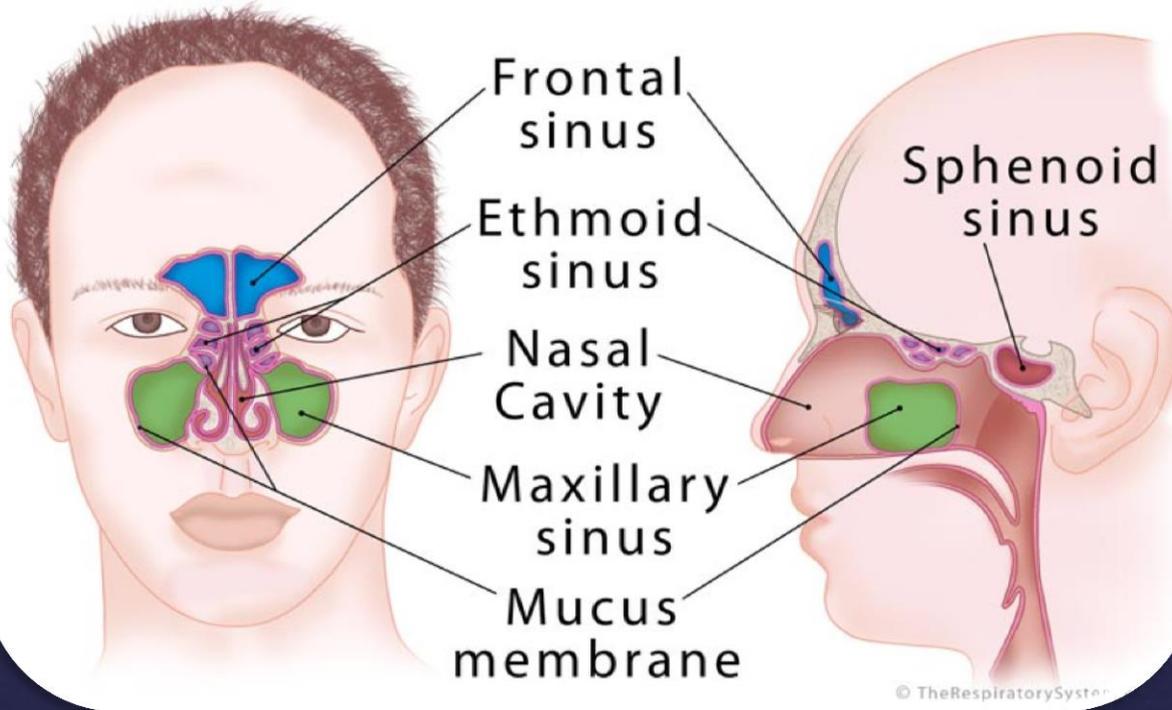


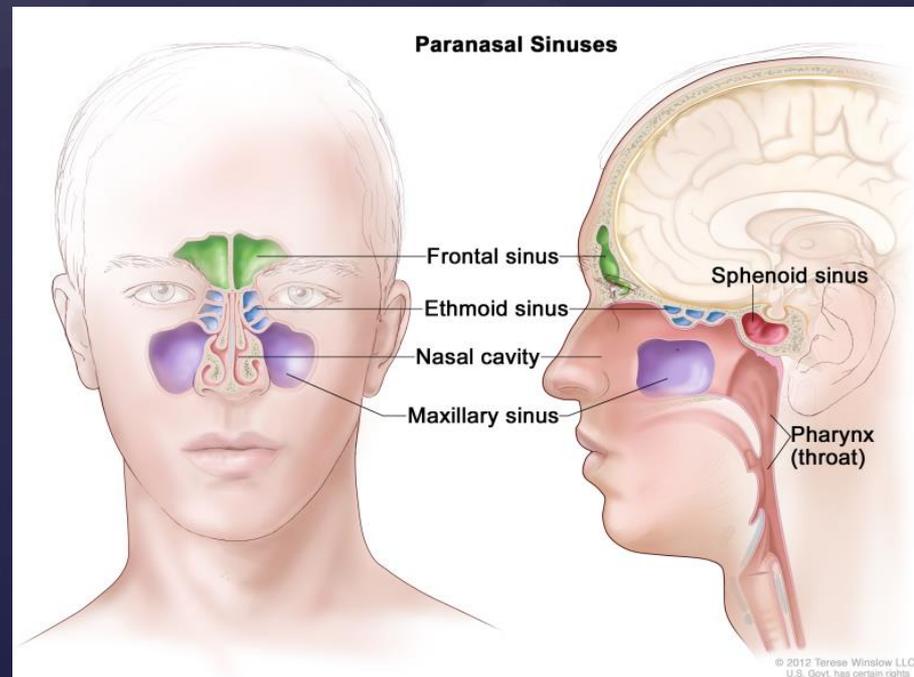
Paranasal sinuses & their clinical examination

Paranasal Sinuses



*By,
Dr Sowmya GV
Dept. of OMDR, IDS
III year BDS lecture*

- ⌘ Sinuses are hollow air filled sacs lined by the mucous membrane.
- ⌘ Paranasal sinuses are present in the bones around the nasal cavity.
- ⌘ The orbit serves as a landmark to appreciate the location of various paranasal sinuses.



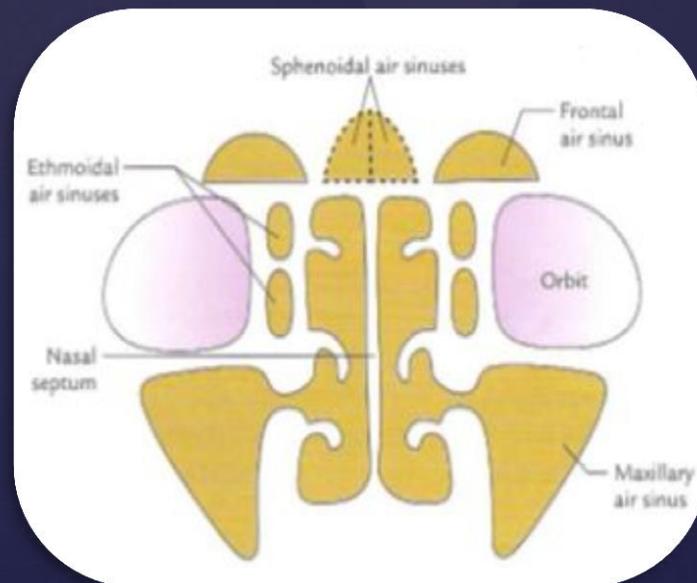
☞ The relationship of the Paranasal sinuses to the orbit is as follows:

☞ The **frontal air sinus** above

☞ The **maxillary air sinus** below

☞ The **ethmoidal air sinus** medial

☞ The **sphenoidal air sinus** behind the orbit



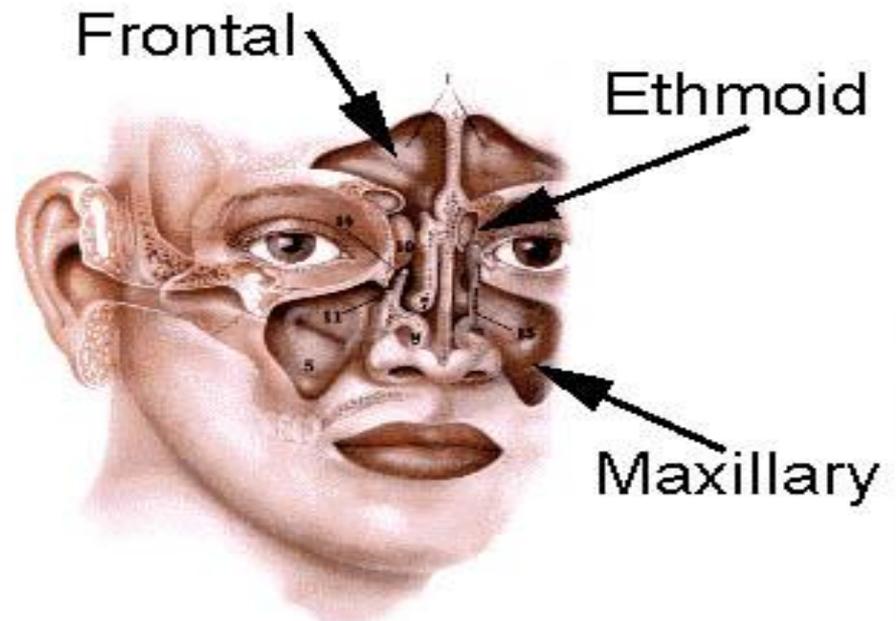
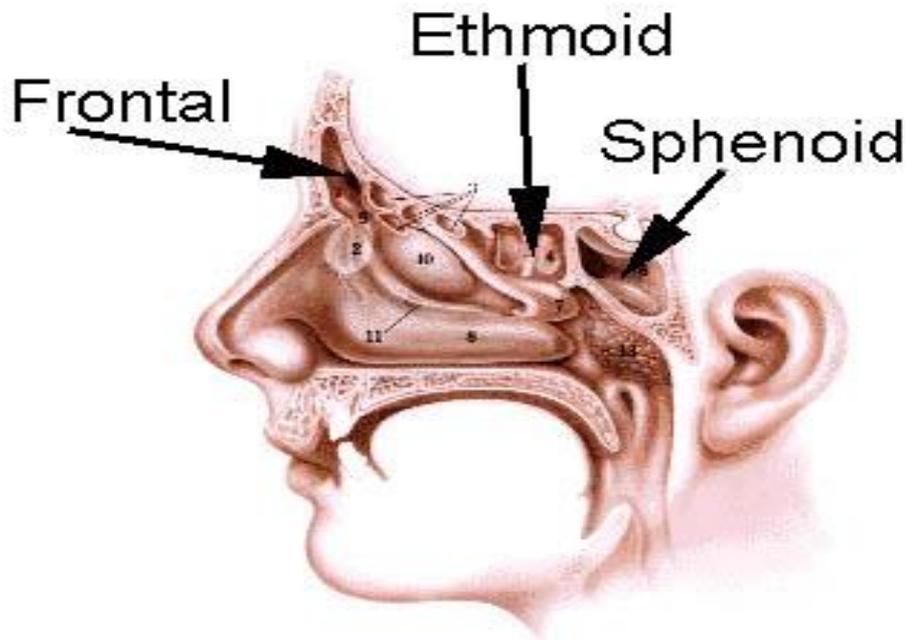
- Four pairs of paranasal sinuses

