the first molar. The cysts may invaginate into the maxillary sinus. Resorption or displacement of adjacent teeth occasionally can occur. Treatment of the diseased tooth (may include extraction or endodontic therapy) will often result in healing of the cyst. Occasionally, cyst resection or marsupialization is needed. On pathologic examination, RCs are nonspecific in appearance (Figure 10).

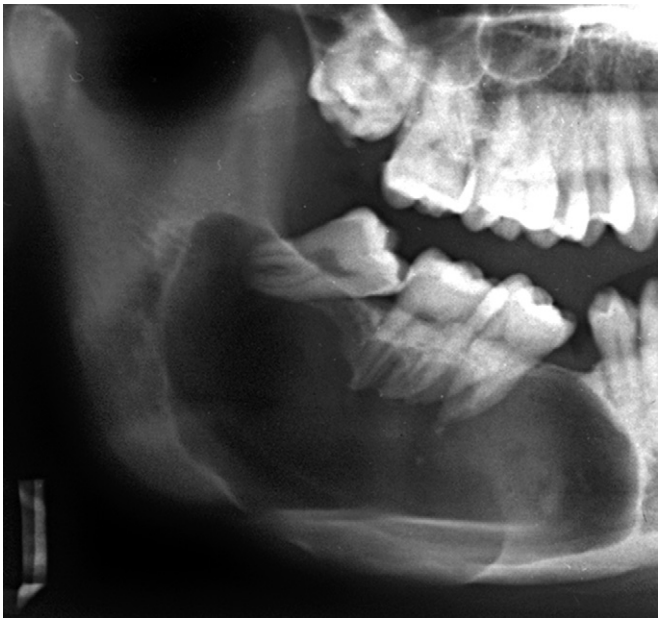

Figure 4. Magnified Panorex image of right mandibular angle, revealing a large odontogenic keratocyst. Notice the lack of expansion and scalloped borders. (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.)

Small cysts are difficult to differentiate from an apical granuloma, which represents a chronically inflamed connective tissue mass related to the apex of a diseased tooth. Collapsed and healed cysts that have invaginated into the maxillary sinus may simulate ossifying fibromas.

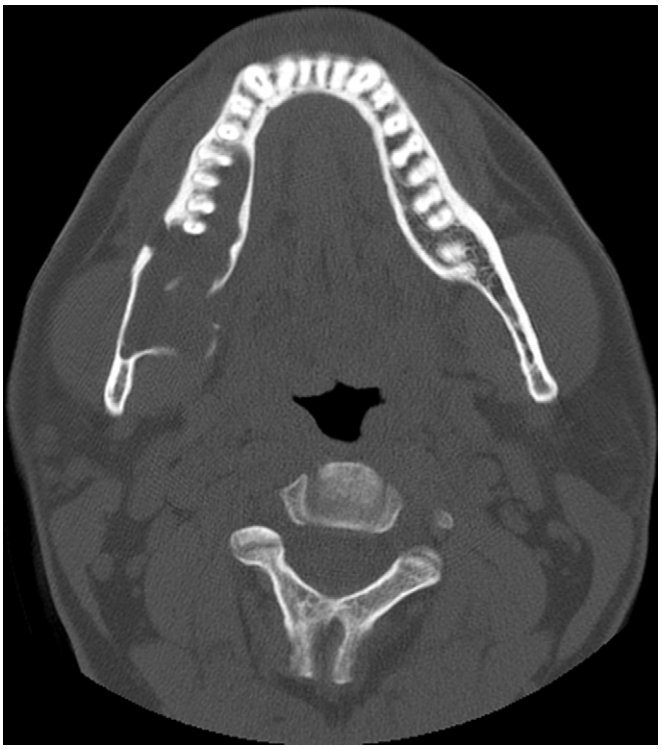

Figure 5. Axial computed tomography image of an odontogenic keratocyst located posteriorly in the mandible. Lucent minimally expansile lesion oriented along the axis of the mandible. Note the cortical dehiscence.

Figure 6. Axial computed tomography image, showing a dentigerous cyst related to the crown of an unerupted molar. Again seen is the characteristic attachment of the cyst to the cemento-enamel junction.

Buccal Bifurcation Cyst (BBC)

BBCs, also known as paradental or mandibular infected buccal cysts, affect children from 6–11 years old, with no sex predominance. BBCs are found on the buccal aspect of viable mandibular molars and can be associated with local pain and swelling. Identification is by its specific location, with the epicenter on the buccal (lateral) aspect of the mandibular first and second molar (first > second) [6], with ''buccal tilting'' of the tooth and root apices pointing towards the lingual (medial) cortical plate. Lesions are radiolucent and well corticated unless secondarily infected. The lamina dura should remain intact (Figure 11). BBCs can resorb or displace teeth. Differential diagnosis should include DC, periodontal abscess, or Langerhans cell histiocytosis. BBCs are lined by a nonspecific, nonkeratinized, stratified squamous epithelium, with areas of epithelial hyperplasia and inflammation in the connective tissue walls [6], and can be indistinguishable from RCs, except for the characteristic location. Treatment is usually surgical enucleation without extraction.

