



Abstract

The maxillary antrum and dental region share a close anatomical relationship, which means that dental infections and other odontogenic diseases can affect the maxillary sinus. There is variability in the literature of reported maxillary sinus mucosal hyperplasia of odontogenic origin, ranging from 58% to 78% and greater variability regarding the frequency of dentally induced maxillary sinusitis, ranging from 4.6% to 47%.

Determining the primary site of disease in these cases can be a diagnostic dilemma from both clinical and radiographic standpoints. Radiographic examinations such as conventional intraoral periapical radiography, dental panoramic radiography, standard plain film of the paranasal sinuses, CT, and MRI can be useful in evaluating sinus disease of odontogenic origin.

Some common dental pathologies that can affect the maxillary antra such as periapical cysts, follicular cysts, odontomas, keratocystic odontogenic tumors, dental implants and orofacial fistulas will be discussed and their imaging findings reviewed.

Objectives

1. Discuss the development of the maxillary sinus.
2. Describe the anatomical relationship between the dental region and the maxillary antrum.
3. Review the various radiologic examinations of both the maxillary sinus and adjacent dental structures.
4. Review the spectrum of odontogenic diseases affecting the maxillary sinus and their radiographic appearances.

Development of the Maxillary Sinus

- The maxillary sinus forms part of the paranasal sinuses, which include the sphenoid, ethmoid, and frontal sinuses.
- It is the first of these to develop, which occurs in the third month of fetal life.
- In the fifth month, the maxillary sinus grows into the maxilla.
- Final growth of the maxillary sinus occurs between 12 to 14 years of age, corresponding to eruption of the permanent teeth.
- Even after eruption of the permanent maxillary teeth, pneumatization can continue to occur.

Anatomical Relationship Between the Dental Region and the Maxillary Antrum

- The adult maxillary sinus is an air-filled cavity within the body of the maxilla.
- It is bounded by the dento-alveolar portion of the maxilla, the orbital floor, the lateral nasal walls, and the lateral wall of the maxilla.
- In dentate individuals, the continued pneumatization and expansion can occur such that only the sinus mucoperiosteum (Schneidarian membrane) is left.
- In edentulous individuals, continued expansion may leave only the alveolar bone between the sinus and oral cavity (as a result, patients may need an alveolar ridge augmentation prior to dental implants).
- The roots of the second molars are closest to the maxillary sinus, followed by the first and third molars, the second and first premolars, and canine.
- The attachment of the labial levator and orbicularis oculi muscles on the lateral wall of the maxilla can direct the spread of infection.
- The weak lateral wall is more easily penetrated than the sinus floor. As a result, odontogenic infections commonly present with soft tissue vestibular/fascial infections, and rarely sinusitis.

Radiographic Examination of the Maxillary Sinus and Adjacent Dental Structures

- Intraoral periapical radiography: Can help evaluate for a dental connection in maxillary sinus disease. Limited by lack of three-dimensional information and incomplete visualization of the maxillary sinus.
- Panoramic radiography: Can help establish the anatomic relationship between the dental structures and maxillary sinus. Limited spatial resolution.
- Plain film radiography: Occipitomental and lateral views are usually sufficient for the assessment of uncomplicated conditions. However, the dentoalveolar and inferior areas of the maxillary sinus overlap.
- Computed tomography: High spatial resolution helps delineate bony and soft tissue abnormalities and are best done in the coronal plane.
- MR: Superior soft tissue definition. Compact bone and teeth yield poor signal.

