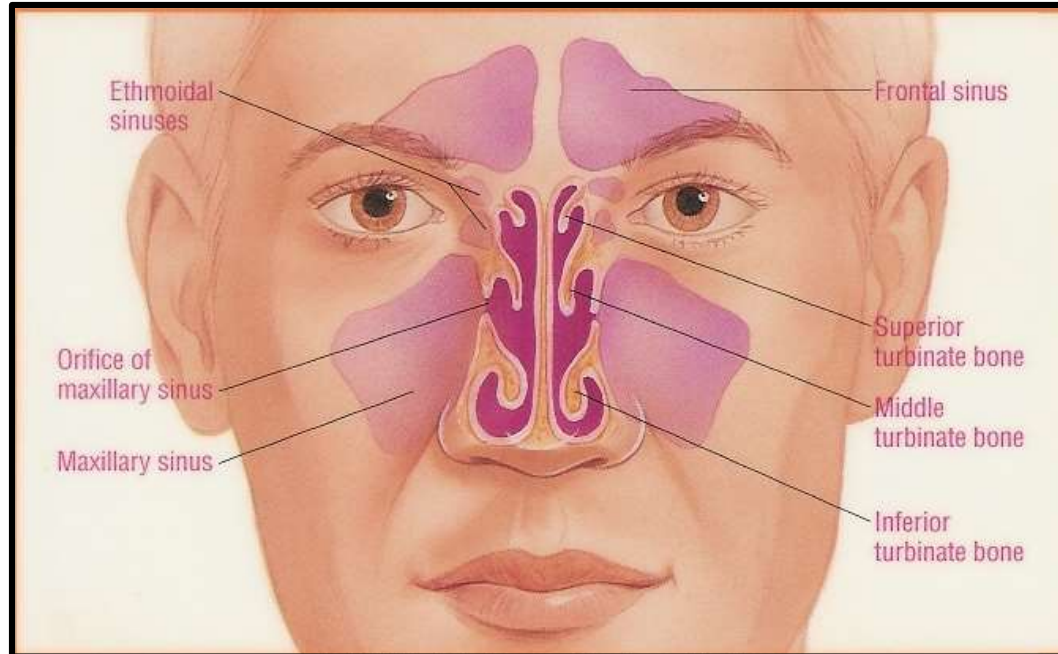


# MAXILLARY SINUS



*Presented by:- Dr. Priyanka H.Sawant*

*Guided by:- Dr. N. Vimala*

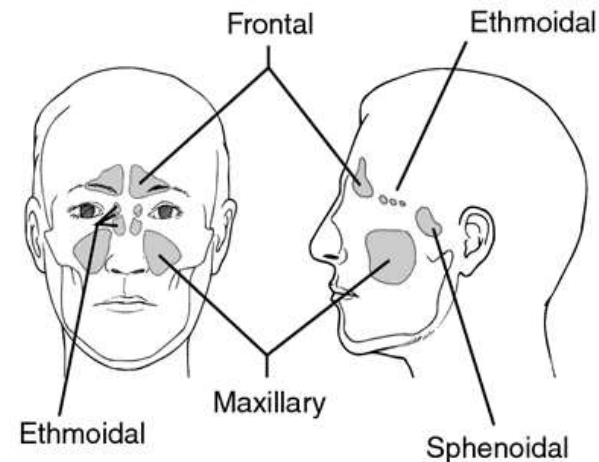
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# INTRODUCTION

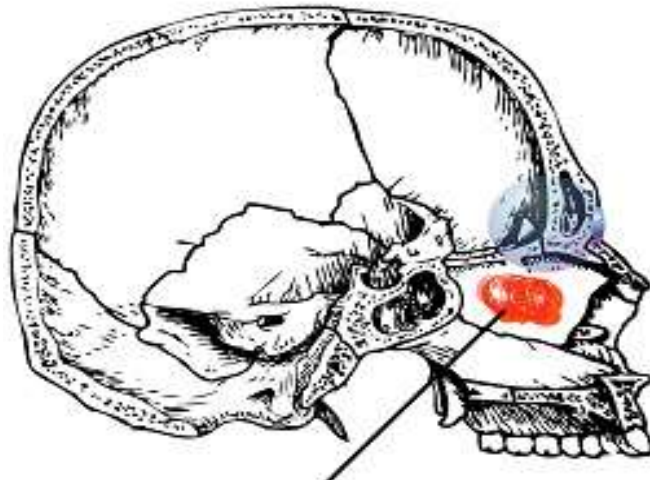
- Paranasal Sinuses (PNS) are air containing bony spaces around the nasal cavity
- These spaces communicates with the nasal airway and forms the various boundaries of nasal cavity and named for the bones in which they locates.
- There are 4 pairs of paranasal sinuses(bilaterally) viz

- Maxillary air sinus*
- Frontal air sinus,*
- Ethmoidal air sinus,*
- Sphenoidal air sinus.*



# Definition

- *“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 the nasal vestibule”*



Maxillary Sinus

( Ref: Orban's Oral Histology – 10th Ed.)

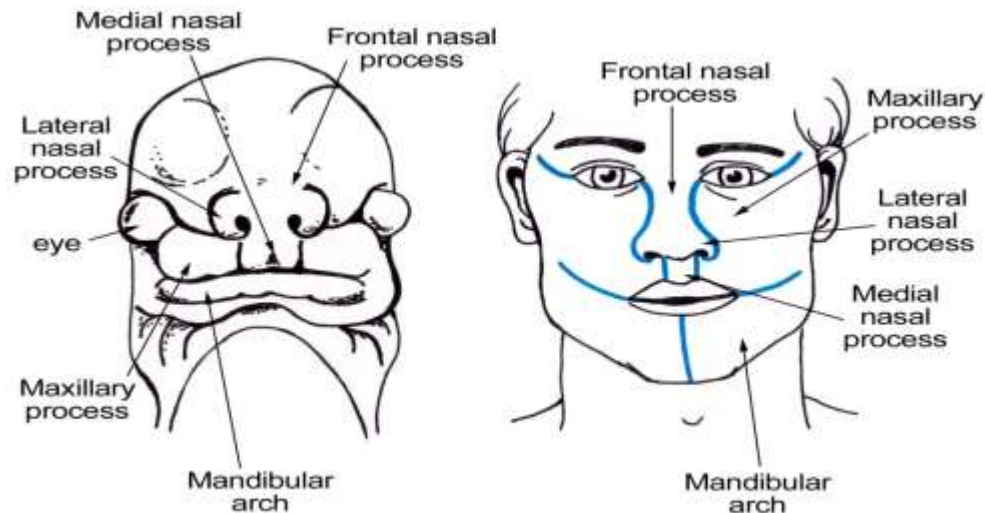
## DISCOVERY

- The maxillary sinus was first discovered and illustrated by Leonardo da Vinci, but the earliest attribution of significance was given by NATHANIEL HIGHMORE.
- The British surgeon and anatomist who described it in detail in the year 1651

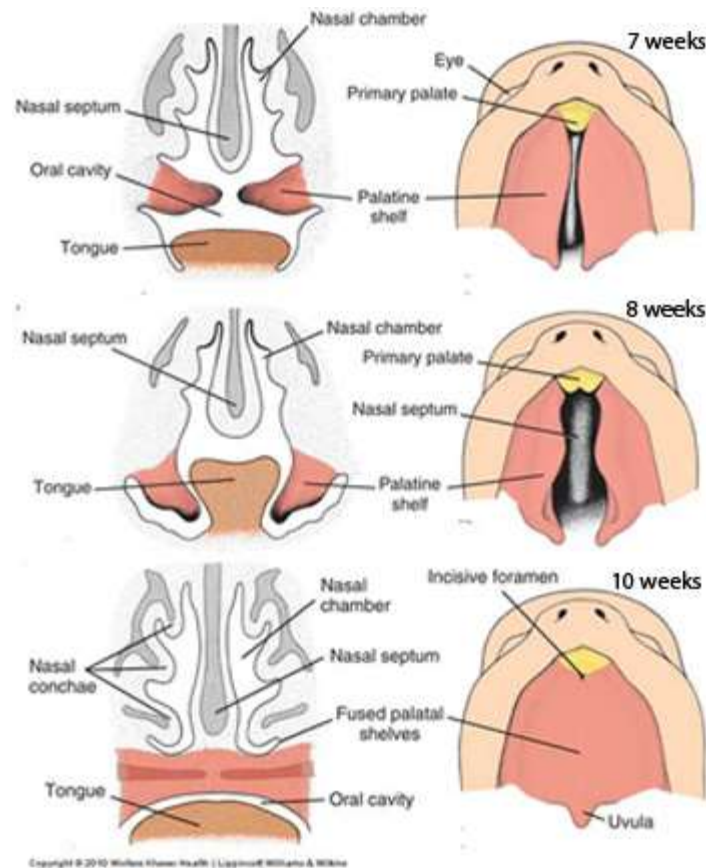


# DEVELOPMENT

- Maxillary sinus is the first of the PNS to develop.
- 4th week I.U.L. – dorsal portion of *1st Pharyngeal arch* forms the Maxillary process, which extends forward and beneath the developing eye to give rise to the maxilla.



# Initial development of the maxillary sinus follows a number of morphogenic events in the differentiation of nasal cavity



Horizontal shift of the Palatal Shelves & fusion with one another.



Nasal Septum separates the 2<sup>o</sup> Oral cavity from the two nasal chambers.



Influences further expansion of the lateral nasal wall & 3 wall begin to fold.