Lateral Periodontal Cyst (LPC)

LPCs are found in young adults, with no sex predominance [7]. They are painless, noninflammatory cysts that may be developmental. LPCs are most commonly found in the mandible from the lateral incisor to the second bicuspid region, lateral to the tooth root. Lesions are usually well defined, unilocular, radiolucent, with inert margins (Figure 12). Occasionally multiloculated (botryoid) forms are seen [1]. Large

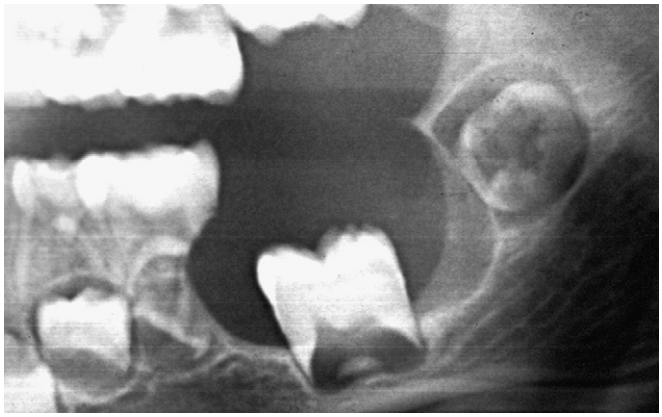

Figure 7. Magnified panoramic image, showing the typical pericoronal position of a dentigerous cyst. Notice the attachment to the cemento-enamel junction of the involved tooth. (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.)

cysts may displace adjacent teeth. Cyst cavities are lined by a thin layer of nonkeratinized stratified squamous or cuboidal epithelium. Small LPCs may be difficult to differentiate from OKCs, small ABs, central mucoepidermoid carcinoma, or neurofibroma.

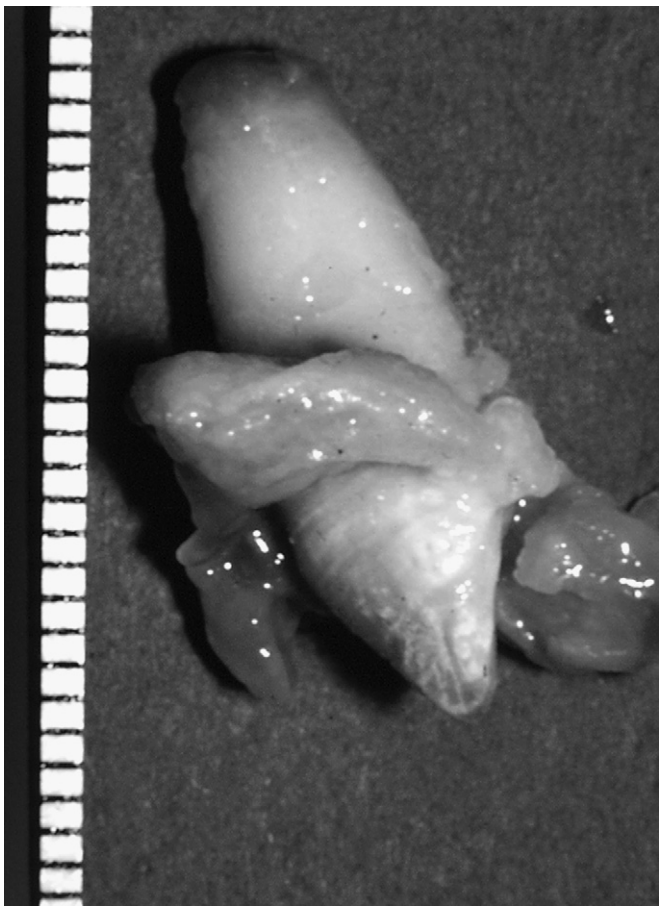

Figure 8. Gross specimen image, showing the remnants of a dentigerous cyst. Note attachment to the involved maxillary cuspid.