A. **Frontal** - above eyes in forehead bone

B. **Maxillary** - in cheekbones, under eyes

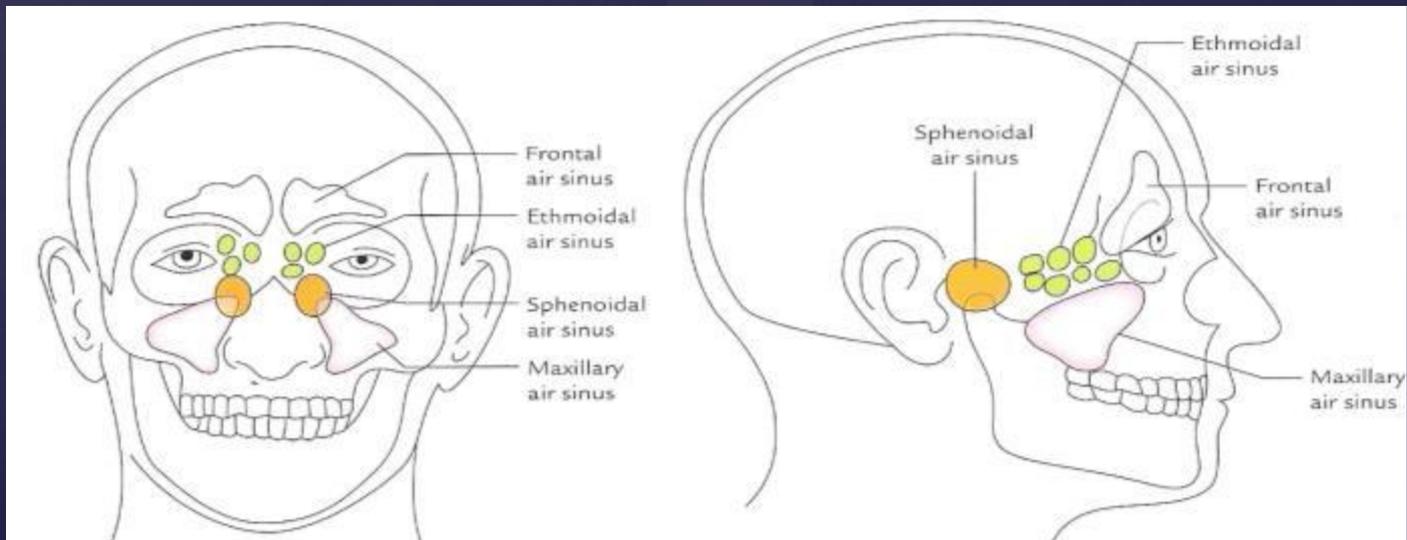
C. **Ethmoid** - between eyes and nose

D. **Sphenoid** - in center of skull, behind nose and eyes



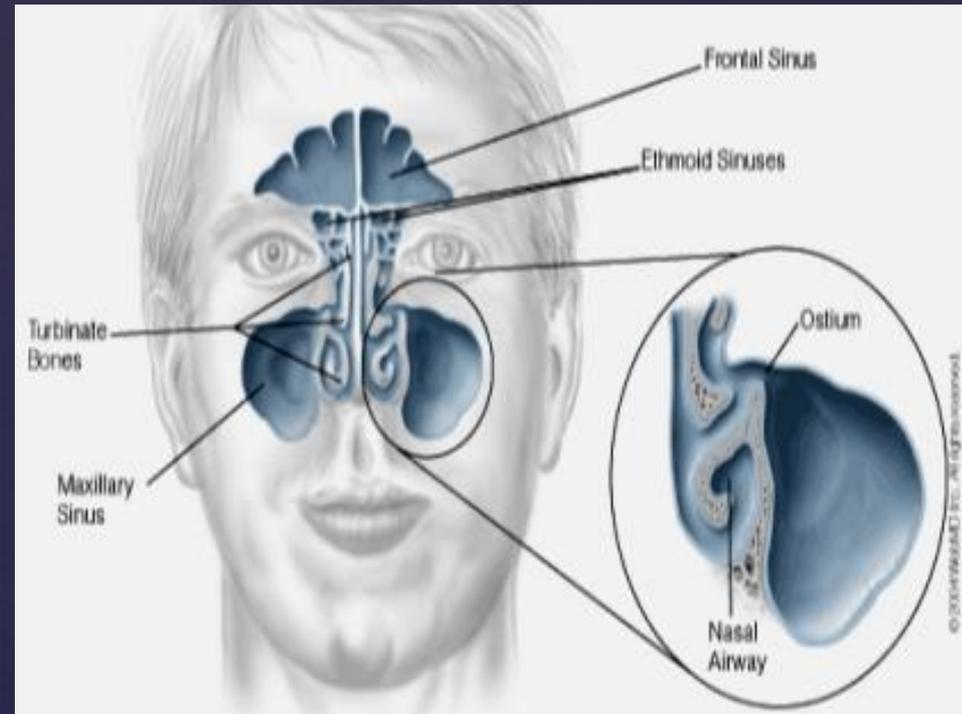
& Clinically the sinuses are divided into:

1. **Anterior group** – includes those sinuses which drain into the middle meatus - **frontal, anterior and middle ethmoidal, and maxillary sinus.**
2. **Posterior group** – includes those sinus which do not drain into the middle meatus – **posterior ethmoidal and sphenoid air sinuses.**



& Paranasal sinuses open into the nasal cavity through its lateral wall. They develop as mucosal **diverticulae** of the nasal cavity invading the adjacent bones.

& Sinuses have small orifices (**Ostia**) which open into recesses (**meati**) of the nasal cavities which are covered by turbinates (**conchae**).



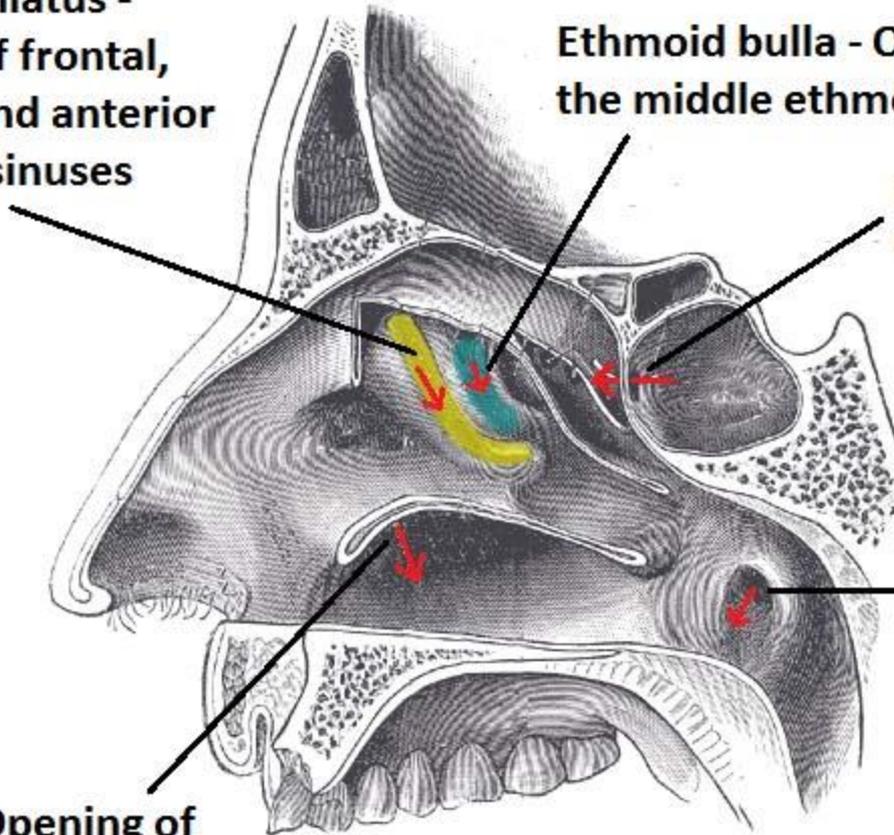
**Semilunar hiatus -
Openings of frontal,
maxillary and anterior
ethmoidal sinuses**

