Maxillary Sinus Pathology of Odontogenic Origin

Brady Huang, MD, Tore A. Larheim, DDS, PhD, P-L Westesson, MD, PhD, DDS
Division of Diagnostic and Interventional Neuroradiology, Department of Imaging Sciences
University of Rochester Medical Center, Rochester, New York

Abstract
The maxillary antrum and dental region share a close anatomical relationship, and odontogenic infections and tumors can affect the maxillary sinus. There is variability in the density of the bony wall between the antrum and surrounding structures, making radiographic evaluation important. Odontogenic diseases can affect the maxillary sinus directly or indirectly and can lead to inflammation. Commonly affected structures include the following:
- Odontogenic tumors
- Dental implants
- Oroantral fistulas

Some common dental pathologies that can affect the maxillary antra include:
- Periapical cysts
- Follicular cysts
- Keratocystic odontogenic tumors
- Odontogenic keratocysts
- Odontogenic myxomas
- Adenomatoid odontogenic tumors

The roots of the second molars are closest to the maxillary sinus, followed by the first and third molars, and the second and first premolars. The maxillary sinus is pneumatized in utero, starting in the third month of gestation and continues to age. Final growth of the maxillary sinus occurs between 12 to 14 years of age, corresponding to eruption of the permanent teeth.

Anatomical Relationship Between the Dental Region and the Maxillary Sinus
- 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 pterygoid process, the lateral nasal walls, and the lateral wall of the maxilla.
- 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.

Development of the Maxillary Sinus
- Odontogenic Diseases Affecting the Maxillary Sinus
- Cysts are classified as intrinsic if derived from the maxillary sinus, extrinsic if derived from adjacent structures.
- Cysts arising from the sinus mucosa include pseudo-cysts, mucocles, and most commonly, retention cysts.
- Cysts arising from the oral cavity and adjacent structures include dentigerous cysts, radicular cysts, and follicular cysts.
- Benign tumors or tumor-like lesions can cause deviations, expansion, or erosion of the sinus walls.
- The relationship between the dental structures and maxillary sinus.

Radiographic Examination of the Maxillary Sinus and Adjacent Dental Structures
- Intranasal periapical radiography: Can help evaluate for a dental connection in maxillary sinus disease. Limited by lack of three-dimensional information and isocenter deviation 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: Occasional and lateral views are usually sufficient for the assessment of uncomplicated conditions. However, the dentoskeletal and inferior areas of the maxillary sinus overlap.
- Computed tomography: High spatial resolution helps delineate bony lesions with high density but soft tissue poor signal.
- MRI: Superior soft tissue definition. Compacts bone and teeth yield poor signal.

Figure 1. Four-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 (arrow). (A) Axial CT image shows an expansive process (arrow) with an intact sclerotic border (arrowhead) in the maxillary sinus. (B) Axial T2-weighted images show high signal intensity fluid (arrows). (C,D) Axial T2-weighted images pre and post contrast demonstrate uniform intermediate signal, with a thin peripheral rim of enhancement (arrow).

Figure 2. Follicular cyst in a 15-year-old female examined for an unexplained maxillary right posterior pain. A follicular or dentigerous cyst arises from the accumulation of fluid between reduced enamel epithelium and crown. It encroaches on the crown and is attached to the neck of an unerupted tooth. (A) Panoramic radiograph demonstrates an expansive lesion with a thin sclerotic rim (arrow) in the maxillary sinus, as well as an unerupted odontome (arrowed). (B) Axial CT images show an expansive lucency with root resorption (arrow). (C) Axial T2-weighted images show hyperintense signal within the antral cavity (arrow). (D,E) Axial and coronal STIR images show multicystic intraosseous odontoma (arrowheads). (F) Axial T1-weighted images and post contrast demonstrate an intermediate signal within the maxillary sinus, with a thin rim of peripheral enhancement (arrow).

Figure 3. Keratocystic odontogenic tumor in a 15-year-old male with painless expansion of the maxilla, complicated by abscess. These are benign unicystic or multicystic intrasosseous tumors, which have a characteristic lining of parakeratinized or hyperplastic squamous epithelium. They can be locally invasive and are sometimes associated with aggressive behavior. The keratocystic odontogenic tumor expands into the maxillary sinus (arrowed) and extends into the labial cortex (arrow).

Figure 4. Odontoma found incidentally during orthodontic consultation in a 15-year-old female. Odontomas are a rare benign neoplasm (hamartoma) in which normal cells and tissues are present. They are characteristically surrounded by a fibrous capsule and are usually found incidentally. (A) Panoramic radiograph demonstrates a large odontoma in the right maxillary sinus (arrow). (B) Axial CT image shows a large mass of calcification in the right maxillary sinus (arrow) with surrounding bony lucency (arrowhead). The lateral maxillary wall is destroyed and there is soft tissue extension.

Figure 5. Dental implant complication in a 45-year-old male with pain and inadequate healing. This can result if there is a dental communication (fistula) between the maxillary sinus and mouth or if there is inflammation. (A) Panoramic radiographic shows an expansile process in the maxillary sinus, but no evident communication in place, and (B) Axial CT image shows two of the implants located within the maxillary sinus (arrowheads). They are located to the right maxillary sinus, and there is bony erosion, with adjacent widening of the sinus wall.

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 mucosa during tooth extraction and foreign body complications such as broken roots or teeth into the sinus during root canal therapy. (A) Axial CT image shows the displaced root within the alveolar part of the maxillary sinus (arrow) and associated sinus mucosal thickening. (B) Osteitis in another patient with a problematic tooth extracted. (C) Axial 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