Odontogenic Diseases Affecting the Maxillary Sinus

- Sinusitis of odontogenic origin can arise from a periapical abscess, chronic apical or extensive marginal periodontitis, or after dental extraction.
- Maxillary sinus lesions may arise primarily from the antra or secondarily from the teeth.
- Cysts are classified as intrinsic if derived from the antra, and extrinsic when they arise from an odontogenic source.
 - Cysts arising from the sinus mucosa include pseudocysts, mucocoeles, and most commonly, retention cysts.
 - Only pseudocysts are associated with periapical/periodontal disease, as treatment of the dental source may lead to resolution of pseudocysts.
 - Intrinsic cysts should not be considered if they have a cortical lining.
- Extrinsic cysts include dentigerous cysts, calcifying odontogenic cysts, odontogenic keratocysts, and most commonly, radicular cysts (periodontal).
 - Benign tumors or tumor-like lesions can cause deviations, expansion, or erosion of the sinus walls.
 - These include ameloblastoma, odontoma, cementoma, ossifying fibromas, calcifying epithelial odontogenic tumor, squamous odontogenic tumor, odontogenic myxoma, and adenomatoid odontogenic tumor.
- Malignant tumors include gingival malignancies, adenoid cystic carcinoma, and sarcomas

Figure 1. 45-year-old female with a periapical cyst found incidentally on dental radiography. Periapical cysts, or radicular cysts, are the most common type of jaw cyst. They arise from epithelial residues in the periodontal ligament secondary to inflammation. (A) Panoramic radiograph demonstrates a round opacity in the left maxillary sinus with sclerotic borders (arrows). (B) Axial CT image shows an expansive process (arrow) with an intact sclerotic border (arrowhead) in the maxillary sinus. (C) Axial T2-weighted image demonstrates a fluid level (arrowhead) with high signal anteriorly (arrow). (D,E) Axial T1-weighted images pre and post contrast demonstrate uniform intermediate signal, with a thin peripheral rim of enhancement (arrow).



Figure 2. Follicular cyst in a 13-year-old female examined for an unerupted maxillary right first premolar. A follicular or dentigerous cyst arises from the accumulation of fluid between reduced enamel epithelium and crown. It encloses the crown and is attached to the neck of an unerupted tooth.

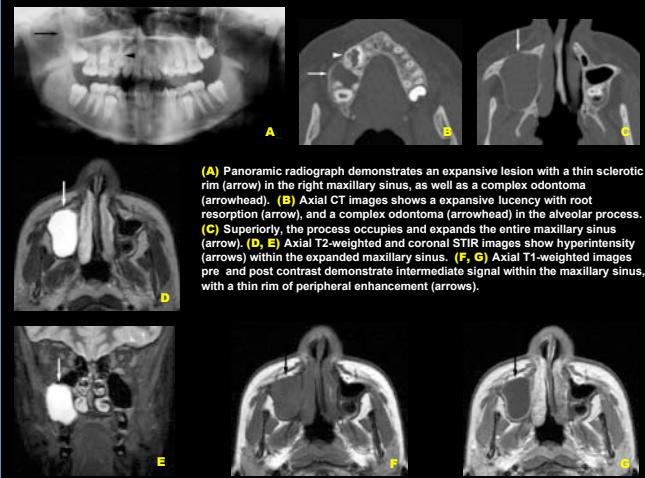


Figure 3. Keratocystic odontogenic tumor in a 16-year-old male with painless expansion of the maxilla, complicated by sinusitis. These are benign unicystic or multicystic intraosseous tumors, which have a characteristic lining of parakeratinized stratified squamous epithelium. They can be locally invasive and usually contain thick, yellow, cheesy material (keratin). (A) Axial CT images after biopsy and drainage shows an expansive process in the left maxillary sinus (arrow), with a multilocular component posteriorly (arrowheads). (B) More superiorly, the maxillary sinus is expanded with cortical defects in the posterior wall (arrow). (C) Coronal CT shows an air-fluid level, expansion of the palatal sinus wall (arrow), and lateral and alveolar sinus wall cortical defects (arrowheads).