**Ethmoid bulla - Opening of
the middle ethmoid sinus**

**Opening of
sphenoid sinus**

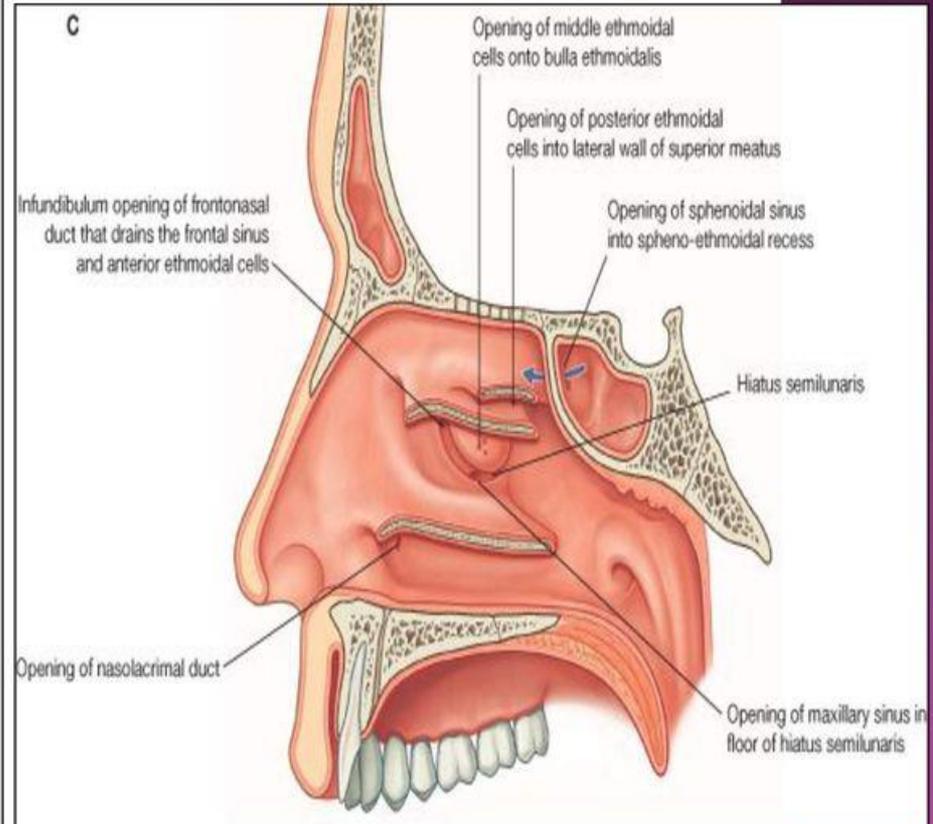
**Opening of
nasolacrimal duct**

**Opening of
eustachian tube**

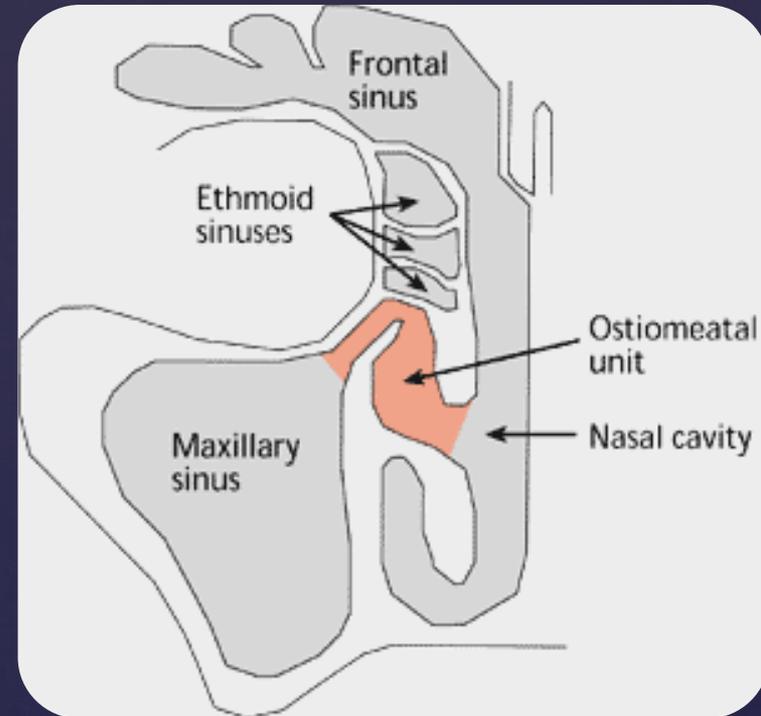


SINUSES OPENING IN LATERAL WALL

- ◉ **Sphenoethmoidal recess** receives the opening of **sphenoidal air sinus**
- ◉ **Superior meatus**; receives the opening of **posterior ethmoidal sinus**.
- ◉ **Middle meatus**; contains **bullae ethmoidalis** and **hiatus semilunaris**,
- ◉ Receives the openings of **maxillary, frontal, & anterior, middle ethmoidal sinuses**.
- ◉ **Inferior meatus**; receives the opening of **nasolacrimal duct**.

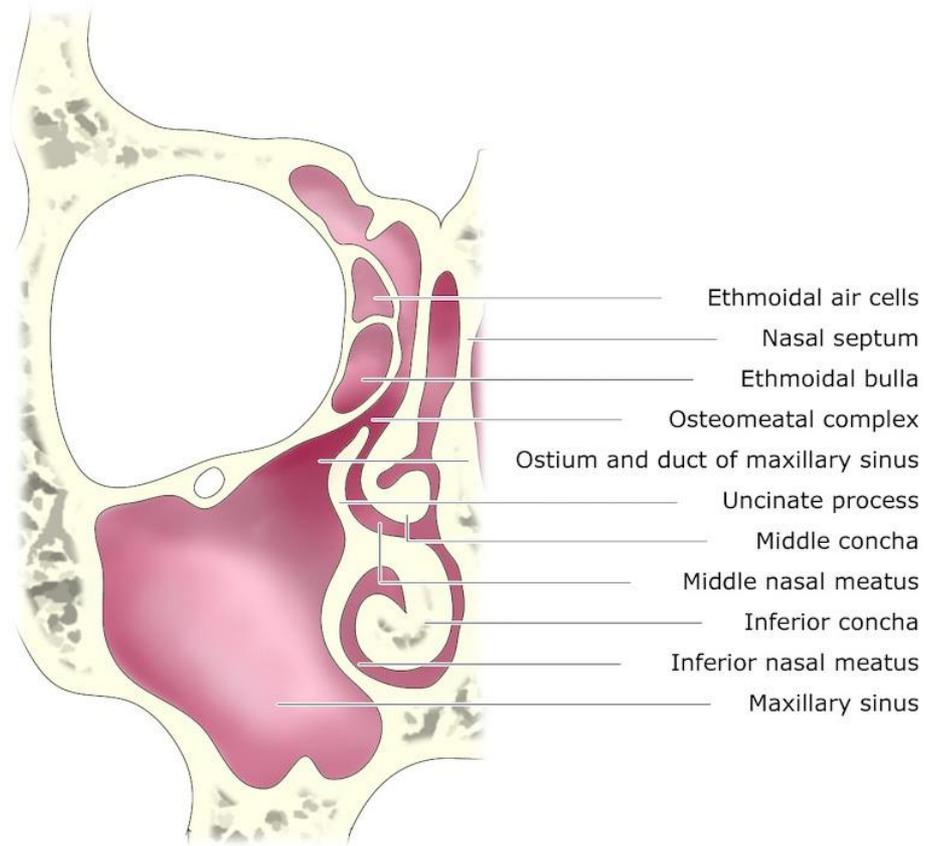


- ‡ The **ostiomeatal complex (OMC)** or **ostiomeatal unit (OMU)**, sometimes less correctly spelled as **osteomeatal complex**, is a common channel that links the frontal sinus, anterior ethmoid air cells and the maxillary sinus to the middle meatus, allowing airflow and mucociliary drainage
- ‡ Its patency is critical for normal sinus drainage and ventilation.
- ‡ Obstruction of the OMC is thought to be the underlying etiology for most cases of sinusitis.
- ‡ OMC serves as a common drainage pathway for frontal, maxillary and ethmoidal air sinuses.