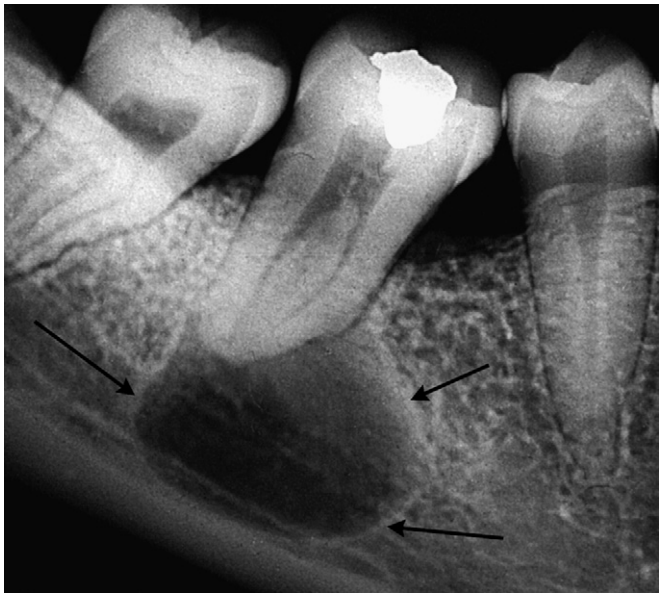

Figure 9. Intraoral film, showing typical radicular cyst as a unilocular corticated lucent lesion at the root apex of the involved tooth.

Calcifying Odontogenic Cyst (COC)

COCs are also known as keratinizing and calcifying ameloblastoma, keratinizing and calcifying odontogenic cyst or Gorlin cysts. Classification is controversial, and the World Health Organization has classified them as a benign tumour. COCs are usually seen in the second and third decades of life, with no definite sex predilection [8]. COCs represent only 1% of all jaw cysts. In younger patients, COCs are usually central; in older patients, they are usually peripheral. COCs usually present as painless swellings. Treatment is usually with enucleation and curettage.

COCs are most commonly found anterior to the first molar and involve the canine and incisor of either the maxilla or mandible. COCs can be radiolucent or characteristically may contain radiopaque pebble-like flecks of calcifications

Figure 10. Gross specimen of a radicular cyst attached to the root apex of the involved tooth.

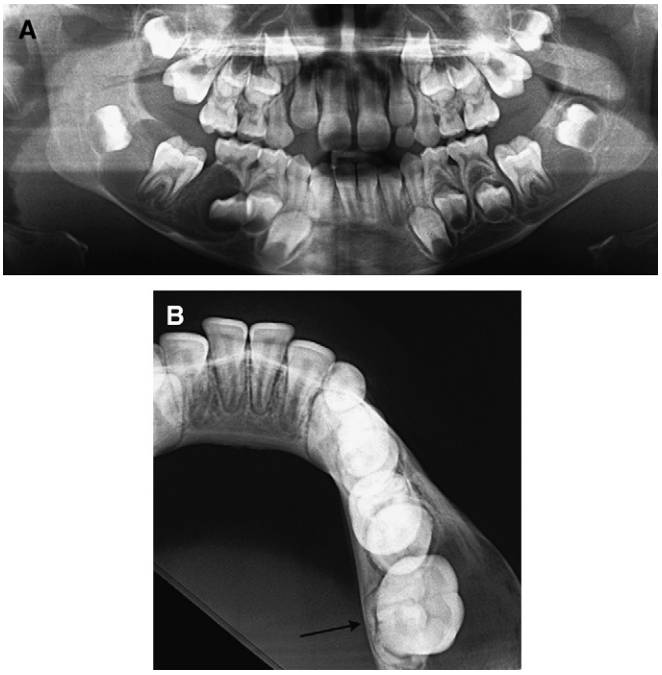

Figure 11. Panoramic image (A) of bilateral buccal bifurcation cysts, with occlusal view (B) of the left-sided cyst. Note the position of the cysts with an epicenter along the buccal (lateral) aspect of the first molars and the displacement of the roots towards the medial cortical plate of the mandible (arrow in B). (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.)

(Figure 13). Lesions are often associated with an unerupted tooth and may resorb adjacent tooth roots [9]. COCs are associated with an odontoma in 20% of cases and are seen as an associated radiopaque mass. The pathologic hallmark is the presence of ''ghost-cell'' keratinization: degenerated keratin-filled epithelial cells that appear eosinophilic with only an outline of the nucleus and nuclear membrane. The lining is otherwise odontogenic epithelium 4–10 cells thick, with tall columnar basal cells. DCs should be considered as a differential diagnosis when completely radiolucent. Certain

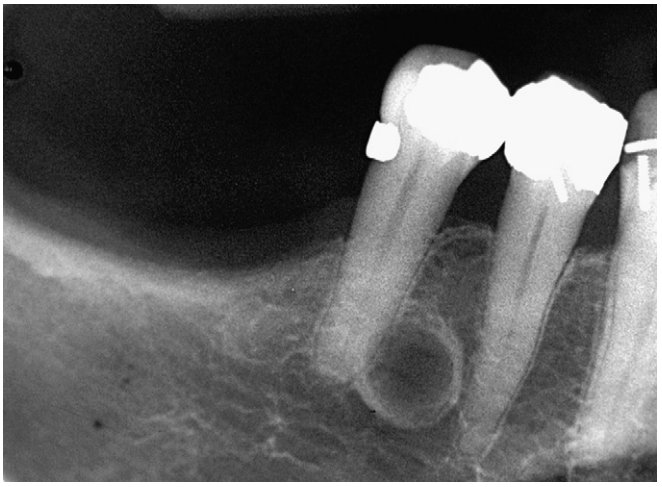

Figure 12. Intraoral film, showing typical position of a lateral periodontal cyst adjacent to the root of a mandibular bicuspid. (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.)