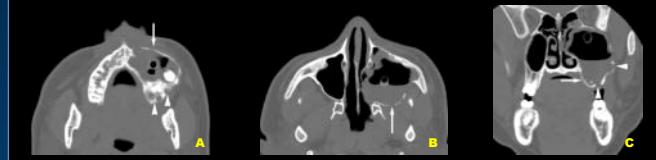


Figure 4. Odontoma found incidentally during orthodontic consultation in a 15-year-old female. Odontomas are a tumor-like malformation (hamartoma) in which enamel and dentin, and sometimes cementum is present. They are characteristically surrounded by a fibrous capsule and are usually found incidentally. (A) Panoramic radiograph demonstrates a large radiopaque mass in the right maxillary sinus (arrow). (B) Coronal CT image shows a large mass of cortex/enamel density in the right maxillary sinus (arrow) with surrounding fibrous capsule (arrow). The lateral sinus wall is destroyed and there is root resorption.

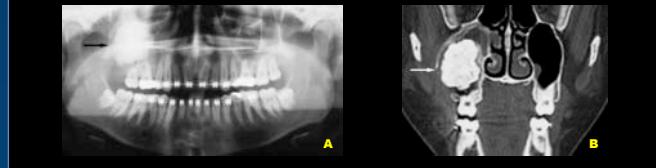
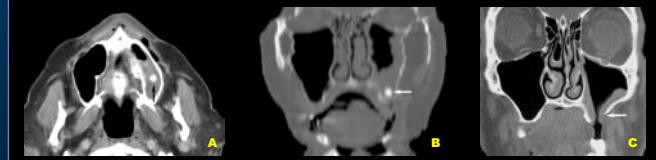


Figure 5. Dental implant complication in a 45-year-old male with pain and inadequate healing. This can result if implants penetrate into the maxillary sinus. Preoperative imaging can evaluate the dimension of the alveolar process, in order to determine the need for an alveolar ridge augmentation or sinus lift with bone grafting. (A) Panoramic radiograph shows three implants in place, but exact anatomical positioning cannot be evaluated. (B) Axial CT image shows two of the implants located within the nasal cavity (arrowheads) and one located in the maxillary sinus (arrow). (C) Sagittal reformatted CT image shows no bone support other than the sinus wall, and mucosal thickening around the implant.



Figure 6. Maxillary sinusitis due to a displaced root in a patient with a problematic tooth extraction. Other common causes of maxillary sinusitis related to dentistry include perforation of the sinus membrane during tooth extraction and extrusion of materials into the sinus during root canal therapy. (A,B) Axial and Coronal reformatted CT images shows the displaced root within the alveolar part of the maxillary sinus (arrow) and associated sinus mucosal thickening. (C) Orofacial fistula in another patient with a problematic tooth extraction. A coronal CT shows the opening between the oral cavity and maxillary sinus (arrow), with associated minimal mucosal thickening.



Acknowledgments

All images used in this poster are from Larheim TA and Westesson PL. Maxillofacial Imaging, Springer Germany, 2006. We also wish to thank our Radiology Graphics Department for their assistance in the preparation of this exhibit.

References

1. Larheim, TA, Westesson, P-L. Maxillofacial Imaging. Springer 2006.
2. Mehra P, Murad H. Maxillary sinus disease of odontogenic origin. Otolaryngol Clin N Am. 2004; 37(2):347-64.
3. Ericson, S. Conventional and computerized imaging of maxillary sinus pathology related to dental problems. Oral Maxillofacial Surg Clin N Am. 1992;4(1):153-61.
4. Maloney PL, Doku HC. Maxillary sinusitis of odontogenic origin. J Can Dent Assoc. 1968;34(1):591-603.
5. Legert KG, Zimmerman M, Steina P. Sinusitis of odontogenic origin: pathophysiological implications of early treatment. Acta Oto-Laryngologica. 2001;124(6):655-63.
6. Falk H, Ericson S, Hugoson A. The effects of periodontal treatment on mucous membrane thickening in the maxillary sinus. J Clin Periodontology. 1986;13:217.