OSTEOMEATAL COMPLEX(OMC)

- ‡ The ostiomeatal complex is composed of five structures:
- ‡ maxillary ostium: drainage channel of the maxillary sinus
- ‡ infundibulum: common channel that drains the ostia of the maxillary antra and anterior ethmoid air cells to the hiatus semilunaris
- ‡ ethmoid bulla: usually a single air cell that projects over the hiatus semilunaris
- ‡ uncinate process: hook-like process that arises from the posteromedial aspect of the nasolacrimal duct and forms the anterior boundary of the hiatus semilunaris
- ‡ hiatus semilunaris: final drainage passage; a region between the ethmoid bulla superiorly and free-edge of the uncinate process



F Gaillard
2010
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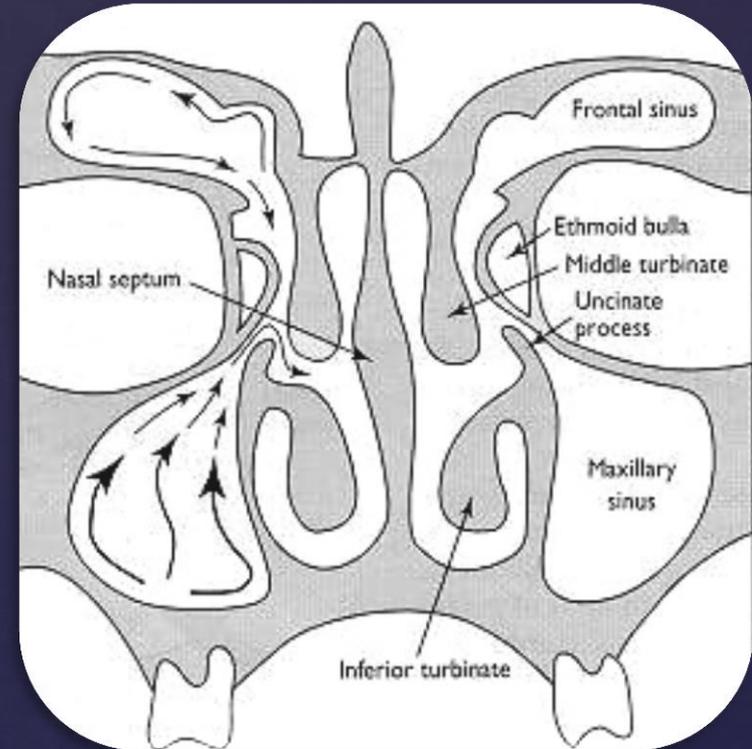
1. Humidifying and warming inspired air
2. Regulation of intranasal pressure
3. Increasing surface area for olfaction
4. Lightening the skull
5. Resonance
6. Absorbing shock
7. Contribute to facial growth

Functions

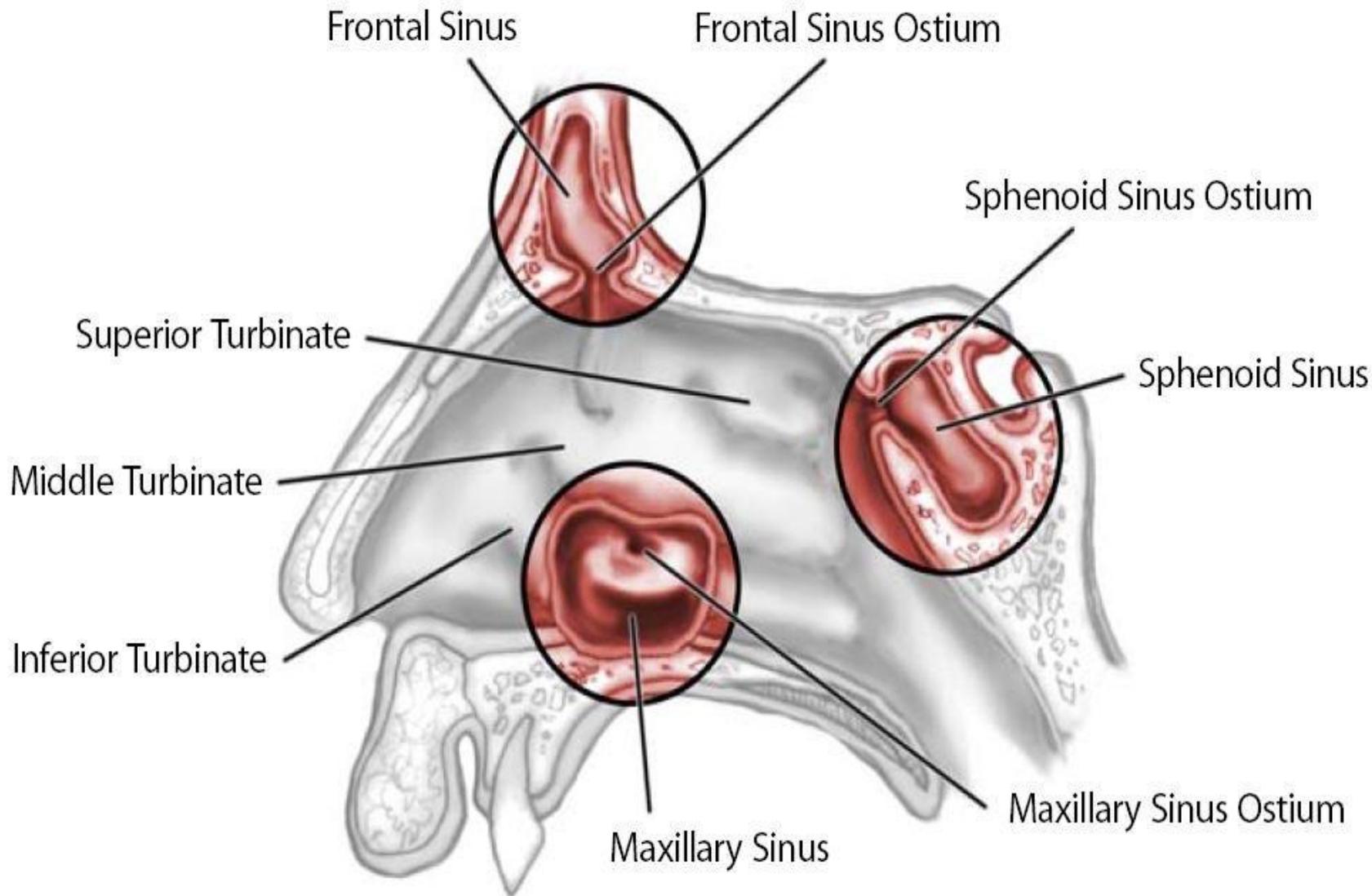
& **Hilding** was the first that described each sinuses' mucus flow patterns, and his observations are still valid today.

& The ciliated cells in each sinus beat in a specific direction. A resulting pattern of mucus flow results.

& Since many of the sinuses develop in an outward and inferiorly fashion, the ciliated mucosa often moves material against gravity to the sinus' exit.



MUCOCILIARY CLEARANCE

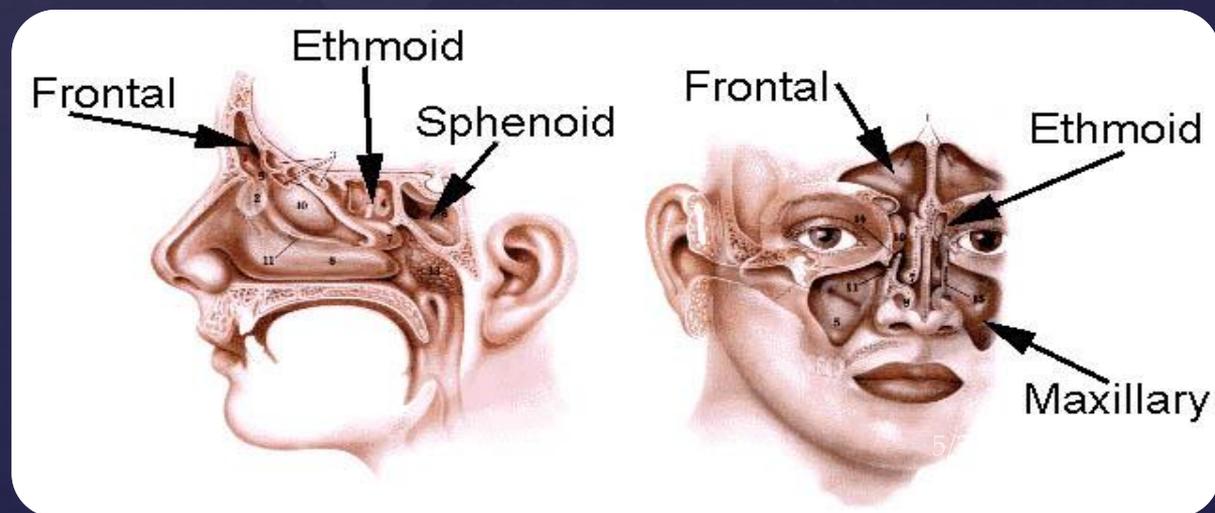


- The development of paranasal sinuses begins as evaginations of the nasal mucous membrane during the 2nd and 4th month of pregnancy.
- The ethmoid and maxillary sinuses are present at birth. The frontal sinus develops during the 2nd year and the sphenoid sinus develops during the 3rd year.

Embryology

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- ⌘ Loc: Btw inner and outer tables of frontal bone; above and deep to supraorbital margin
- ⌘ Asymmetric
- ⌘ Bony septum thin & oblique
- ⌘ 32x24x16mm
- ⌘ Better developed in males.