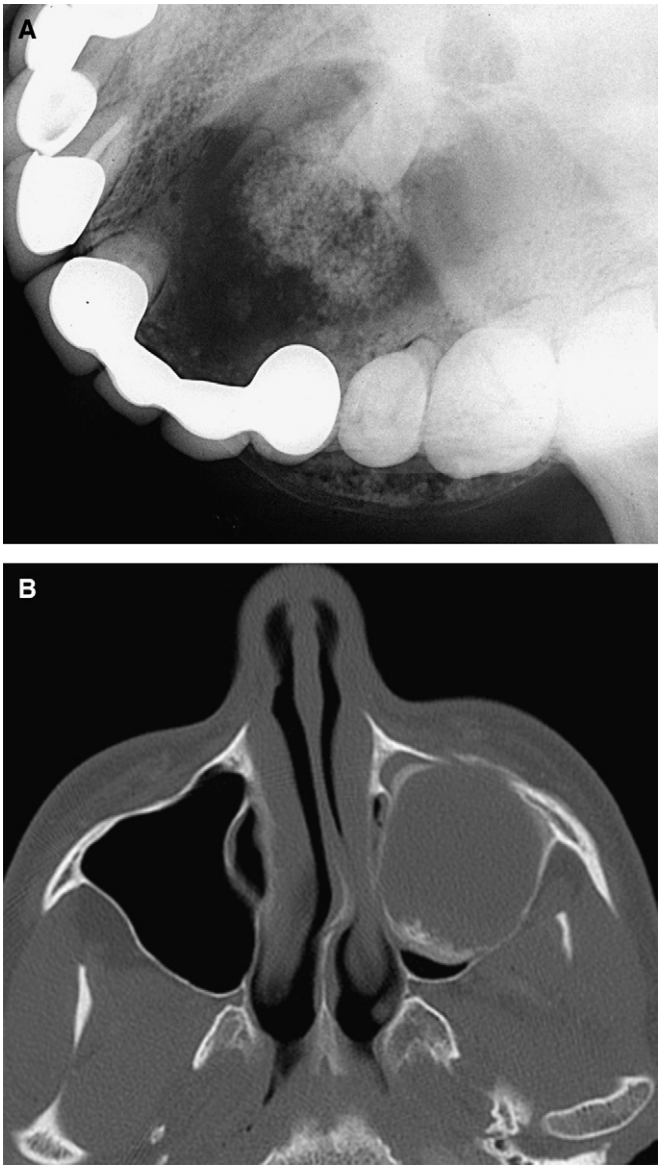

Figure 13. (A) An occlusal film of the maxilla, revealing a large calcifying odontogenic cyst with internal calcification. (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.) (B) An axial computed tomography image, showing a calcifying odontogenic cyst occupying the majority of the maxillary sinus; note the presence of calcifications along the posterior wall of the cyst.

other lesions, including adenomatoid odontogenic tumour, ameloblastic fibroodontoma, or calcifying epithelial odontogenic tumour, should be considered when there are internal calcifications.

Nasopalatine Cyst (NC)

NCs are also known as an incisive canal cyst, cyst of palatine papilla, nasopalatine canal cyst, or median palatine cyst. They are most frequently found in the fourth-sixth decades and are most common in males [1]. NCs are non-odontogenic cysts that arise along fusion lines of the maxillary process. They are mostly asymptomatic, presenting only