3 Conchae & Meatuses arise

# 3 Meatus



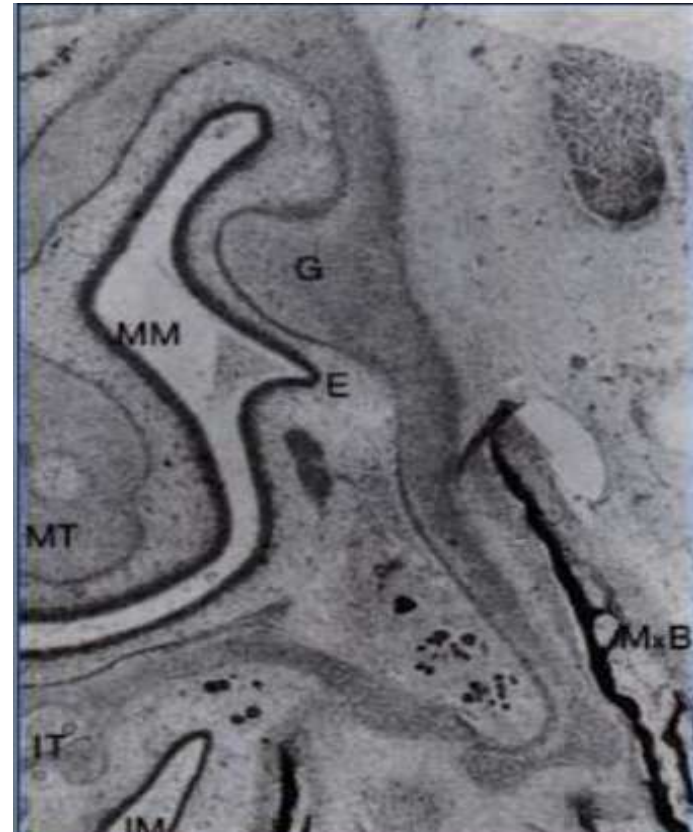
## Superior & Inferior Meatus

Remain as *shallow depressions* along the lateral nasal wall for first half of I.U. life

## Middle Meatus

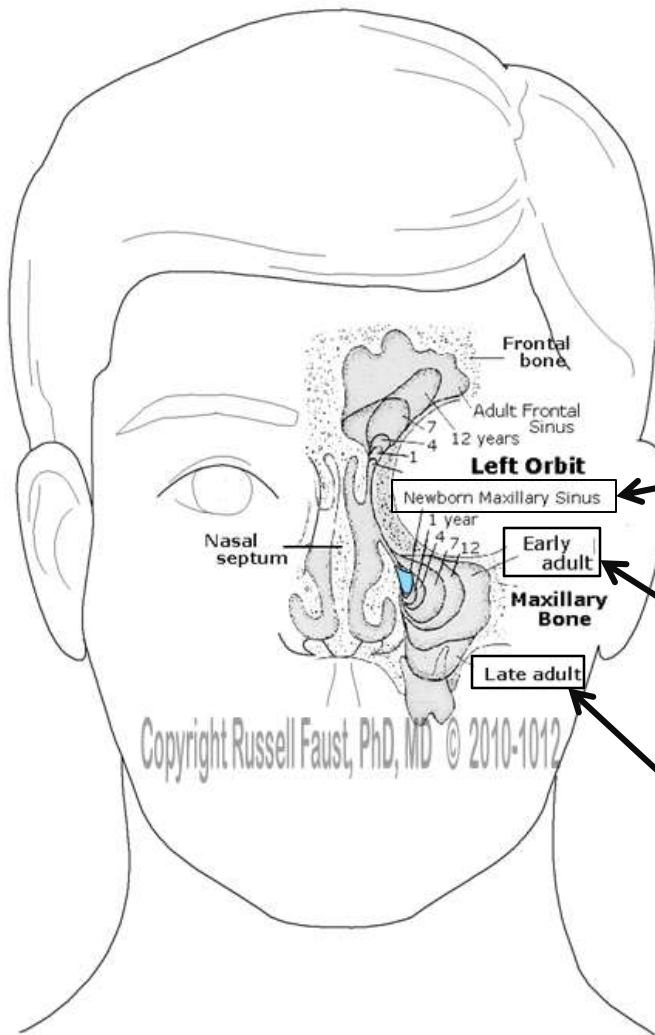
*Expands* immediately into lateral Nasal wall in an inferior direction occupying more of the further Maxillary body

*Development of sinus starts at 12 weeks as an evagination of the mucous membrane in the lateral wall of the middle meatus of the nose when the nasal epithelium invades the maxillary mesenchyme (Kitamura 1989)*



E evagination IM inferior meatus IT inferior turbinate MM middle meatus MT middle turbinate MxB maxillary bone

In its development M.Sinus is:



- Tubular at birth
- Ovoid in childhood
- Pyramidal in adulthood

# DIMENSION OF SINUS FROM BIRTH TO OLD AGE

0-3 years



- At birth Filled with deciduous tooth germs
- Size: 7mm x 4mm x 4mm. Vol 6-8ml (Sperber, 1989)
- 20<sup>th</sup> month-posterior development (Ennis 1937)
- 3<sup>rd</sup> year : ½ Adult size (Ennis 1937)

3-4 years



- Increase in width with facial growth
- Position: 2<sup>nd</sup> deciduous molars and crypts of 1<sup>st</sup> permanent molars. (Sperber 1989)

7-9 years



- Size: 27mm x 18mm x 17mm
- Growth corresponds to permanent teeth eruption (Ennis 1937)

*Anteroposterior/Height/Width*



9-12 years

- Antral floor same level with nasal floor



12-15 years

- Floor of sinus 5-12.5 mm below nasal floor
- Size: 32mm x 33mm x 25mm (Turner 1902)
- Vol 15-20 ml (Nivert 1930)
- P Sinus floor :  
1<sup>st</sup> molar 2<sup>nd</sup> molar 2<sup>nd</sup> premolar



old age

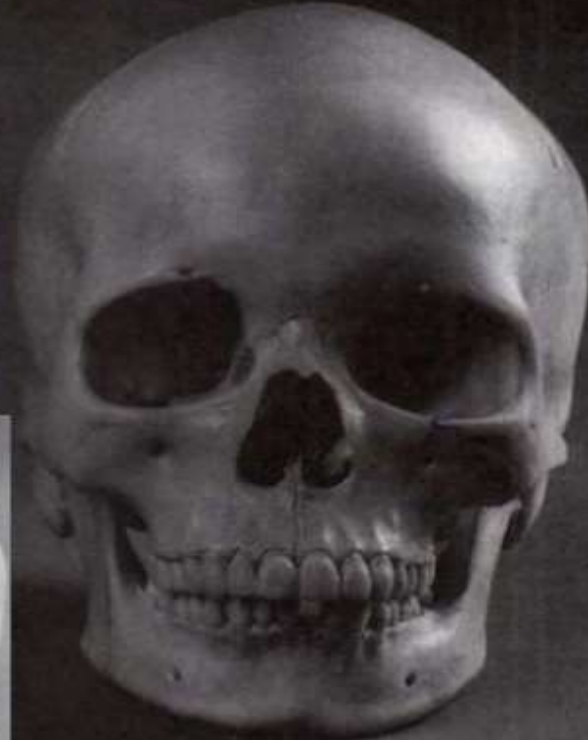
- Resorption of ridge with continued sinus pneumatization which leaves a thin layer of cortical bone separating the sinus mucosa from oral mucosa

Skull showing the proportion of middle 3rd to the rest of the face



Neonate

Child age 5

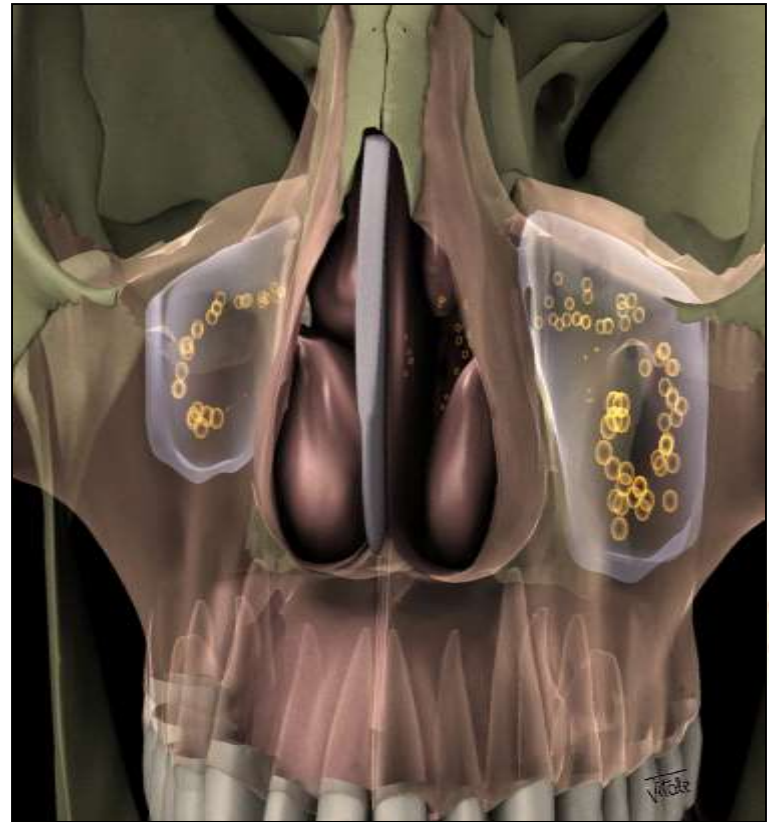


Young Adult

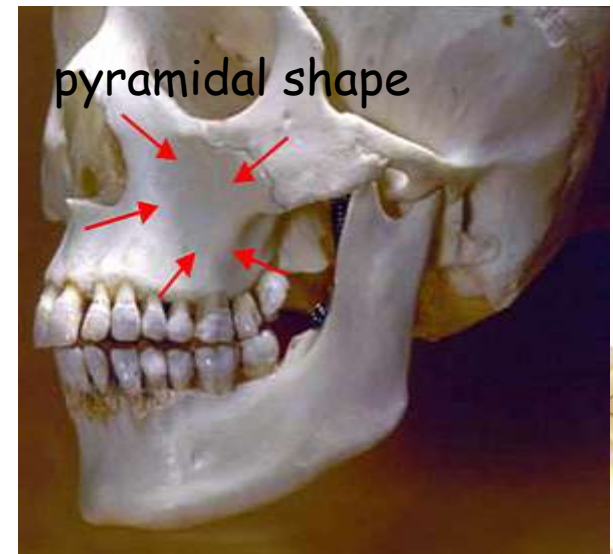
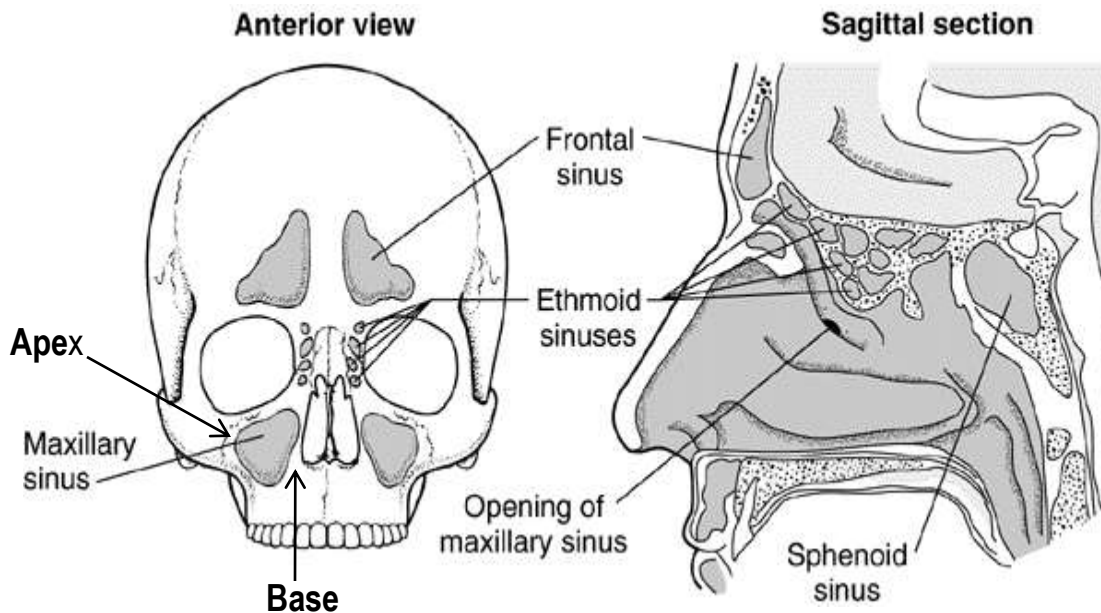