Frontal sinus

↳ ◉ Opens into Middle meatus

Relations:

↳ ◉ Ant : Skin over forehead

↳ ◉ Posterior: Meninges + frontal lobe of brain

↳ ◉ Inf: Orbit + contents

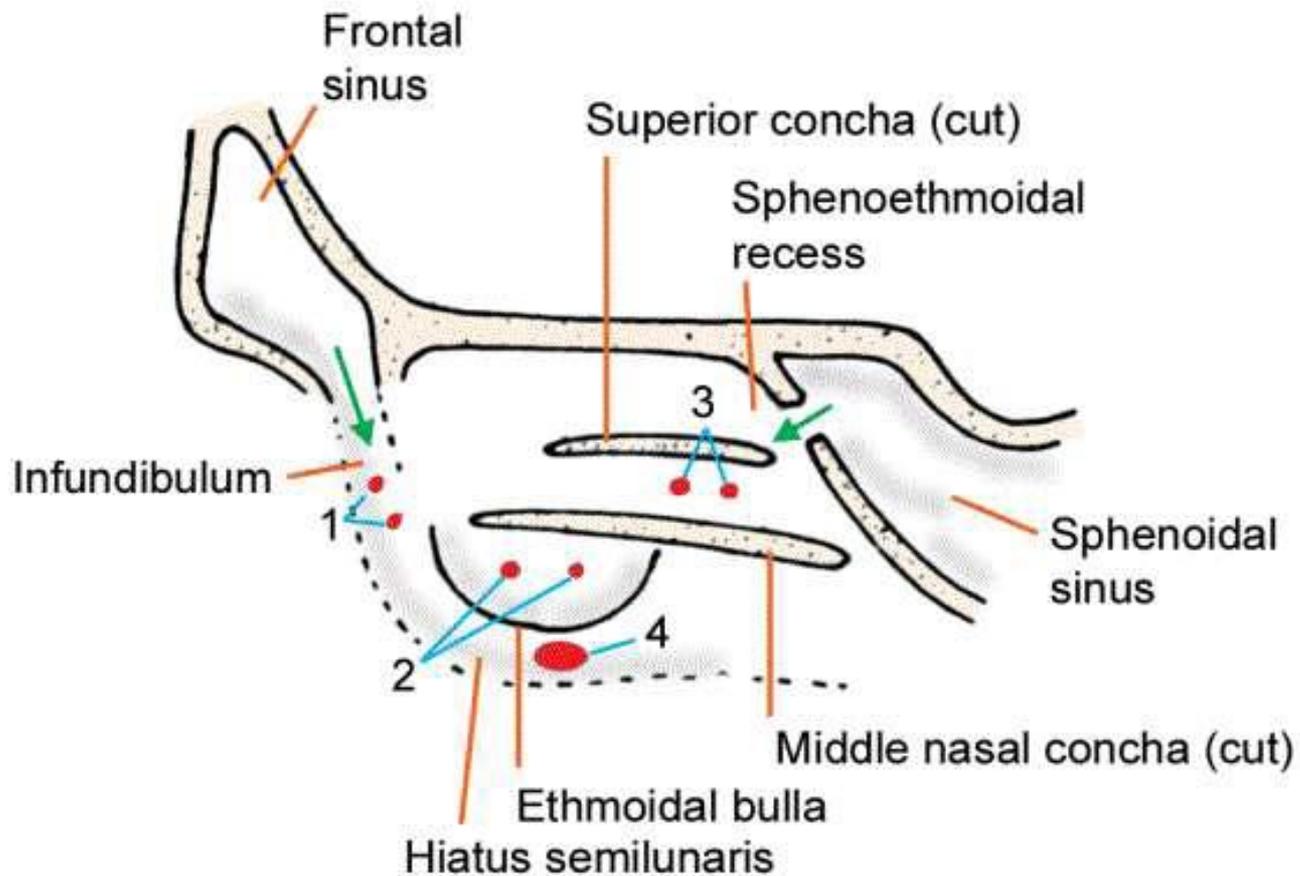
↳ ◉ Drains into Frontal recess

↳ ◉ Arterial supply: Supraorbital artery

↳ ◉ Venous Drainage: Supraorbital and superior
ophthalmic veins

↳ ◉ Lymphatic: Submandibular nodes

↳ ◉ Nerve: Supraorbital nerve



- 1 = Openings of anterior ethmoidal sinuses
- 2 = Openings of middle ethmoidal sinuses
- 3 = Openings of posterior ethmoidal sinuses
- 4 = Opening of maxillary sinus



- **Transilluminated** by using a small, bright light source in a darkened room.
- The light is placed above the inner canthus of the eye and the amount of light passing through the sinus is compared with the opposite side.
- A sinus filled with a mass or fluids does not allow as much light to pass.



- ❖ Infection of frontal air sinus may spread posteriorly into the anterior cranial fossa causing *frontal lobe abscess* or downwards into the orbit leading to *orbital cellulitis*.
- ❖ The pain of frontal sinusitis is usually severe and localized over the affected sinus - *frontal headache*. it shows characteristic periodicity, also known as *office headache*.

Clinical Considerations

Clinical Features

Frontal Headache

- Usually severe and localized over the affected sinus.
- It shows characteristic periodicity
- It is also called “office headache” because of its presence only during the office hours.

Tenderness

- It can also be elicited by tapping over the anterior wall of frontal sinus in the medial part of supraorbital region.

Edema of upper eyelid with suffused conjunctiva and photophobia

Nasal discharge

- A vertical streak of mucopus is seen high up in the anterior part of the middle meatus



ORBITAL COMPLICATIONS

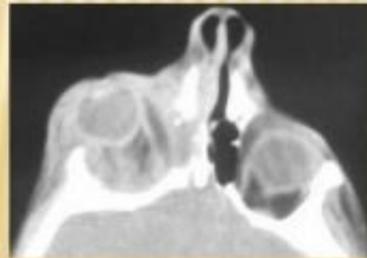
ORBITAL CELLULITIS

NOTES: Patients may complain of pain and diplopia and a history of recent orbital trauma or dental surgery.:

- ▣ Symptomatology
 - ▣ Post-septal infection
 - ▣ Eyelid edema and erythema
 - ▣ Proptosis and chemosis
 - ▣ Limited or no extraocular movement limitation
 - ▣ No visual impairment
 - ▣ No discrete abscess
- ▣ Low-attenuation adjacent to lamina papyracea on CT