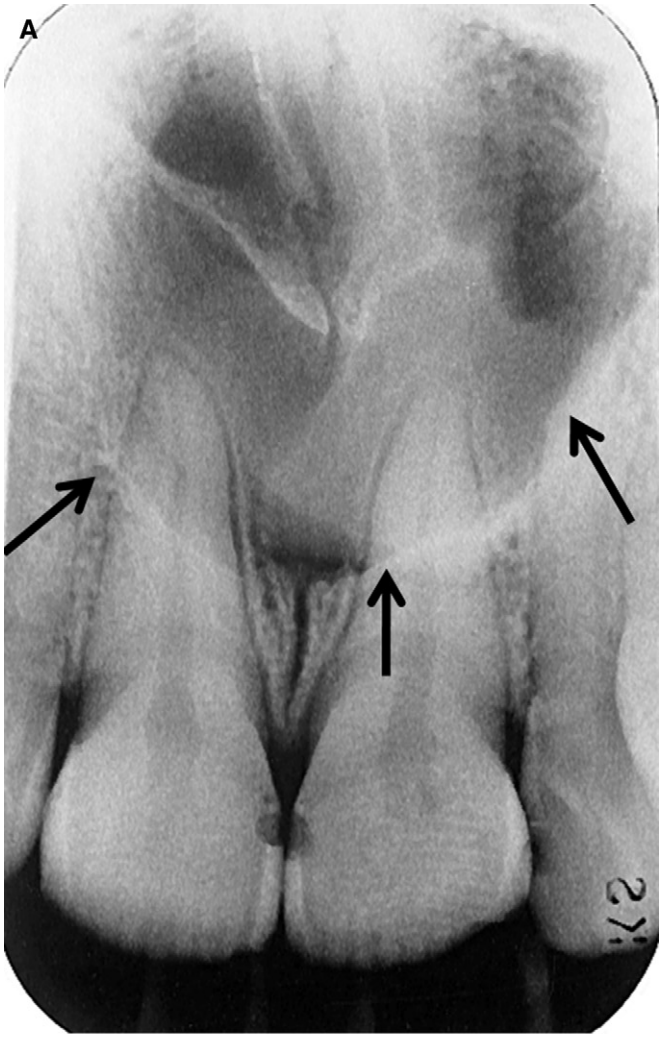

Figure 14. (A) Periapical film, showing the typical location of a nasopalatine cyst (arrows) centered on the incisive canal. (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.) (B) An axial computed tomography image of a nasopalatine cyst.

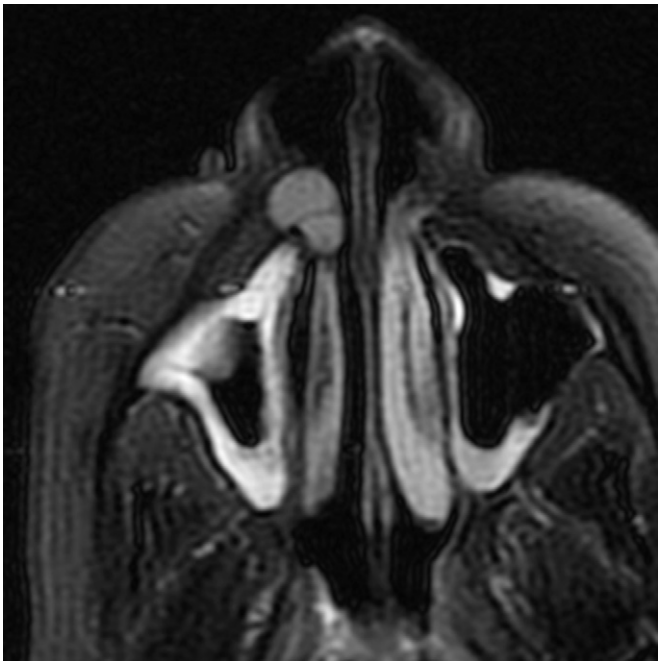

Figure 15. Axial T2FS magnetic resonance image of a mildly hyperintense cyst occurring in the characteristic location of a nasolabial cyst.

when large and can swell or discharge mucoid material (patients may report a salty taste).

Lesions are found within the nasopalatine duct (incisive canal) in the midline of the maxilla, between the roots of the central maxillary incisors, which can be displaced or rarely slightly resorbed. They can involve both Stenson canals. They are usually radiolucent, with corticated borders (Figure 14) and may be round, oval, or heart shaped. MR imaging usually shows homogeneous hyperintensity on both T1- and T2-weighted sequences. T1-weighted sequence hyperintensity may be because of keratin or viscous fluid [4]. NCs can splay the roots of the central maxillary incisors. Cyst lining varies from nonstratified to pseudostratified (respiratory) squamous epithelium. Differential diagnoses include variant large foramina, RCs, or RCs and/or granulomas associated with the central incisors.

Nasolabial Cyst (NLC)

NLCs are also known as nasoalveolar cysts. They are 3 times more common in females, and 11% of cases are bilateral [10]. They usually present in adults and are more common among blacks and Hispanics. They are located in the nasolabial soft tissues and the upper lip near the nasal aperture. They may deform the nasal ala. The lesions are painless unless infected and may drain spontaneously into the mouth or nose. They are homogeneously hypoattenuating, circular, or ovoid soft-tissue masses on CT examinations and are homogeneously hypointense to isointense on T1-weighted and hyperintense on T2-weighted MR images [4], although signal characteristics can vary, depending on cyst contents (Figure 15). On histologic examination, they may be similar to NC.

