Subject: Dental Anatomy and Oral Histology

MAXILLARY SINUS

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CONTENTS

• Introduction
• Functions of Maxillary Sinus
• Development & Age changes
• Developmental Anomalies
• Anatomy of Maxillary Sinus
• Microscopy of Maxillary Sinus
• Diagnostic Evaluation
• Applied aspects & Dental implications
• Conclusion
Maxillary sinus - Part of a series of pneumatic cavities, called the paranasal sinuses, that surround the nasal chamber and lie immediately adjacent to the orbit and dura of the anterior cranial fossa.
The Maxillary sinus is the pneumatic space that is lodged inside the body of the maxilla and that communicates with the environment by way of the middle nasal meatus and nasal vestibule.

- Largest PNS
HISTORY

• Maxillary sinus was first illustrated by Leonardo da Vinci & later the significance was given by Nathaniel Highmore.

• Highmore - the first to describe in detail the morphology of the maxillary sinus and to advance the idea of pneumatization by the sinuses.

• Antrum of Highmore. (Greek- Antron- cave)
Functional Importance

- Humidifying and warming inspired air
- Increasing surface area for olfaction
- Lightening the skull
- Resonance of voice
- Absorbing shock
- Contribute to facial growth
- Production of bactericidal lysozyme to the nasal cavity.
EMBRYOLOGICAL DEVELOPMENT

• First to develop in 2\textsuperscript{nd} month of IU life.

• 32mm CRL in an embryo
Horizontal shift of palatal shelves

→

Fusion of palatal shelves

→

Nasal septum separate the secondary oral cavity from 2 nasal chambers

→

Expansion of lateral nasal wall—wall begins to fold
3 nasal conchae & 3 meatuses

Middle meatus expands into lateral nasal wall in an inferior direction (cartilagenous skeleton of lateral nasal capsule)

Occupies future maxillary body
Development of palate

A. Intermaxillary segment and maxillary extensions. B. From intermaxillary segment originate part of middle sulcus of upper lip (philtrum), next ventral part of upper jaw (premaxilla) in the extent of four dentes incisivi and also primary palate having triangular shape.

Palate development. A. Frontal section of head in 8th week of development. Tongue moves caudally and palate plates moved into horizontal position. B. Frontal view of palate plates that are already in horizontal position but not fused yet so that nasal septum could be visible.

Palate development. A. Frontal section of head in 7th week of development. Palate plates are in vertical position on both sides of tongue foundation. B. View of palate plates before their horizontalization. Primary palate is not yet separated.

Palate development. A. Frontal section of the head in 10th week. Palate plates fuse and connect with nasal septum. B. Foramen incisivum is preserved in the place of fusion of primary and secondary palate.
Nasal Turbinates

- Superior meatus
- Superior turbinate
- Ethmoidal sinuses
- Ethmoidal air cell
- Middle meatus
- Middle turbinate
- Inferior meatus
- Maxillary sinus
- Inferior turbinate
- Nasal septum
- **Maxillary sinus** - first to be developed and aerated at birth.

- Shows biphasic growth. The first growth phase during the first three years of life, and the next growth phase occur between 7 – 18 years.

- Initially located medial to the orbit, later sinus extends laterally & inferiorly.

- Floor of sinus does not extend below the level of nasal cavity until the eruption of permanent teeth.

- **50mm CRL fetus - 1mm MS** - First glandular primordia appears
AGE CHANGES

BIRTH
- 7-16mm (AP)
- 2-13mm (SI)
- 1-7mm (ML)

1 YEAR
- 15
- 6
- 5.5

15 YEAR
- 31.5
- 19
- 19.5
AGE CHANGES

ADULT
• 34mm (AP)
• 33mm (SI)
• 23mm (ML)

OLD AGE
• Resorption of ridge - thinning of sinus wall
• Extension of sinus till crest
SHAPE OF MAXILLARY SINUS

- At birth - tubular
- At childhood - oval
- At adult - pyramidal in shape
ANATOMY OF THE MAXILLARY SINUS

• Lies primarily in the maxilla
• The sinus is found to vary widely in shape and accordingly classified into four types -
  – Semi-ellipsoidal
  – Paraboloid
  – Hyperbolic
  – Cone shaped

**Thickness** of the bony walls - 2 to 5 mm
Structure and Variations

• It is four-sided pyramid
• The base is facing medially toward the nasal cavity and apex of which is pointed laterally toward the body of the zygomatic bone.
4 SIDED PYRAMID