Bailey et

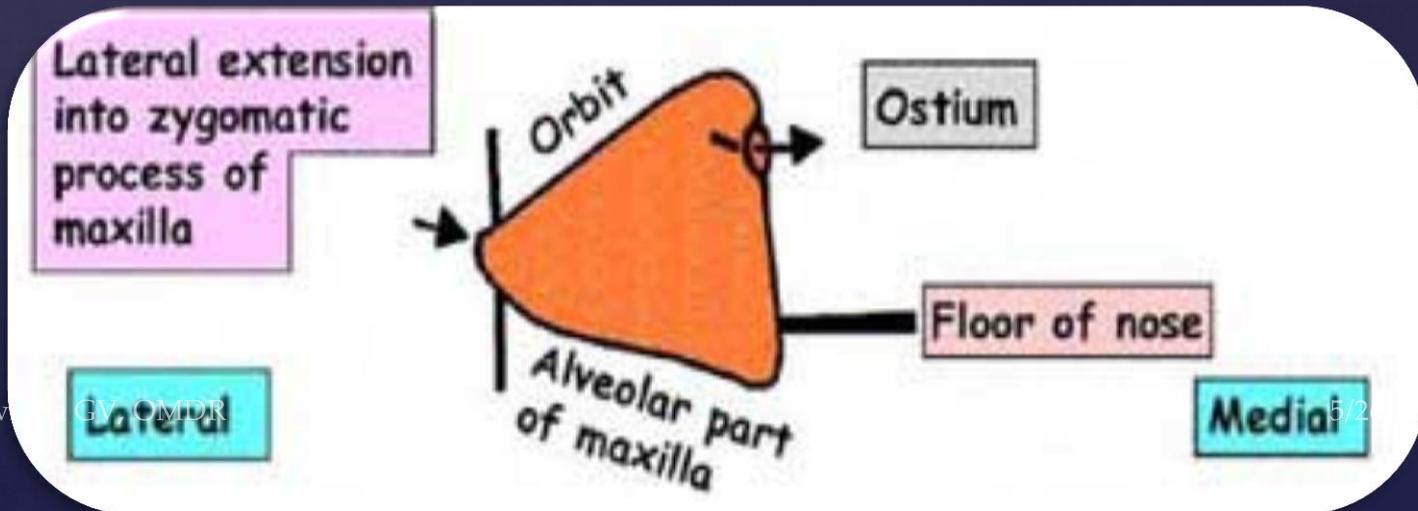
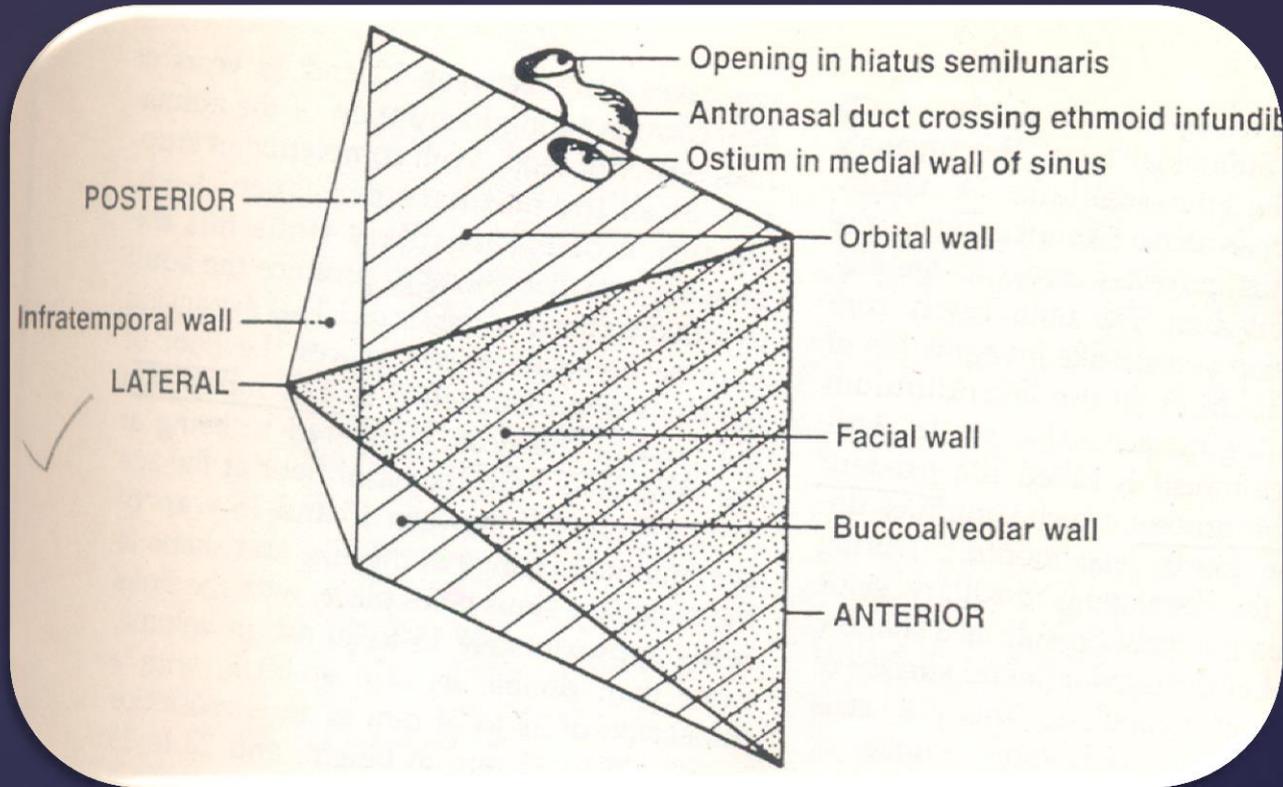


Ramadan et



- ❖ “Antrum” based on Greek word “Antron” meaning cave
- ❖ Also called “Antrum of Highmore” after Nathaniel Highmore, an English physician.
- ❖ Are paired structures located in the body of maxilla & are mirror image of each other.
- ❖ Size is variable up to 3.5cms in height, 2.5cms in width, 3.2cms antero posteriorly.
- ❖ It opens into the middle meatus of the nose in the lower part of the hiatus semilunaris.

Maxillary Sinus



- © Lies in body of maxilla
- © Largest; first to develop
- © Pyramidal; Base : med towards lat wall of nose; apex: lat in zygomatic process of maxilla
- © Opens into middle meatus (lower part of hiatus semilunaris)
- © Relations: Ant. Wall- Formed by facial surface of maxilla, related to soft tissues of cheek
- © Post. Wall- infratemporal and pterygopalatine fossa

Medial wall- middle and inferior meatuses. At places unciniate process, ant and post fontanelle and inferior turbinate

© Floor-Alveolar and palatine processes of maxilla

© Roof- Floor of orbit

© 3.4x2.5x3.5cm

- ‡ Develop at about **12wk** as an evaginations from the primitive ethmoid infundibulum in the lateral wall of the middle meatus.
- ‡ It expands not only downward but also forward & backward from its initial evagination, the site which persist as the anteronasal duct.
- ‡ It undergoes concurrent lateral expansion & by the end of the 1st yr, extends beneath the orbit as far as the infra-orbital canal.
- ‡ By the end of the 2nd year the sinus has reached about half its adult size.
- ‡ As the facial growth continues by the surface deposition on the face, alveolar processes & palate, it is accompanied by the resorption of the internal structure.

Primary Pneumatization

- Sinus continues to develop as a slit-like invagination of nasal epithelium off infundibulum into cartilaginous nasal cap
- continues until late in 4th fetal month
- sinus remains within nasal capsule as shallow pocket at inferior lateral surface of ethmoidal infundibulum

Secondary Pneumatization

- ⌘ Begins 5th week of fetal life, growing into adjacent maxilla
- ⌘ At birth, sinus is a small ovoid groove on side of maxilla close to orbit
- ⌘ Average size: 7mm a-p length, 4mm in height, 4mm in width
- ⌘ Estimated volume of 6-8 cc

Development

After Birth

- ⌘ Sinus grows anteriorly and inferiorly with the face at yearly rate of:
 - ⌘ 2mm vertically
 - ⌘ 3mm anteroposteriorly
- Age 4-5 months, seen on plain films

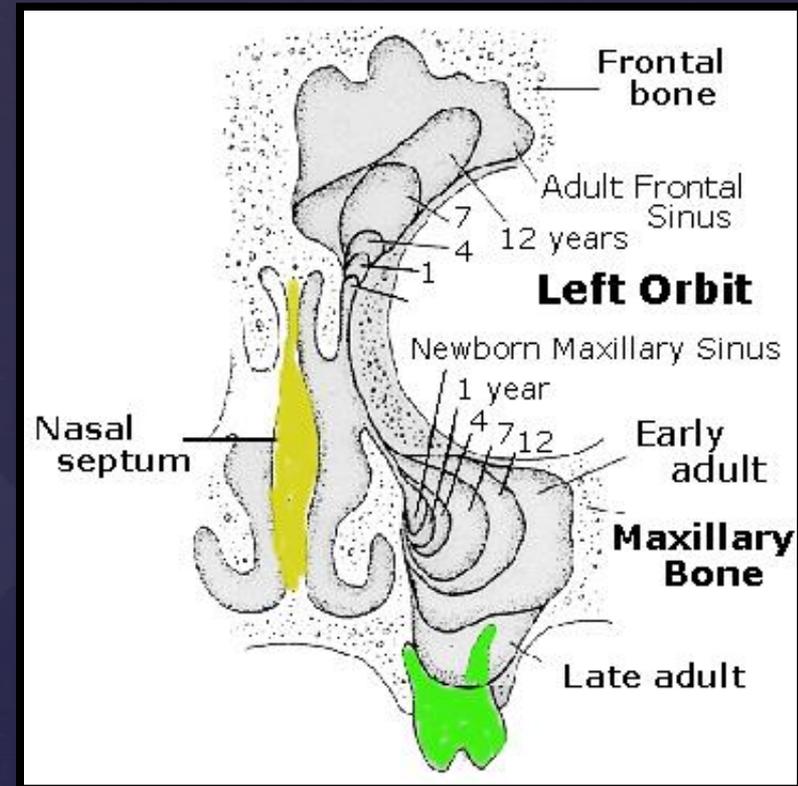
Three recognized growth spurts:

- Birth to 2.5 yrs old
- 7.5 yrs to 10 yrs old
- 12 yrs to 14 yrs old

Development

Growth spurts

- ❖ Age 3, seen above 1st permanent molar area
floor is still above level of nasal floor
- ❖ Age 7, growth spurt resumes corresponds to eruption of permanent teeth
- ❖ Final spurt from 12 to 14 yrs corresponds to posterior permanent teeth
- ❖ Some expansion continues throughout life down to roots or into residual ridge



DEVELOPMENT

- ‡ **Vascular supply:** Branches of the internal maxillary artery - the infraorbital, lateral branches of the sphenopalatine, greater palatine, and the alveolar arteries.
- ‡ **Venous drainage:** runs anteriorly into the facial vein and posteriorly into the maxillary vein .
- ‡ **Innervation:** by branches of V2 - the greater palatine nerve and the branches of the infraorbital nerve.
- ‡ **Lymphatic drainage:** submandibular lymph nodes.

& **Inspected** for the presence of asymmetry, deformity, swelling, erythema, ecchymosis or hematoma in middle third of the face. Epiphora, nasal discharge from the nostril should be noted.