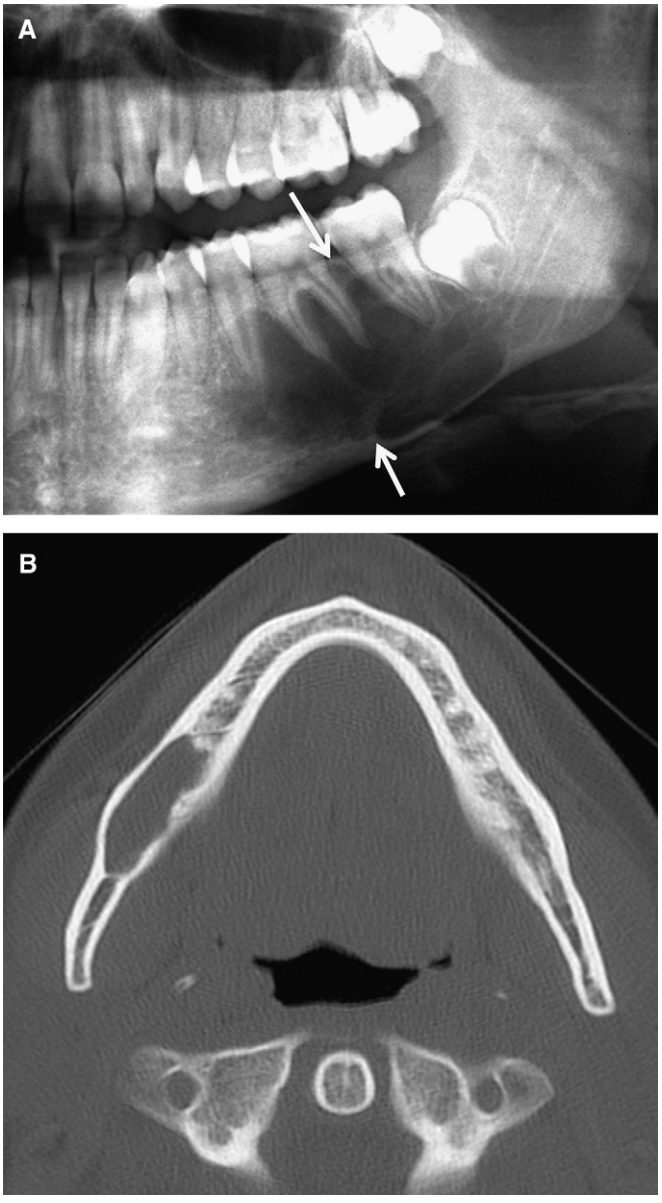

Figure 16. (A) A magnified panoramic radiograph of an simple bone cyst. Note the scalloped borders around the roots of the teeth and the endosteal surface of the outer cortical boundaries (white arrows). (From Oral Radiology. 5th ed. White and Pharoah, Mosby, 2004, with permission.) (B) An axial computed tomography image of a simple bone cyst occupying the body of the mandible, with minimal expansion and mildly scalloped margins.

Differential diagnoses should include nasal furuncles and RCs from the maxillary incisors.

Simple Bone Cyst (SBC)

SBCs are also known as hemorrhagic bone cysts, solitary bones cysts, or unicameral bone cysts. They are more common in males, and 70% of cases are found in the second decade. SBC are much more common in tubular bones, such as the humerus and the femur [11]. They are of unknown etiology, usually asymptomatic but can cause pathologic fractures. Lesions may be associated with cemento-osseous dysplasia or fibrous dysplasia.

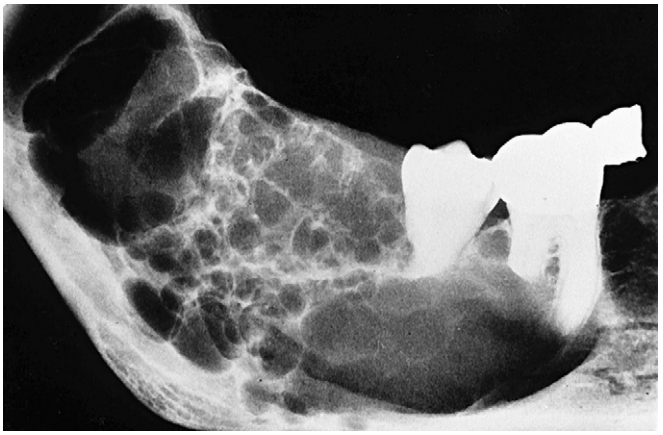

Figure 17. Radiograph, showing the classic appearance of ameloblastoma involving the mandible. The lesion is expansile and multilocular, with numerous well-defined internal septations. Note the erosion of adjacent tooth roots.