• Base (facing medially) - lateral wall of nose

• Apex - pointed laterally towards body of zygomatic bone
4 sides

- Anterior - Facial surface of body of maxilla
- Inferior - alveolar & zygomatic process
- Superior - orbital surface
- Posterior - infratemporal surface
• Base- thinnest wall
• Presents perforation-osteum, at the level of middle meatus, within hiatus semilunaris (Crescent-shaped groove in the lateral wall of the nasal cavity)
• In course of development MS often pneumatizes the maxilla beyond the boundaries of the body

• Some of the processes of the maxilla become invaded by the air spaces-these expansions are ref to as recesses
  – Alveolar process-50%
  – Zygomatic process-41.5%
  – Frontal process-40.5%
  – Palatine process-1.75%
• Occurrence of zygomatic recess brings the superior alveolar neurovascular bundles into proximity with the space of the sinus.

• The alveopalatine recess pneumatizes the floor of the sinus adjacent to roots of first molar & less often second premolar, first premolar & second molar, in the order of frequency.

• Height and width of the maxillary sinus in edentulous cadavers are significantly greater than those of dentate cadavers.
• Alveopalatine recesses reduce the amount of bone between the dental apices and sinus space—char. by 3 depressions separated by 2 incomplete bony septa.

Fig. 17-1
Septa in the maxillary sinus give a compartmentalized appearance to the sinus.
Fig. 17-1

Septa in the maxillary sinus give a compartmentalized appearance to the sinus.
Fig. 17-2

Maxillary sinus showing septa that divide it into separate compartments.
Intraoral periapical radiograph:

In these radiograph the roots of the maxillary teeth may appear to project directly into the sinus and may produce conical elevations on the floor of the sinus, yet there is always a layer of bone and mucosa covering these roots.
Blood supply

- Facial artery and Branch of third part of maxillary artery (pterygopalatine part)
  - Posterior superior alveolar artery
  - Infra-orbital artery
  - Greater palatine artery.

- Venous drainage - to the anterior facial vein, sphenopalatine vein and pterygoid plexus.
Nerve supply

Maxillary division of trigeminal nerve

✓ Infraorbital nerve.

✓ Posterior, middle & anterior superior alveolar nerves.

✓ Greater and lesser palatine nerves.
Lymphatic drain

The lymphatic drain of the sinus is through the networks serving nasopharynx or the submandibular lymph nodes.
MICROSCOPIC FEATURES OF THE MAXILLARY SINUS

• Lining consists of three layers:
  – an epithelial covering
  – a lamina propria
  – the periosteum.

• Thickness of combined layers is generally less than 1 mm
• Sinus lining- Rapid regenerative capability

• Mainly by ingrowth from margins of mucosal defect, from islands of mucosa left behind
Microscopic Features

- Epithelial layer
- The basal lamina
- Subepithelial layer including the periosteum
• The epithelium- pseudo-stratified, columnar and ciliated

• Derived from- olfactory epithelium of middle nasal meatus.
- Columnar ciliated cells - numerous cellular type
- Basal cells, columnar nonciliated cells and mucous producing, secretory cells called as Goblet cells.
• A ciliated cells encloses nucleus, cytoplasm with numerous mitochondria and enzyme-containing organelles.
• Goblet cell is a flask shaped secretory cell- golgi apparatus, zymogen granules
• Secretory mucosubstances released by exocytosis
• Basal bodies serve as the attachment of the ciliary microtubules to the cells – characteristic of the apical segment of the cell

• Cilia- composed of 9+1 pairs of microtubules

• Provide motile apparatus to the sinus epithelium
• Ciliary beating- mucous blanket moves from the sinus interior towards the nasal cavity

• Direction- genetically programmed
- Mucous secretion forms a blanket
- Cilia are constantly beating at an approximate rate of 1000 strokes/min
- Flow rate of the mucous blanket -6 mm/min.
• Mucous blanket covering the epithelial surface is necessary to maintain ciliary function.

• Resistance of the sinus mucosa to infection and easier penetration for micro-organism
• Lamina propria - thin layer of connective tissue
• Thinner than that of nasal mucosa
• Fewer mucous, seromucous, and serous glands
• Secretion from these glands is controlled by divisions of the autonomic nervous system.
• Numerous nonmyelinated and fewer myelinated axons
• Subepithelial glands –
• Serous – Ninhydrin Schiff, Sudan black B
• Mucous – Alcian blue

• Myoepithelial cells
Periosteum-

- Adherent to the overlying lamina propria
- Can be stripped easily from underlying bone.
- Prone to edematous swelling on slight irritation
Clinical examination

Inspection

✓ Assess asymmetry.