& **Palpated** by placing the index and middle finger on either side of the nose, respectively, below the rim of the orbit



Clinical examination of maxillary sinus

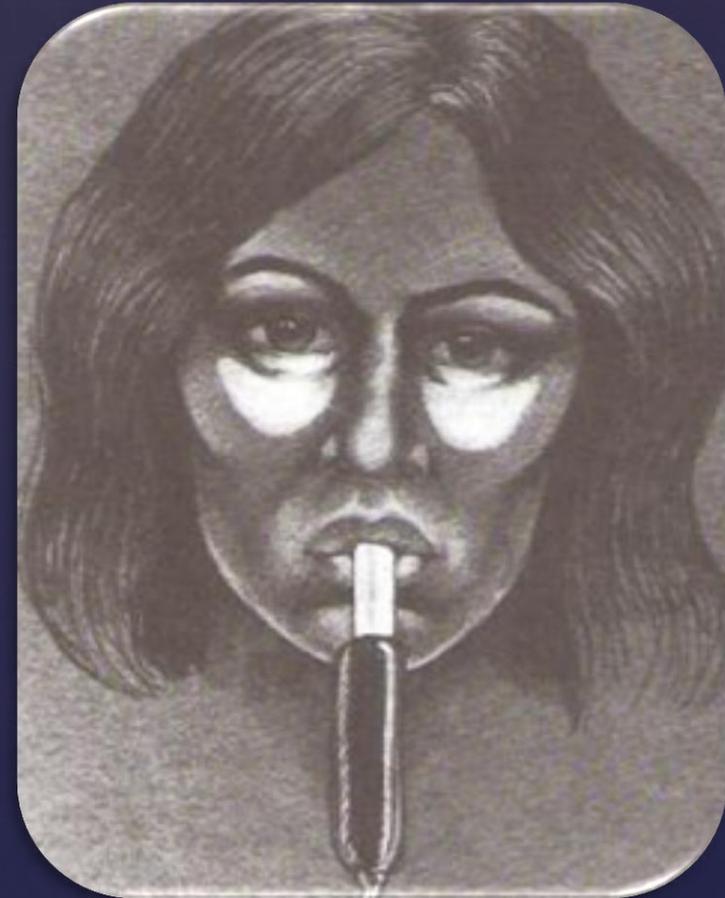
⌘ If gentle pressure doesn't produce pain, the sinus can be **percussed** using tip of the middle finger of the other hand. Although the absence of pain on percussion doesn't rule out the possibility of sinusitis, pain induced in this manner is a good indication of its presence

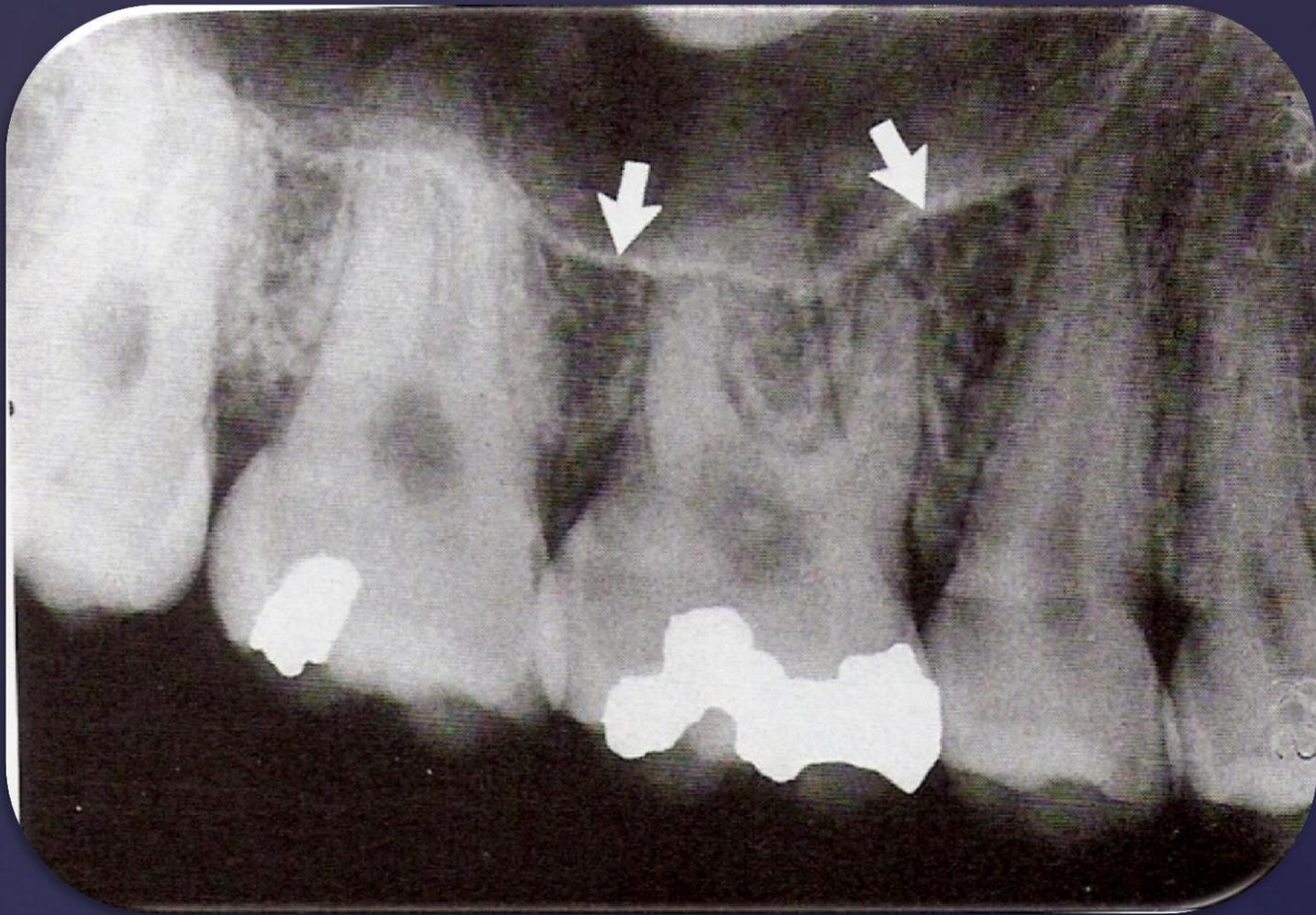


- ‡ **Intraoral** examination should be performed looking for alveolar ulceration, expansion, tenderness or paraesthesia of the upper molar and premolar region.
- ‡ **Extraoral** examination involving eyes should be looked for proptosis, upward displacement of the globe and restriction of the movement producing diplopia.
- ‡ **Rhinoscopy** - A nasal speculum and headlight or mirrors are necessary for proper examination of the nasal passage.
- ‡ **Nasoendoscopy** - The nasal opening of the maxillary sinus is examined using a narrow fiberoptic endoscope.

& **Transillumination** - Performed in the dark room by insertion of an electrically safe bright light into the mouth and pressing it firmly against the ant and lateral aspects of the hard palate with pts lips closed. The amount of light passing through each sinus can be compared.

& **Fiberoptic anthroscopy** - mainly used in orbital blow out fractures where clinical and radiological examination is inconclusive.