# Anatomy of Maxillary Sinus

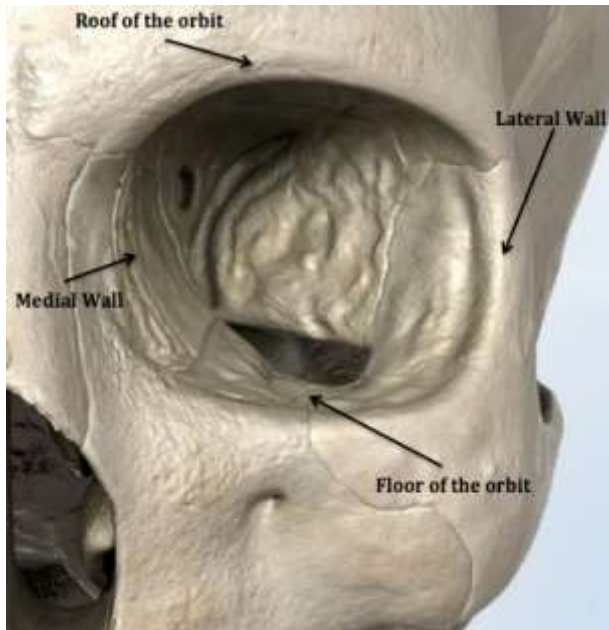
- Maxillary Sinus  
Previously called as  
“Maxillary Antrum of Highmore”
- Largest of the PNS
- Pyramidal shaped cavity within the body of the Maxilla



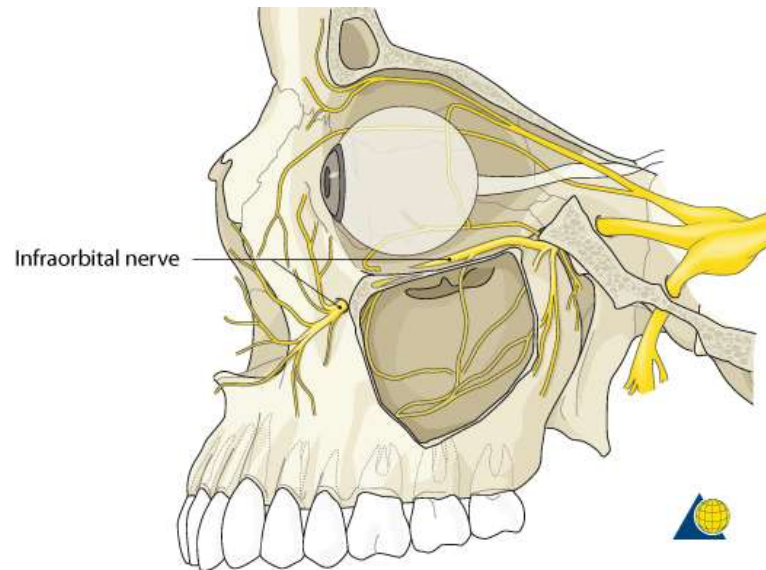
- Pyramidal in shape with the *base* of the pyramid forming the lateral nasal wall and *apex* at the root of the zygoma.



# ROOF OF THE ANTRUM

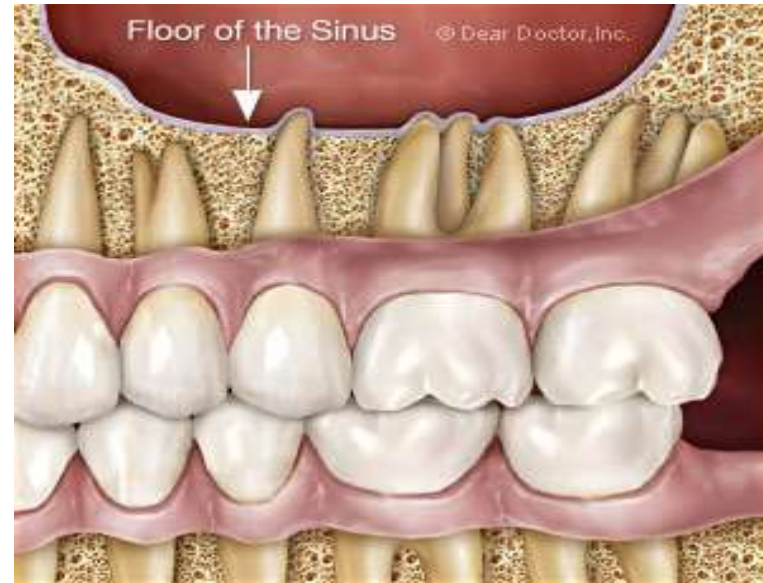


Formed by *floor of the orbit* and is transversed by the infraorbital nerves. It is *flat* and slopes slightly anteriorly and laterally.



# FLOOR OF THE SINUS

- *Curved* rather than flat formed by alveolar process of the maxilla. and lies *about 1cm* below the level of the floor of the nose.
- Closely related to root apices of the maxillary premolar and molar.



# ANTERIOR WALL

- Formed by the *facial surface* of the maxilla.
- *Canine fossa* is an important structure of this wall.

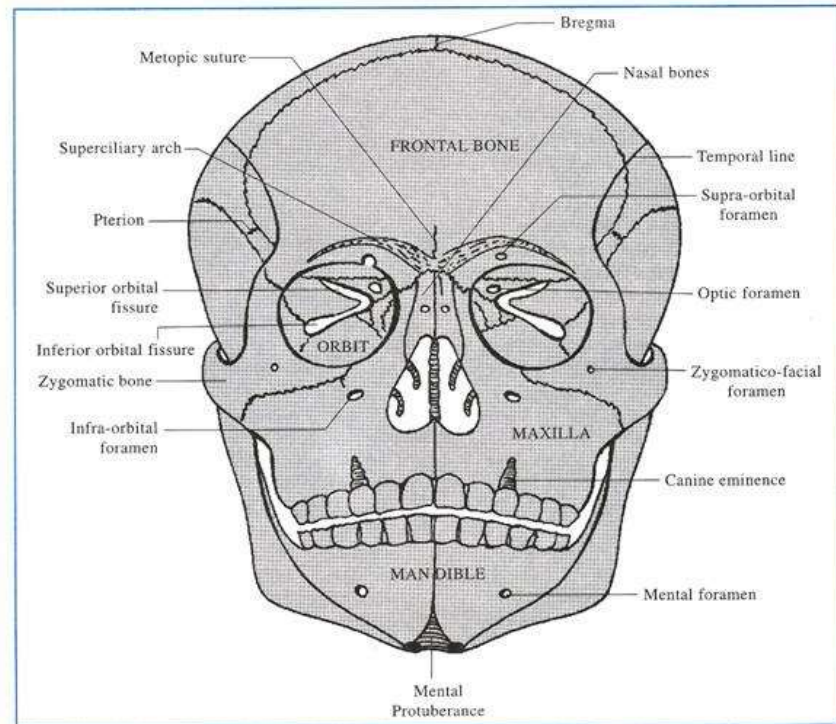
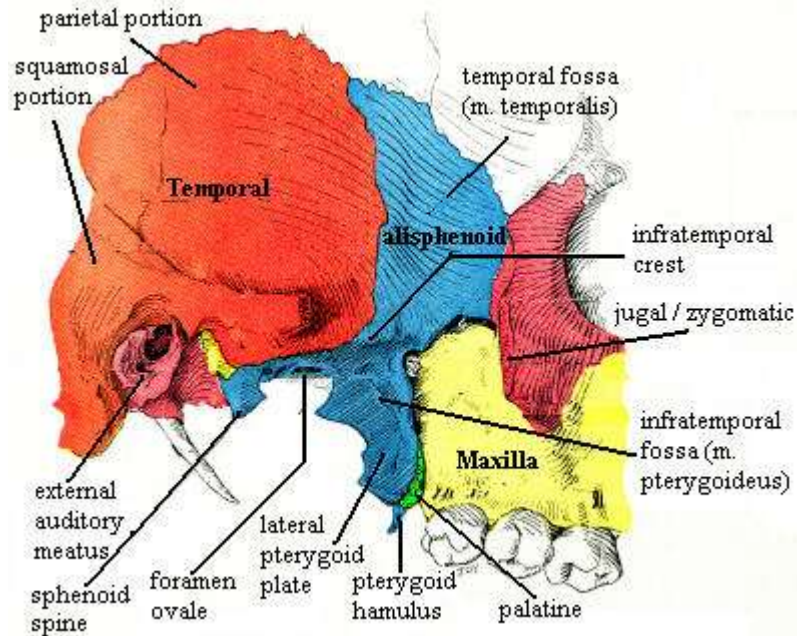


Fig. 1.40. *Norma frontalis.*

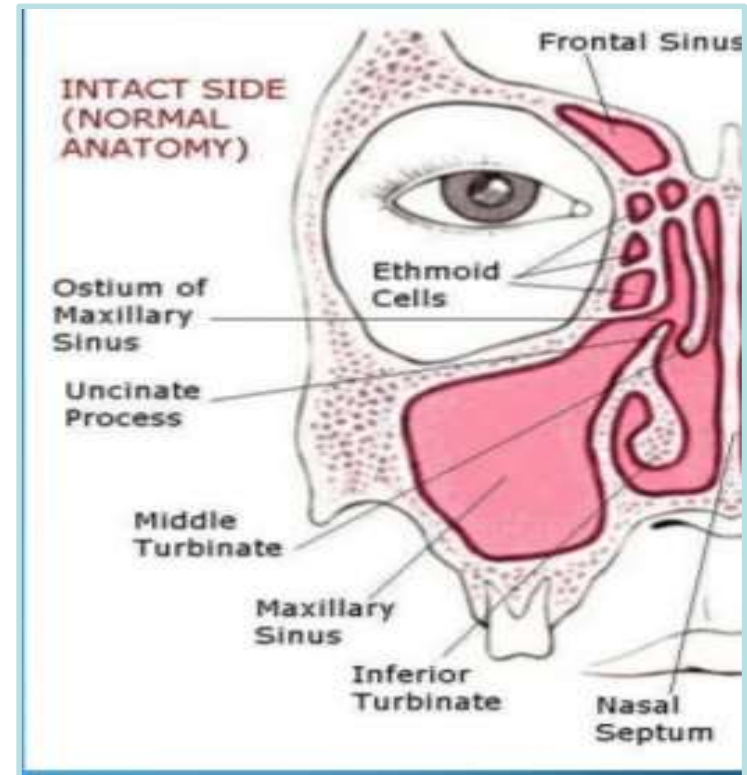
# POSTERIOR WALL

- Formed by *sphenomaxillary wall*.
- A thin plate of bone separate the antral cavity from the infratemporal fossa.