SBCs in the jaw area are found almost exclusively in the mandible, with the posterior mandible affected most. They are radiolucent and may appear multiloculated because of scalloping of the endosteal surface. Internal septations may sometimes be seen corresponding to prior pathologic fractures. SBC may have very delicate or uncorticated margins. A characteristic scalloped margin that extends between tooth roots can occur (Figure 16). Enhancement of the periphery and internal septations, fluid-fluid or gas-fluid levels may be seen on CT and MR imaging [11]. SBCs usually do not displace or resorb associated teeth. The lamina dura of the involved tooth should be retained, and there is usually minimal or no expansion of the mandible. On histopathologic examination, SBCs are not true cysts, because they do not have an epithelial lining. Differential diagnosis includes OKC, but these are usually better corticated and can displace and resorb adjacent teeth.

Ameloblastoma (AB)

ABs are also known as adamantinoma and adamantoblastoma. AB is a neoplasm of odontogenic epithelium. It is usually benign but locally aggressive. Malignant forms of AB that can metastasize are very rare. ABs occur mostly in the third-fourth decade and have no sex predominance. They account for 10%–18% of all odontogenic tumours and 1% of all tumours and cysts in the jaw [12]. ABs are painless, slow-growing tumours and usually present with jaw swelling.

ABs are mostly located in the molar-ramus region of the mandible (81% in the molar region). They can also be found in the molar-bearing portion of the maxilla and often involve the maxillary sinus. Lesions can be located in the pericoronal region with an unerupted tooth. ABs usually have well-corticated margins, with no associated periosteal reaction. Internally, they may be radiolucent and unilocular (more common in maxillary lesions) or more characteristically have multiple, thick, curved septations (Figure 17). A multiloculated mixed solid and cystic appearance is typical. Even

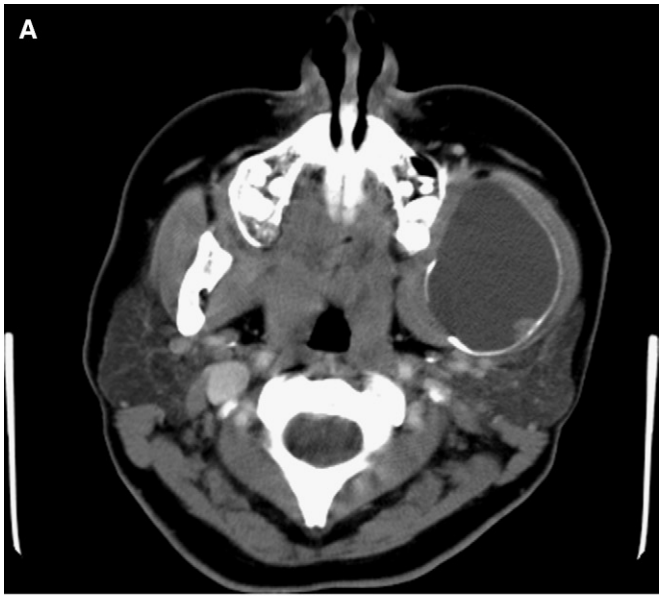

Figure 18. (A) An enhanced axial computed tomography image of a unicystic ameloblastoma. Note the presence of a posteriorly located enhancing mural nodule. (B) An enhanced axial image, showing a multilocular ameloblastoma in another patient with extensive enhancing soft tissue.

radiographically unilocular forms may have a soft-tissue mass projecting from the periphery on cross-sectional imaging. On CT, ABs appear as cystic hypoattenuating lesions, with solid components that may enhance (Figure 18) [13]. Lesions are heterogeneous and mixed signal on MR imaging (Figure 19), with irregularly thickened enhancing