✓ Color of overlaying skin.
Palpation

- Tenderness.
- Swelling and expansion.
- Depression.
Examination of nasal passage

✓ Nasal patency.

✓ Pus discharge.

✓ Nasal polyps.

✓ Erythema, change in the color of nasal mucosa.
Transillumination
Radiographical examination

**INTRA ORAL**
Peri apical
occlusal
Lateral occlusal
Radiographical examination

EXTRA ORAL
Orthopantomogram (OPG)
Occipitomental (WATERS VIEW )
SUBMENTO VERTEX VIEW
PA VIEW
Special radiographical investigations

• CT scan
• MRI
• Ultrasound
• Endoscopy
Microbiology & histological examination:

- Culture and sensitivity and biopsy.
Clinical consideration/Pathology

- Proximity with first molar root
- Congenital anomalies
- Inflammatory diseases
- Cysts and odontogenic infection
- Bone tumors
- Neoplasia
- Trauma
- Implants
PROXIMITY WITH FIRST MOLAR ROOT

• Dental infection: Infection from the maxillary premolar and molars can easily communicate and infect the maxillary antrum.

• Oroantral Communication: Traumatic extraction of maxillary teeth can cause oroantral communication.
• **Root Pieces:** Root pieces of maxillary teeth may sometimes be accidentally forced into the maxillary antrum.

• **Maxillary Sinusitis:** Thickened and inflamed sinus lining compresses the nerve supply of the maxillary posterior teeth causing tenderness of the maxillary teeth.
  – Neuralgia
Fig. 17-5
Maxillary sinusitis caused by apical infection and extensive periodontal lesions involving the molars and premolar. Notice the cloudiness (radiopacity) of the sinus (s).
Fig. 17-7

Apical infection associated with the first molar. A thickened sinus mucosa (arrow) surrounds the lesion in response to the apical infection.
Congenital anomalies

- Agenesis
- Aplasia/hypoplasia
- Cleft palate
- Supernumerary sinus
- Congenital syphilis
- Pituitary gigantism
Inflammatory diseases

√ Bacterial infection.
   – Syphilis (spirochetes)
   – Streptococci
   – Staphylococci
   – pneumococci

√ Fungal infection.

√ Viral infection.
   – Common cold
Cysts and odontogenic tumors

• Odontogenic cysts:
  √ Radicular cysts.
  √ Residual cysts.
  √ Dentigerous cysts.
  √ Premordial cysts.

• Non-odontogenic cysts.
  √ Mucocele and retention cysts.

• Odontogenic tumors:
  √ Ameloblastoma.
  √ Myxoma.
Bone tumors

✓ Fibrous dysplasia.

✓ Ossifying fibroma.

✓ Osteoma.

✓ Giant cell lesions.
Neoplasia

✓ Squamous cell carcinoma.

✓ Adenocarcinoma.

✓ Sarcoma (osteosarcoma).

✓ Ewing’s sarcoma.
Trauma

✓ Tuberosity fracture.
✓ Dentoalveolar fracture.
✓ LeFort’s fractures.
✓ Zygomatic complex fracture.
✓ Orbital floor fractures.
✓ Establishment of oro-antral fistula.
Fig. 17-3

Pneumatization of the sinus. Pneumatization is the enlargement of a sinus by resorption of alveolar bone that formerly served to support a missing tooth or teeth and then occupies the edentulous space. A thin cortex remains over the alveolar ridge (arrow) to maintain a normal contour.
Implants in the maxilla lack sufficient bone height along maxillary sinus, produces significant difficulty for placement of implants in edentulous maxillary jaw.

In that case, we go for sinus lift, which is a surgical procedure which aims to increase the amount of bone in the posterior maxilla.
SINUS LIFT

- Direct
  (Caldwell luc)

- Indirect
Conclusion:

• Important and interesting anatomic structure for dental surgeon.

• Due to close association of sinus and oral cavity, diseases involving these structures may produce confusing symptoms.

• Knowledge of the anatomical relationship between the maxillary sinus floor and the maxillary posterior teeth is important for the preoperative treatment planning of maxillary posterior teeth. Clinicians must be particularly cautious when performing dental procedures involving the maxillary posterior teeth.
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THANK YOU