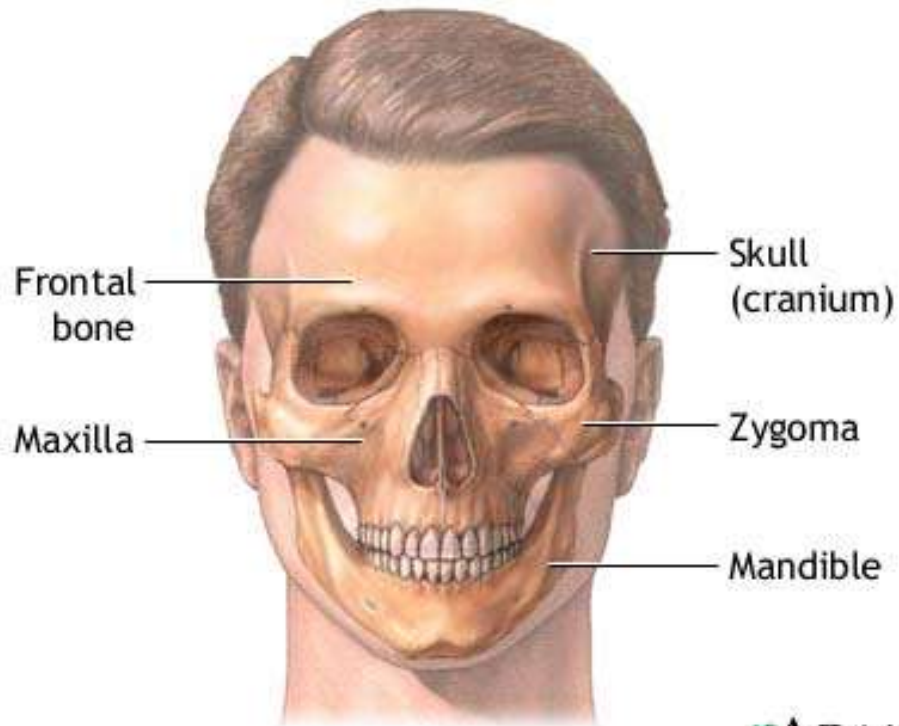
# MEDIAL WALL

- Bounded by the *nasal cavity*
- The opening of the sinus is closer to the roof and thus at a higher level than the floor.



# LATERAL WALL

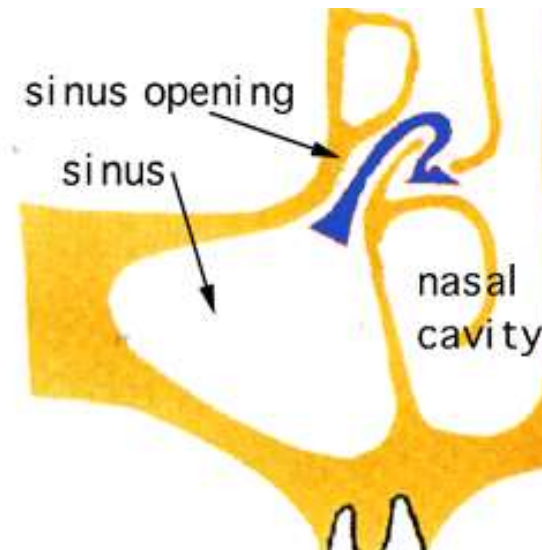
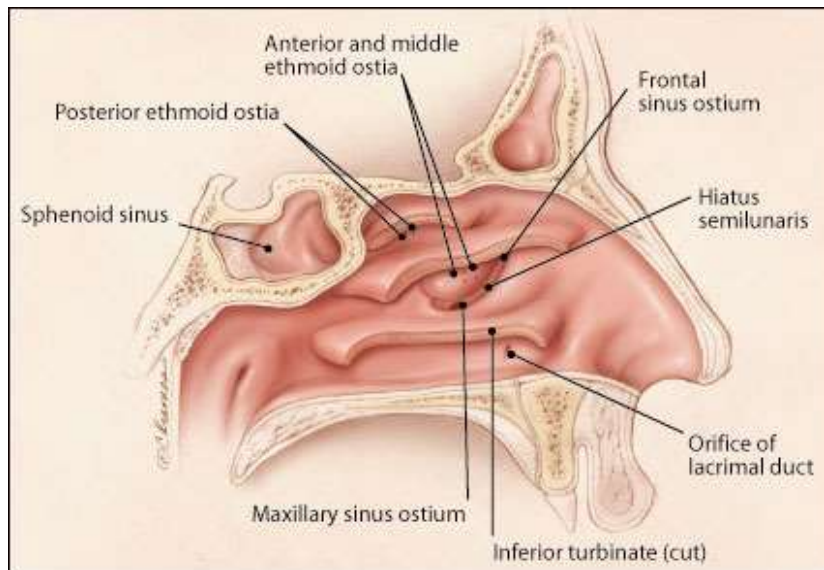
- Related to *zygoma and cheek*.



ADAM.

## Ostium

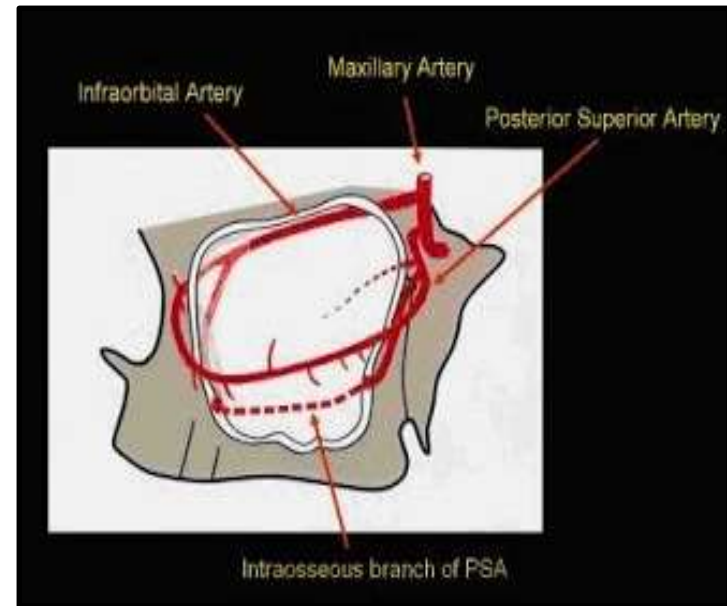
- Ostium of the maxillary sinus is situated high up in medial wall and opens into the middle meatus of the nose in the lower part of the hiatus semilunaris.
- Poorly placed from the point of view of free drainage.
- An accessory ostium is also present behind the main ostium in 30% cases.



## Arterial supply-

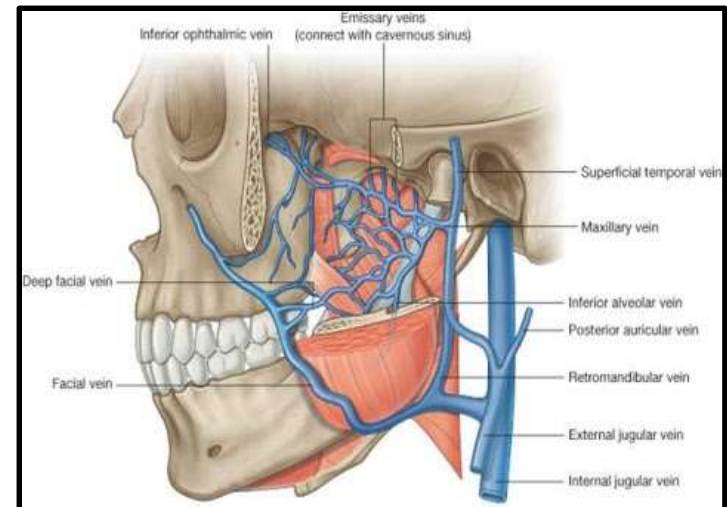
Branch of third part of maxillary artery (pterygopalatine part)