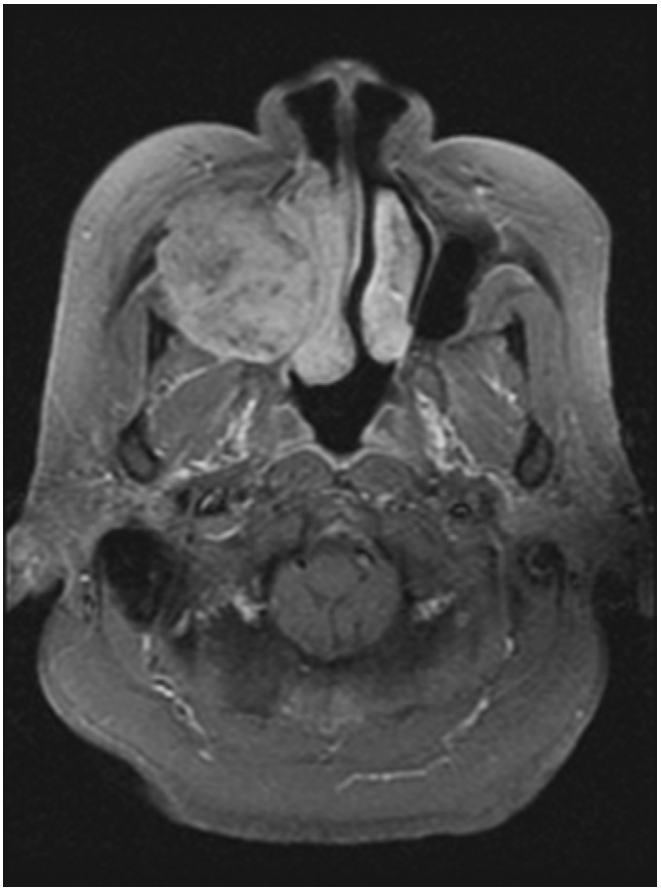

Figure 19. Axial T1FS postgadolinium image of a pathologically proven ameloblastoma arising from the right maxilla. The enhancing soft tissue mass has expanded into the right maxillary antrum and the ipsilateral nasal cavity.

walls, septations, solid components, or papillary projections and cystic spaces, which reflect their gross pathology (Figure 20) [14]. ABs have the propensity to displace and resorb teeth. They typically cause jaw expansion, and there is often loss of the outer cortex [5].

Small pericoronal lesions may appear similar to DCs. OKCs can also look similar but tend to be less expansile than

Figure 20. Surgical specimen of resected ameloblastoma, showing cystic regions within the solid-tumour mass.

Figure 21. Axial computed tomography images of an aneurysmal bone cysts, involving the mandible, note the multiple cystic regions and gross expansion of the mandible. A few small fluid levels are evident.

ABs. Odontogenic myxoma tend to have a few straight septations, and giant cell granuloma tend to be less well defined, with granular wispy septations. Unilocular ABs may appear very similar to aneurysmal bone cysts (ABC), but ABCs may have characteristic fluid levels. There are several histologic subtypes of ABs. All have a common peripheral palisading layer of columnar epithelial cells, with the nuclei polarized away from the basement membrane. These epithelial cells are called ''ameloblasts.'' The mainstay of treatment is surgical resection.

Aneurysmal Bone Cyst (ABC)

ABCs are benign intraosseous lesions composed of blood-filled spaces. ABCs are found in children, with a female predominance. They most frequently affect the long tubular bones and spine. They usually present as painless, enlarging swellings. Many appear to be reactive to preexisting neoplasm (such as giant cell tumour, chondroblastoma, fibrous dysplasia), however, there are also associations with prior trauma, venous obstruction, and neoplastic etiology [11].

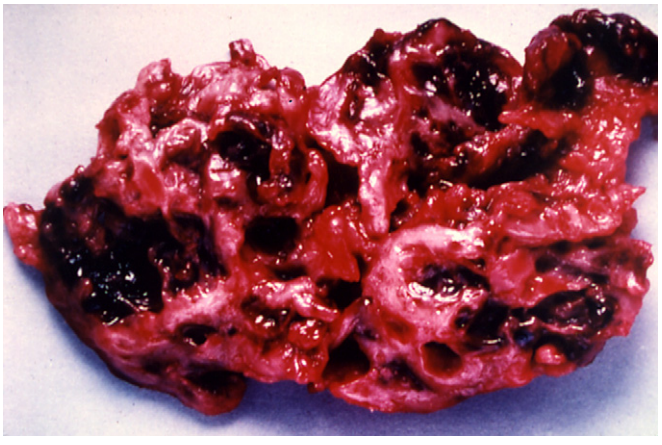

Figure 22. Gross specimen of mandibular aneurysmal bone cyst, showing multiple blood-filled cavities and bony expansion.

ABCs in the jaw area are most common in the molar-ramus region of the mandible. They usually have corticated margins and are frequently multilocular, with granular, ill-defined septations (Figure 21). On radiographic examination, ABCs can appear similar to giant cell granuloma. Alternately, they may be totally radiolucent on plain radiographs, but CT or MR imaging may reveal internal cystic spaces. Fluid-fluid levels may be present. ABCs have a propensity for extreme expansion, which is also seen with the unilocular variety of AB. As mentioned above, differential diagnoses should include giant cell granuloma and unicystic AB. On histopathologic examination, ABCs consist of blood-filled, nonepithelial-lined sinusoids (Figure 22). Surgical curettage and resection are the main treatment modalities. Recurrence occurs in 20%–50% [1].

Conclusion

This article has reviewed a selection of cystic jaw lesions and described a systematic approach to their radiologic evaluation.

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