1. Posterior superior alv artery
2. Infra-orbital artery
3. Greater palatine artery.

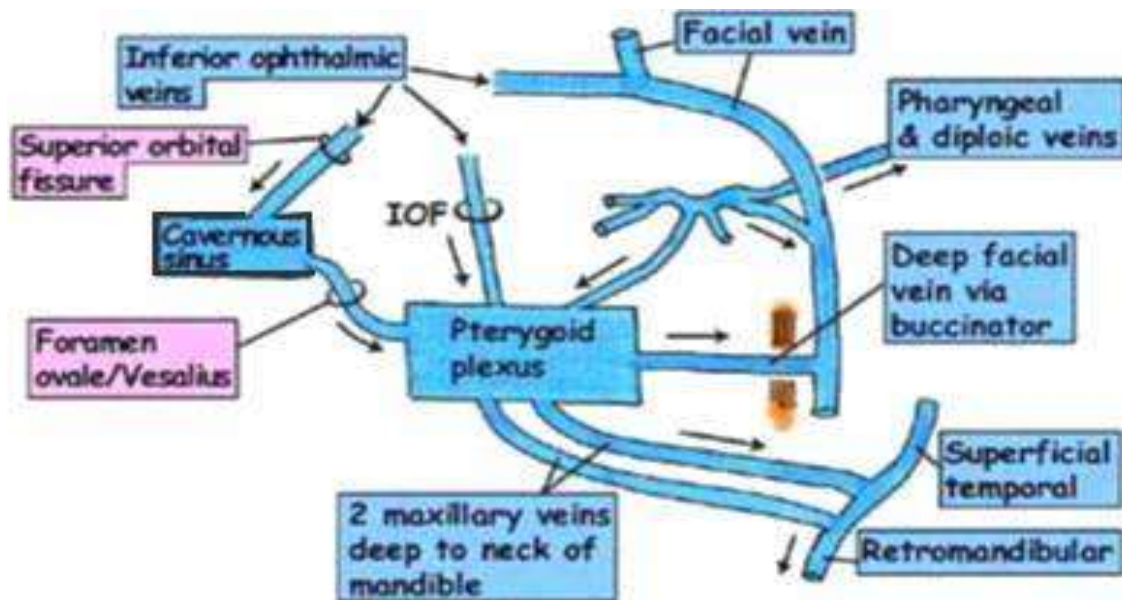


## Venous drainage-

1. Anteriorly- Facial vein
2. Posteriorly- Pterygoid venous plexus

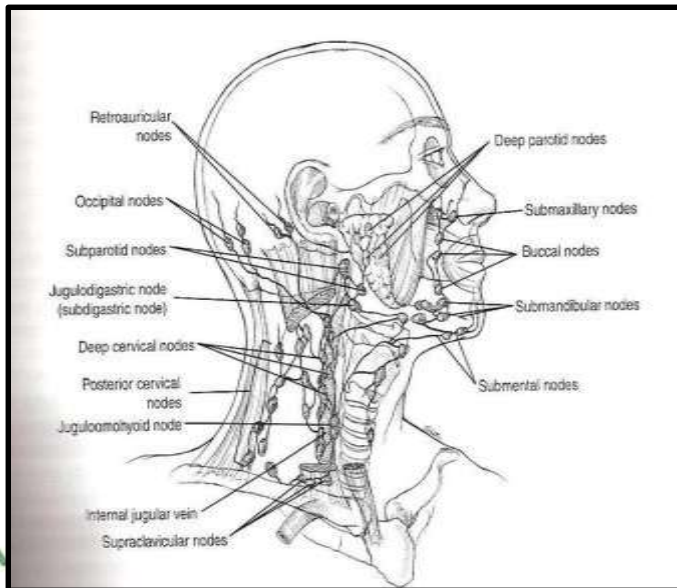
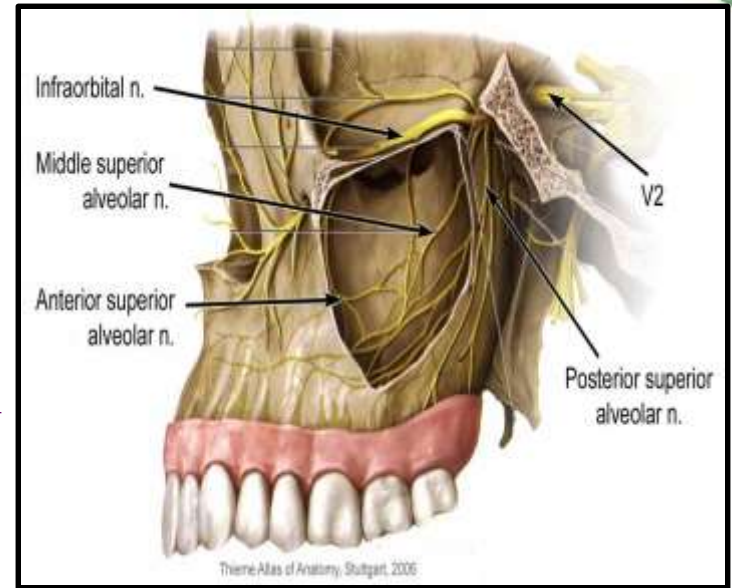


*Infection from the maxillary sinus may spread to involve cavernous sinus via any of its draining veins as the pterygoid plexus communicates with the cavernous sinus by EMISSARY VEIN.*



## Nerve supply

1. Anterior superior alveolar n
2. Middle superior alveolar n
3. Posterior superior alveolar n
4. Infra-orbital nerve



## Lymph drainage

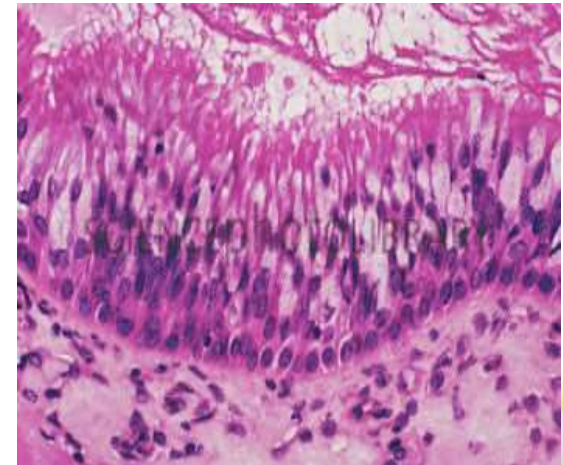
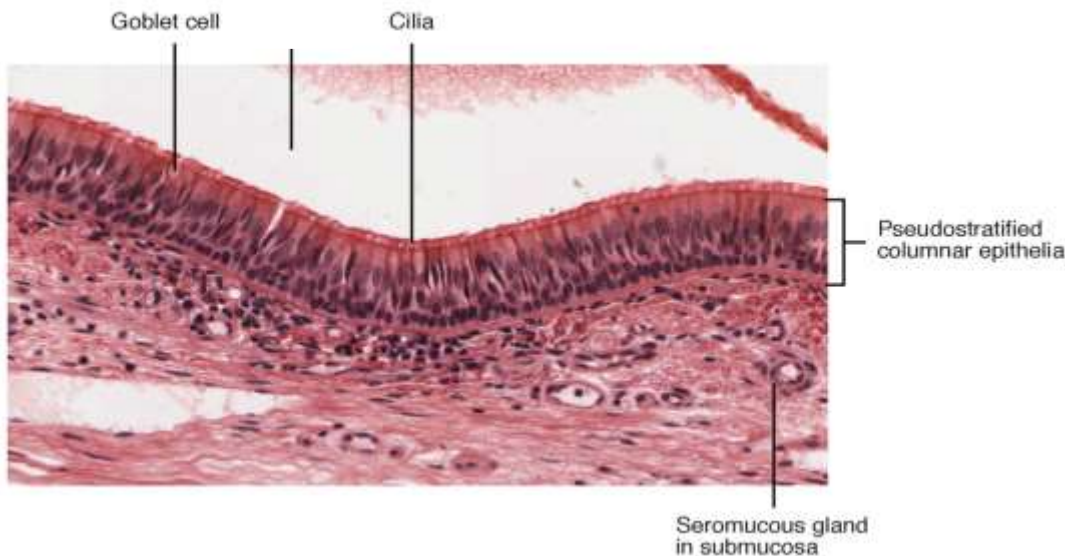
1. Submandibular lymph nodes
2. Deep cervical lymph node
3. Retro pharyngeal lymph nodes

## Microscopic Features

- The maxillary sinus is lined with a mucous membrane of the respiratory type.
- The antral mucous membrane is formed of:
  1. An epithelial layer resting on a basement membrane.
  2. A subepithelial connective tissue layer.

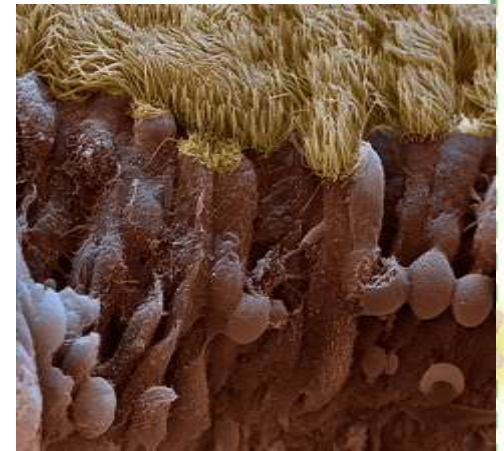
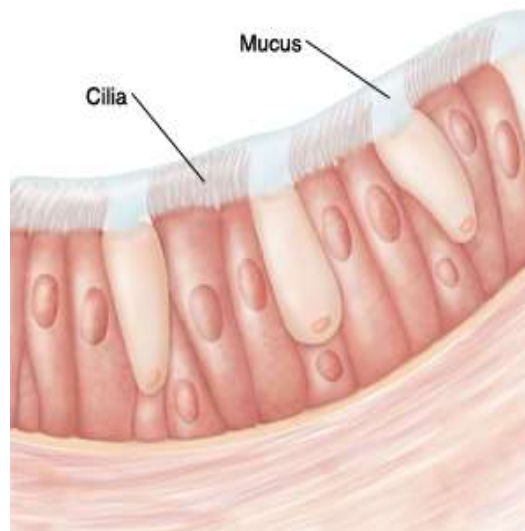
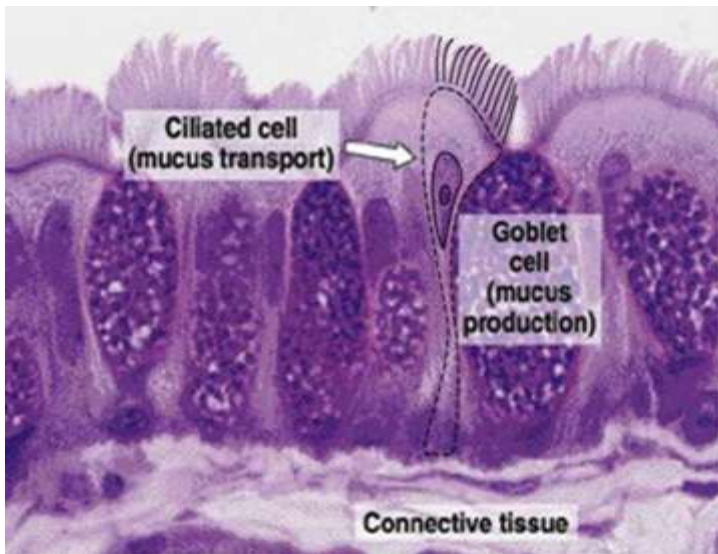
# Epithelium

- The epithelial layer of maxillary sinus lining is **thinner** than that of nasal cavity.
- Lined by **Ciliated Pseudostratified Columnar epithelium** derived from olfactory epithelium of middle nasal meatus
- Most numerous cells -Columnar ciliated cells
- Additional cells- Basal cells,Columnar non-ciliated cells,Goblet cells



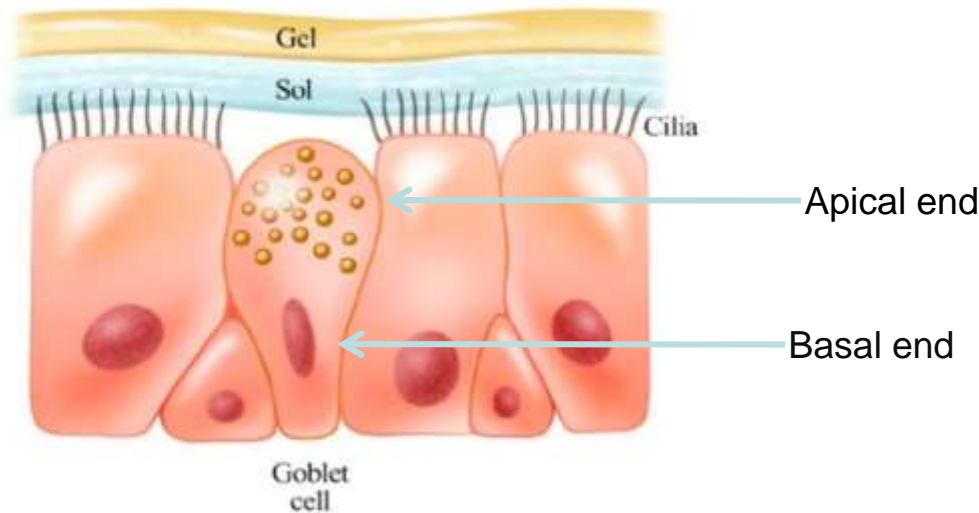
# Ciliated Cells

- The cilia is composed of typical 9+1 pairs of microtubules & provide mobile apparatus to the sinus epithelium which moves the debris, microorganisms, and the mucous film lining the epithelial surface of the sinus into the nasal cavity through the ostium.



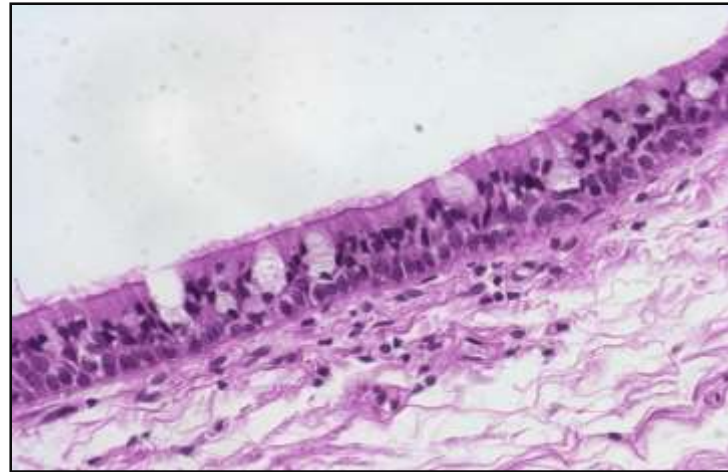
# Goblet Cells

- It is mucous synthesizing and secreting cells.
- It resembles an inverted wine glass with a short stack like basal end containing the nucleus and a swollen apical end containing mucin.
- It is an apocrine gland, i.e it pours its secretion through rupture of its apical cell membrane that get regenerated. So it has all the criteria of the synthesizing and secreting cells.



# The subepithelial connective tissue layer

- It is formed of **connective tissue cells, and intercellular substance** of collagen bundles and few elastic fibers and it is moderately vascular.
- The lamina propria contains subepithelial antral glands composed of mixed glands formed of serous and mucous acini or mixed acini as well as myoepithelial cells.
- The antral glands are more concentrated in the **lamina propria** located around the ostium.
- The mixed secretory product of the antral glands reach the sinus cavity through their excretory ducts.



# Functions

- Imparts resonance to the voice
- Increases the surface area and lightens the skull
- Moistens and warms inspired air
- Filters the debris from the inspired air
- Mucus production and storage
- Limit extent of facial injury from trauma
- Provides thermal insulation to important tissues
- Serves as accessory olfactory organs.

# Pathologic Conditions Of Maxillary Sinus

1. Inflammatory - Maxillary sinusitis
2. Traumatic - Fractured root  
Sinus contusion  
Blow out fracture  
Zygomatic complex fracture
3. Calcification Antroliths
4. Cyst Radicular cyst  
Dentigerous cyst  
Mucous retention cyst
5. Tumor Antral Polyps  
Squamous cell carcinoma

## Maxillary sinusitis

*It is the inflammation of the maxillary sinus mucosa.*

Types: depending upon duration

- a. Acute
- b. Subacute
- c. Chronic

# ACUTE SINUSITIS:

It is the acute inflammation of the sinus mucosa with severe pain in sinus area.

## Dental cause

- Periapical infection from the teeth
- Oroantral fistula
- Dental material in antrum
- Traumatic injuries
- Implant
- Infected dental cyst
- Periodontitis

## Non dental cause

- Mechanical obstruction of ostium
- Bacterial contamination
- Immune deficiency

## Symptoms

- Severe pain, constant and localized
- Area: area of eyeball cheek frontal region.
- Exacerbated by stooping or lowering head.
- Referred to : Teeth, Orbit, ear
- Pain increased by biting on affected side but unaffected by drinking hot cold or sweet fluids.
- Generalized Toxemia: Fever with chills nausea

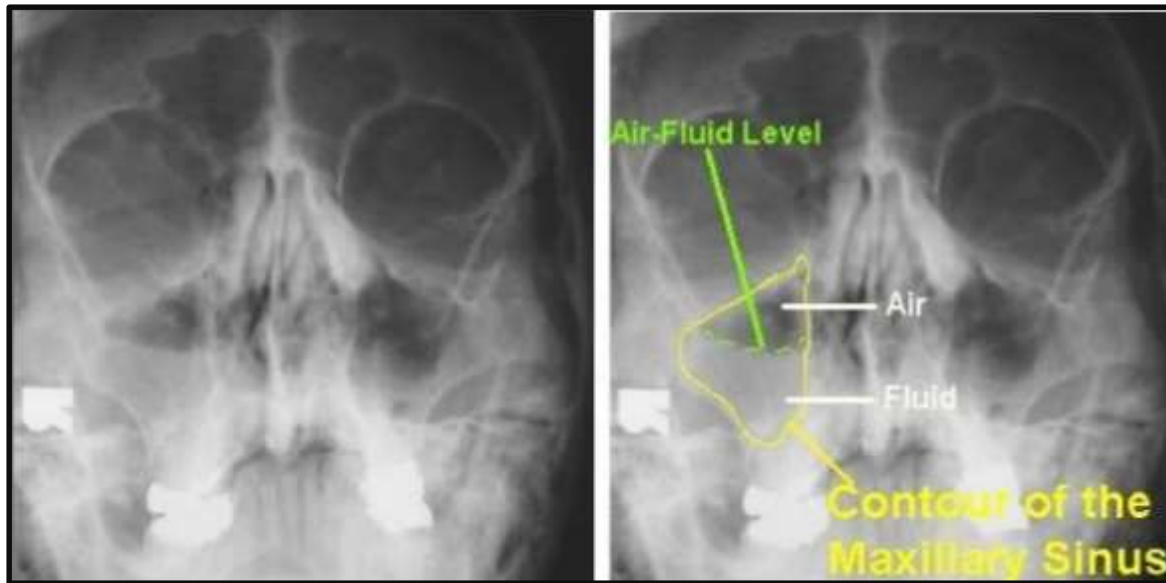
## Signs

- Nasal discharge : watery in start later mucopurulent.
- Nasal mucosa: show reddening and inflammation with pus.
- In case of odontogenic sinusitis: discharge foul odor
- Tenderness to pressure on swelling over the sinus

## DIAGNOSIS;

- 1) Water view radiograph(occipitomental) is radiograph of choice.
- 2) Transillumination test: Shows opacity of involved sinus.
- 3) CT scan : Demonstrate mucosal abnormalities in the nose and sinuses.
- 4) Culture: Nasal secretion may be for culture sensitivity test to see the organism involved.

## RADIOGRAPHIC FEATURES



Waters' view of the sinuses showing partial opacification of the right maxillary sinus, with an air-fluid level

## Treatment

The keystone of therapy are the provision of drainage to remove the pus and to re aerate the sinus mucosa and removal of the cause.

- 1) Drainage is achieved with antibiotics and nasal decongestants, if the cause is dental drainage is achieved by root canal therapy(drain the periapical abscess) or extraction.
- 2) Antibiotics : Doxycycline hydrochloride( vibramycin) 100 mg daily,  
Erythromycin 250-500 mg 6 hourly for 5 days.  
Amoxicillin 250-500 mg 8 hourly for 5 days.
- 3) Decongestant: Shrinks the swollen mucosa and helps to minimize and eliminate mucosal discharge.  
Ephedrine nasal drops(0.5%) for several hours  
Xylometazoline (0.1%)
- 4) Steam Inhalation : Acts by hydrating the mucous layer, making it less viscous and encouraging normal ciliary clearance of the sinus.  
(steam alone or medicated with menthol or eucalyptus)

5) Antral Lavage : Antibiotics and nasal drops fail pus must be removed from the antrum to allow the sinus mucosa to recover. This procedure is carried out by inserting a canula into the maxillary sinus. Warm saline is syringed through the canula and this drains out through the ostium along with the sinus exudate.

### Complications

Serious complications from spreading infection from acute maxillary sinusitis are now rare but most common complication is spread of infection to the orbit.

## SUBACUTE MAXILLARY SINUSITIS:

- 1) It is the intermediate stage between acute and chronic sinusitis. There is pain only in the form of the local discomfort.
- 2) Patient has persistent discharge.
- 3) The voice is nasal, throat is sore with constant irritating cough. Patient can not sleep well.
- 4) The disease may take a long course over week or months.

## CHRONIC SINUSITIS

- The term Chronic sinusitis is poorly defined but is best considered as persistent incompletely resolved acute sinusitis.
- PATHOPHYSIOLOGY: The mucous membrane of the sinus due to chronic inflammation may undergo changes like hyperplasia or atrophy. Multiple polyps formation or degeneration of epithelium where the cilia are lost and ostium shows edematous changes causing complete blockage.
- CAUSE : Persistence of external aggravating factors like nasal polpy,septal deviation ,oroantral fistula.
- CLINICAL FEATURE : General symptoms like tiredness , low grade fever and feeling of being unwell. Stuffy sensation over the affected side of face. Nasal obstruction , nasal discharge and headache are related symptoms.
- INVESTIGATION : Water's view radiograph. Culture of the discharge from the sinus. Transillumination test.

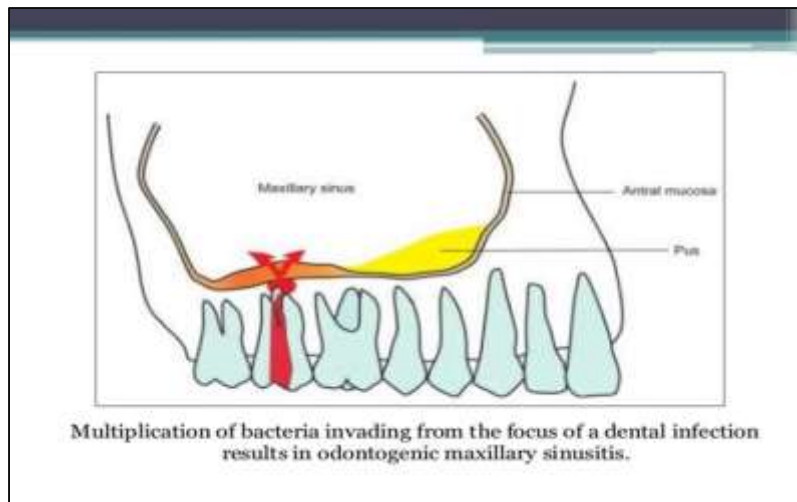
## TREATMENT

Sound treatment must depend on identification of the cause of the chronic sinusitis.

1. Dental origin : Affected teeth must be removed and the socket closed surgically as there will be risk of oroantral fistula.
2. Nasal Polyp : Concurrent presences of polyps should be removed followed by routine post operative antibiotics and analgesics.
3. With presence of Oroantral fistula : Surgical closure of fistula
4. Antrostomy : If above all procedures fails to cure c sinusitis the inferior meatal Antrostomy and middle meatal antrostomy can be done.
5. Transnasal endoscopic surgery : An approach to the middle meatus using rigid instrument to visualize the infundibulum and the natural openings of the sinus.

## Periapical infection from the teeth:

- The spread of pulpal disease beyond the confines of the dental supporting tissues into the maxillary sinus was termed Endo – antral syndrome (EAS) by *Selden (1974)*.
- The anatomic proximity of the roots of the maxillary bicuspid and molar teeth to the floor of the sinus leads to potential infection of the sinus by direct extension of an apical abscess.



# Traumatic Penetration

- *The sinus is directly involved in tooth extraction due to the relation of surrounding structures with maxillary sinus and can lead to an oroantral communication or complicated by displacement of roots.*



# Oroantral fistula

## DEFINITION

Oroantral communication: Abnormal connection between the oral and antral cavities.

When oroantral communication is left open, epithelial tissue may develop in its track --"oroantral fistula".

## Etiology

- Extraction of teeth
- Destruction of portion of floor of sinus by periapical lesion
- Injudicious use of instruments
- Forcing a tooth or a root during the attempted removal
- Extensive trauma to face
- Surgery of maxillary sinus
- Chronic infections
- Implant dentures
- Malignant disease

## Symptoms of fresh oroantral communication:

- Escape of fluids
- Epistaxis
- Escape of air
- Enhanced column of air.
- Excruciating pain

## Symptoms of established oroantral fistula:

- Pain.
- Persistent purulent unilateral nasal discharge.
- Post nasal drip.
- Popping out of antral polyp

## DIAGNOSIS

- All extracted upper teeth are examined to ensure they are intact.
- A large fistula is easily seen on inspection.
- Nose blowing test: The patient is asked to blow air into the pinched nose with the mouth open this forces air into maxillary sinus via its ostium and if any oroantral defect bubbles appear in extraction socket
- Cotton wisp test: The escape of air through the nose can be tested by placing a wisp of cotton near the orrifice.
- Mouth mirror fogging test: A mouth mirror placed at the oroantral fistula causing the fogging of the mirror. .
- Some time the oroantral fistula can be blocked by the antral polyp.

## Treatment of early cases

- Immediate surgical repair to achieve primary closure
- Antibiotic prophylaxis to prevent sinus infection

## Supportive measures

- Antibiotics: Penicillin & its derivatives
  - a. Started with IV route later switched over to oral route
  - b. Penicillin V 250-500 mg every six hour
- Nasal decongestants : Encourages drainage of pus and do not interfere with ciliary secretion. Ephedrine nasal drops(0.5%) every 2 hours.
- Analgesics : For pain relief. Ibuprofen 400mg three time daily

## Treatment of delayed Cases

When a period of 24 hours has elapsed the soft tissue margins of the fistula get infected and it is preferable to defer the surgical closure of the fistula.

**Surgical Management:** It can be done by following ways:

1. Buccal flap advancement procedure
2. Palatal pedicle flap
3. Ashley's operation
4. Caldwell Luc operation
5. Intra nasal antrostomy

# Dental Material In The Antrum

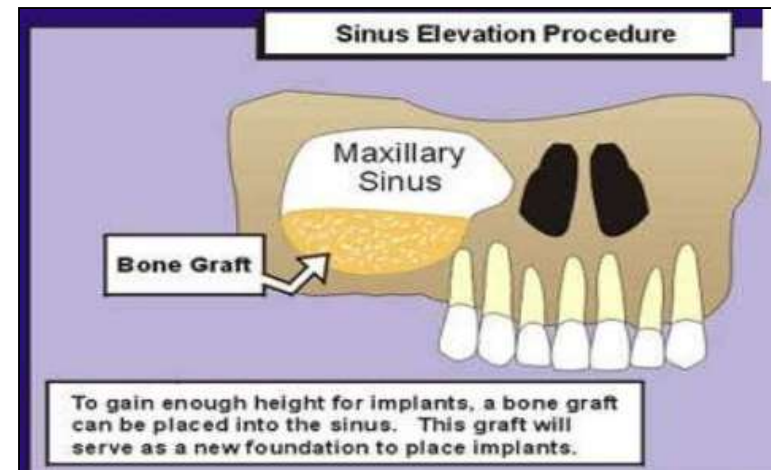
- During obturation, the sinus may be invaded by either sealer or by solid materials such as gutta percha or silver cones
- The material produces an inflammatory reaction with an area of rarefaction in the periapical tissues. Such inflammation is likely to persist until the foreign object is removed

Overextension of dental material sealers, cements, Gp or silver cones

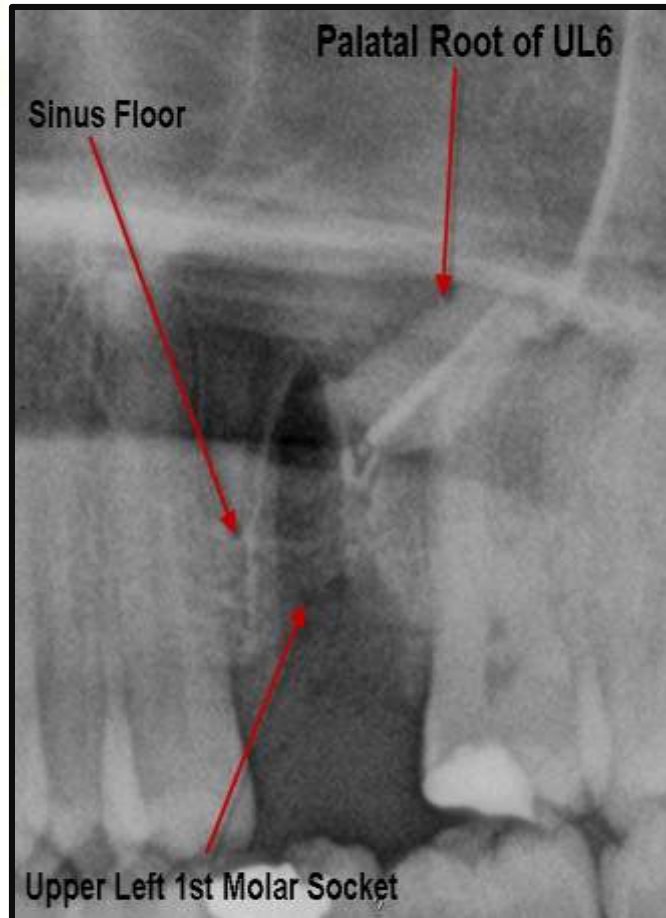


# Implants

- In the maxilla, 7 millimetres of bone height is sufficient to accommodate short implants.
- However, the use of 7–10 mm long implants is a greater concern in the maxilla than the mandible because the implant failure rate is higher in the maxilla.
- Therefore, 13 mm is the recommended minimum occlusocervical bone dimension in the maxilla.
- In case we don't have enough Bone height we go for sinus lift, which is a surgical procedure which aims to increase the amount of bone in the posterior maxilla
- In these cases bone is thin implant can penetrate the sinus or nose causing inflammation of the sinus lining



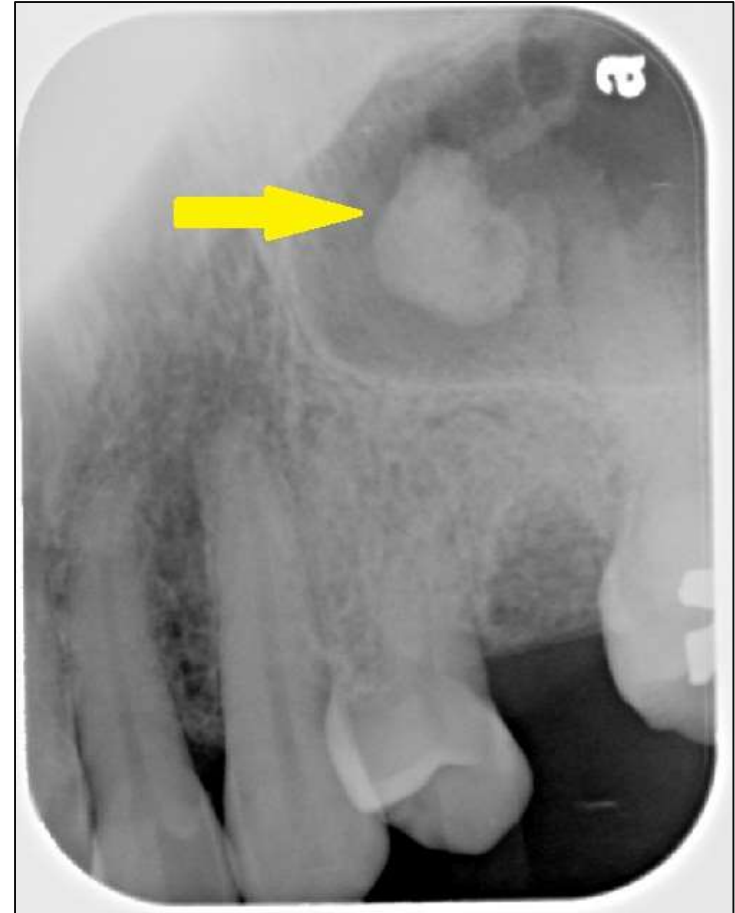
## Fractured Root



- A root tip of the maxillary first molar accidentally pushed into the sinus at the time of tooth extraction.
- Removal of root tip can be done through the tooth socket or through the canine fossa by Caldwell luc approach.

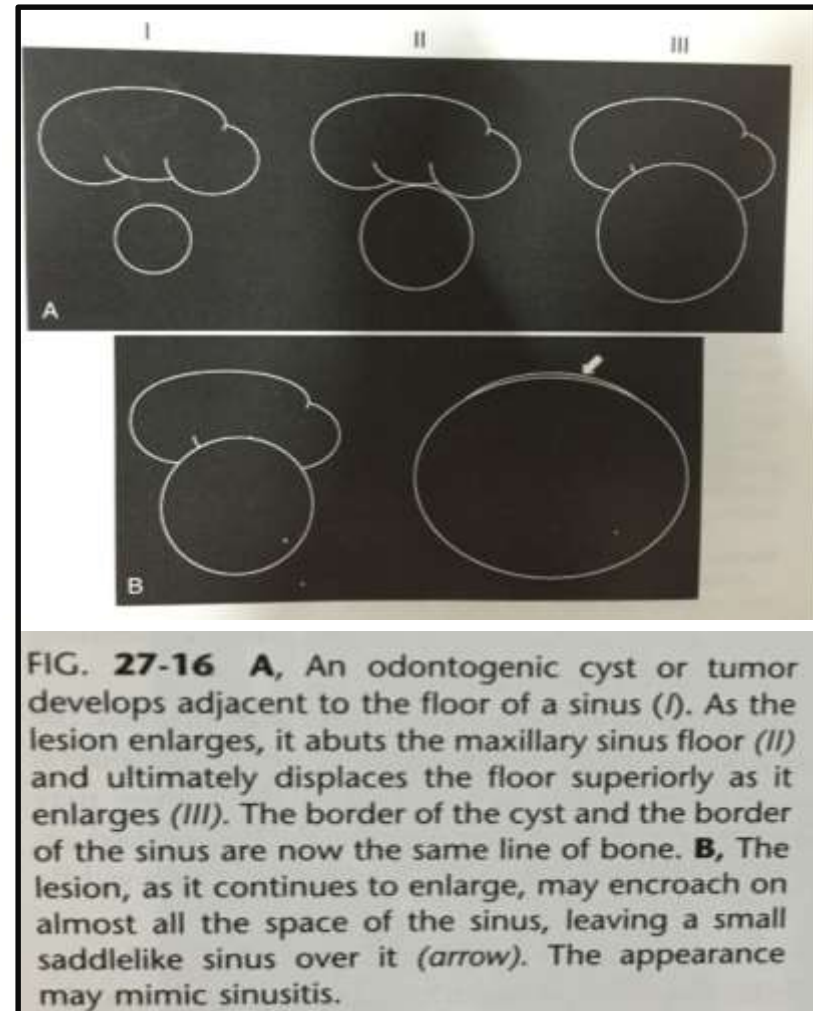
## Antrolith(stone)in the maxillary sinus

- Antroliths are calcified masses found in the maxillary sinus.
- There is calcification of masses of stagnant mucus in site of previous inflammation, root fragments or bone chips.
- Asymptomatic but if continues to grow pt complain of blood stain nasal discharge or facial pain.
- Removal if it is symptomatic

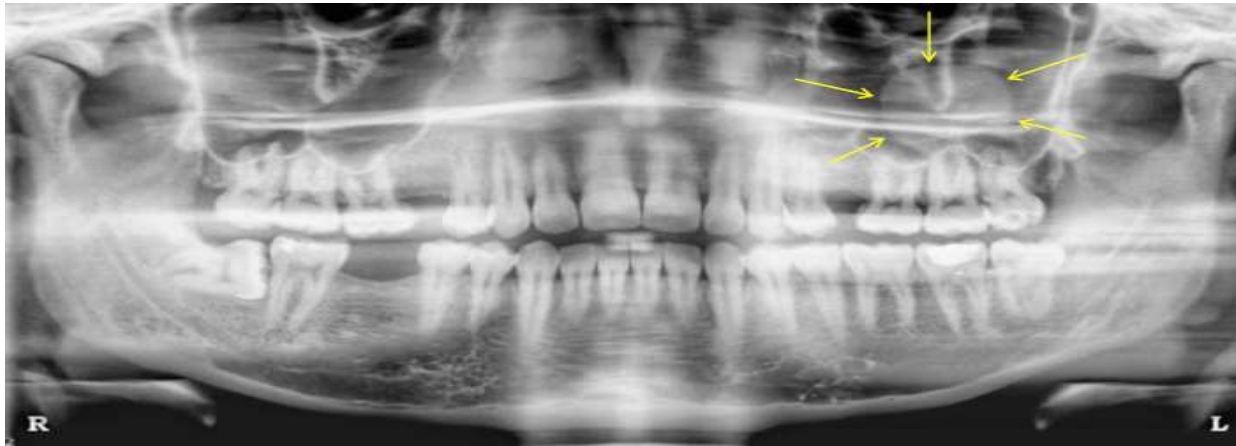


# Odontogenic Cystic Lesion

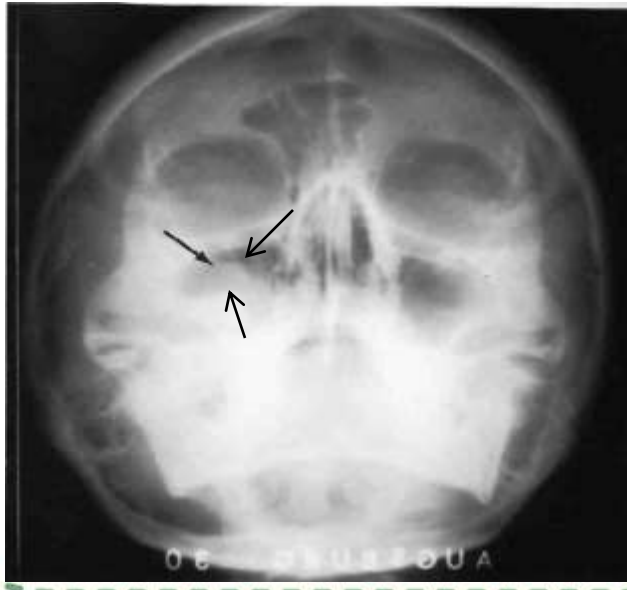
- Odontogenic cysts are the most common group of extrinsic lesions that encroach on the maxillary sinuses.
- The cyst enlarges, the sinus decreases in size.
- The result is a radio-opaque line between the cyst and the air space of the sinus.
- The lesion, as it continues to enlarge, may encroach on almost all the space of the sinus, leaving a small saddlelike sinus over it (arrow). The appearance may mimic sinusitis.



Mucous retention cyst (antral retention cyst) seen as a dome-shaped lesion on the floor of the sinus.



Waters' view showing a dentigerous cyst in the maxillary right sinus.



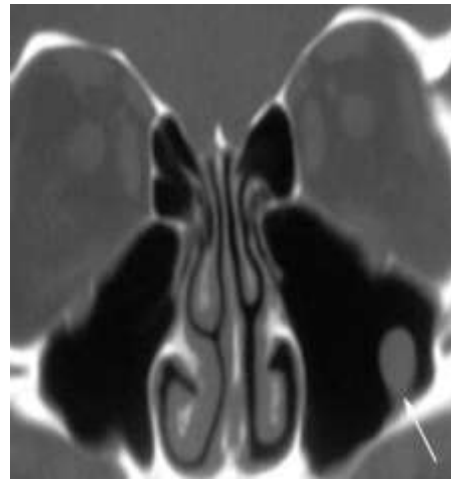
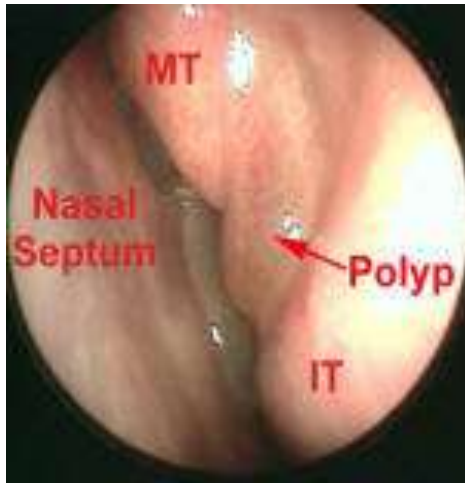
A radicular cyst at the apices of the first molar and extending into the maxillary sinus.



# Benign Tumor

Benign tumors in the sinus may arise from the lining as polyps and papillomas, from bone as osteoma or from maxillary teeth as odontomes.

Polyps: Thickened and folded mucosa in chronic sinusitis



Osteoma in the floor of the maxillary sinus.



# Malignant Tumor

*Squamous cell carcinoma is the most common malignant tumor of the paranasal sinuses.*

SCC in the right maxillary sinus producing destruction of the sinus floor and walls



Clinically the lesion extended into the oral soft tissues



Extra Oral Swelling in SCC

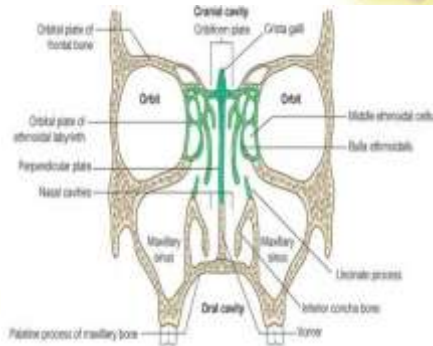


# Developmental anaomalies

- Crouzon syndrome : Early synostosis(fusion) of sutures produces hypoplasia of the maxilla and therefore the maxillary sinus together with the high arched palate.
- Treacher Collins syndrome : Associated with grossly and symmetrically underdeveloped maxillary sinuses and Malar bones.
- Binder syndrome : Hypoplasia of middle third of the face with smaller maxillary length and maxillary sinus hypoplasia.

## CLINICAL IMPORTANCE

- 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 : Because of the thickened and inflamed sinus lining compresses the nerve supply of the maxillary posterior teeth causing tenderness of the maxillary teeth.
- The infraorbital and superior alveolar vessels are frequently ruptured in maxillary fracture causing the hemotoma formation in the antrum.



# Conclusion



- *Due to close proximity of maxillary sinus to orbit, alveolar ridge, diseases involving these structures may produce confusing symptoms. Hence a precise information about the surgical anatomy is essential to surgeons.*
- *The close anatomical relationship of the maxillary sinus and the roots of maxillary molars, premolars and in some instances canines, can also lead to several endodontic complications.*
- *Clinicians must be particularly cautious when performing dental procedures involving the maxillary posterior teeth.*

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