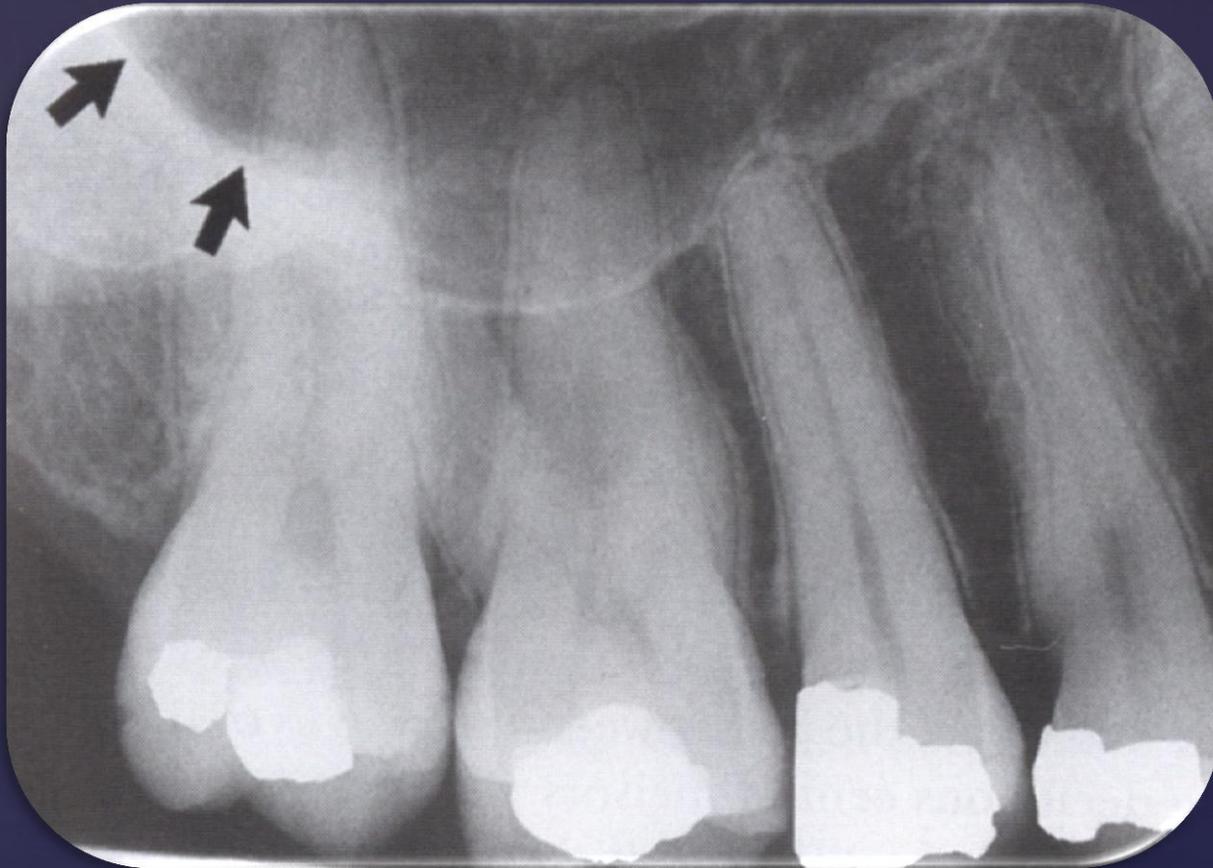


Radiological examination

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5/26/2020









- ⌘ **Caldwell** - best for ethmoids and frontal sinus . Nasal cavity and superior portion of the maxillary antrum.
- ⌘ **Water's view** - best for maxillary sinus and usually shows the roof or upper borders, medial wall and allows comparison of both sinuses. When the mouth is open, sphenoid sinus can be seen.
- ⌘ **Lateral** - sphenoid, frontal, maxillary
- **Submentovertex** – Fluid in maxillary sinus will also layer out. To define the extent of the sphenoid sinus.

- ⌘ **Tomography-** for viewing solid masses such as anthroliths, in the ant wall, post wall, lateral wall, roof of upper borders.
- ⌘ **Computed tomography-** delineation of the soft tissues in the sinus. It allows the comparison of the two sides. High resolution axial and coronal CT provide the most revealing and non invasive tech for paranasal sinuses and adjacent structures.
- ⌘ **Scintigraphy-** radioactive isotopes are used to demonstrate physiological changes in tissue.
- ⌘ **Ultrasound-** is effective in distinguishing normal sinuses, chronically inflamed sinus lining and if the sinus is filled with fluid, tumor or scar.
- ⌘ **Magnetic resonance imaging-** provides multiple section through the sinuses in different planes.

& Numer

& © Lie w

& © Relat

& © Above

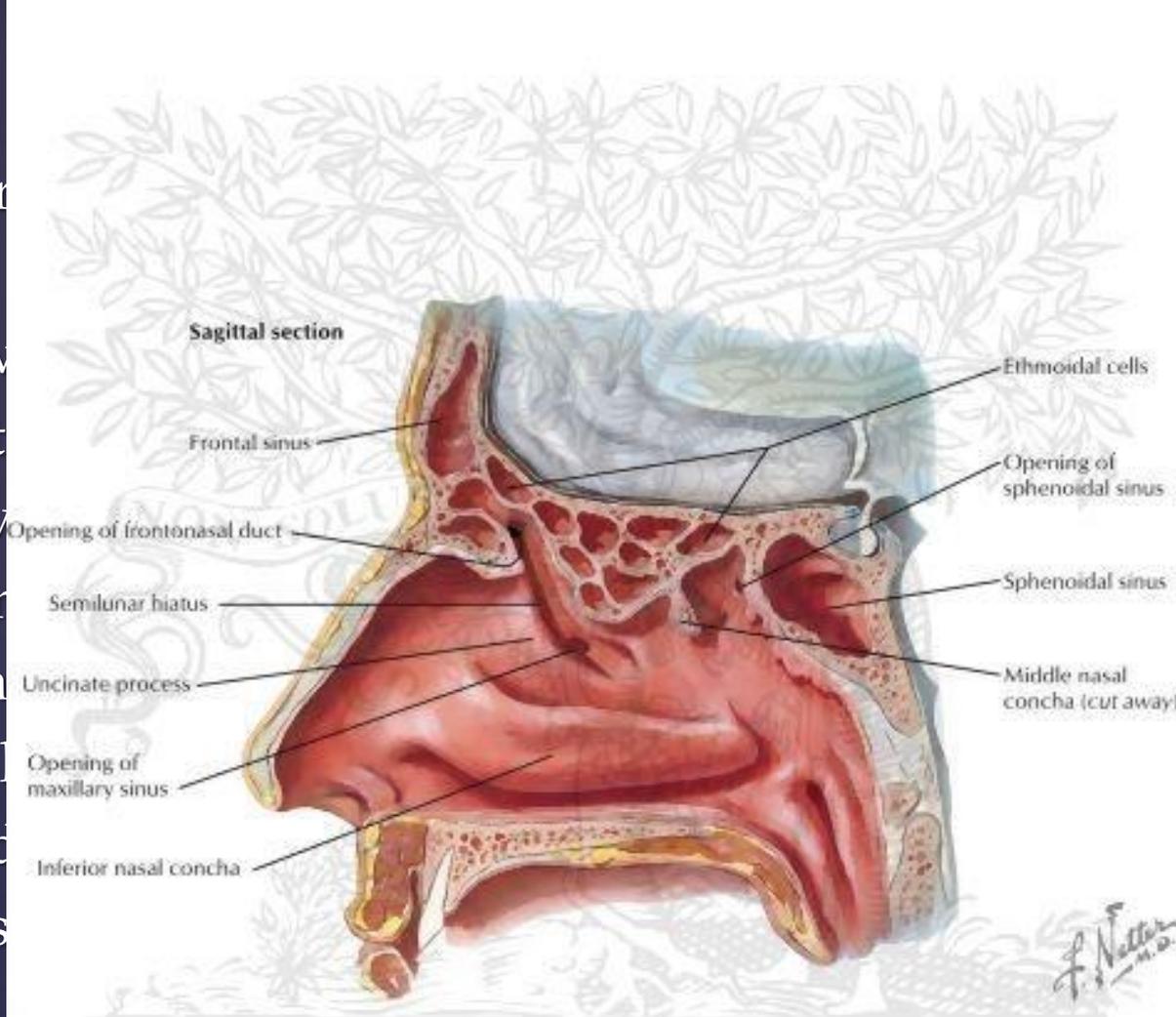
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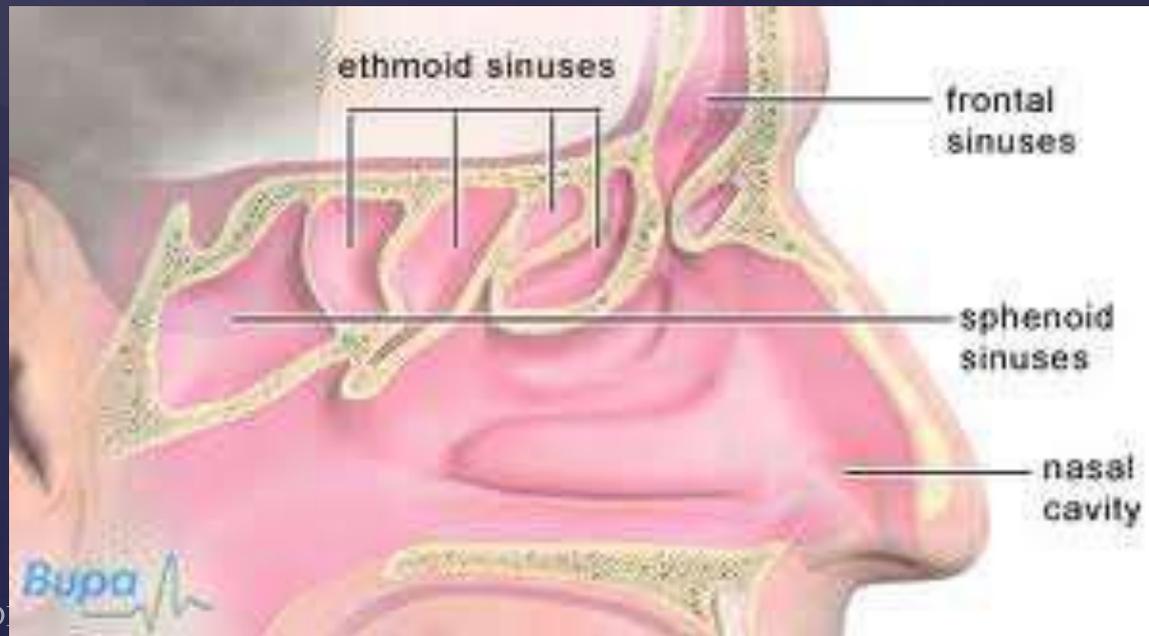
& © Divid

& groups



Ethmoidal Sinus

- ⌘ Anterior: 1-11; opens to ant part of hiatus semilunaris; Ant ethmoidal nerve + vessels;
- ⌘ lymph – submandibular nodes
- ⌘ Middle: 1-7; opens to middle meatus; Postmethmoidal nerve+ vessels+ orbital branches of pterygopalatine ganglion; SM nodes
- ⌘ Posterior: 1-7; opens to sup meatus; Post ethmoidal nerve + vessels; orbital branches of pterygopalatine ganglion; Retropharyngeal nodes.

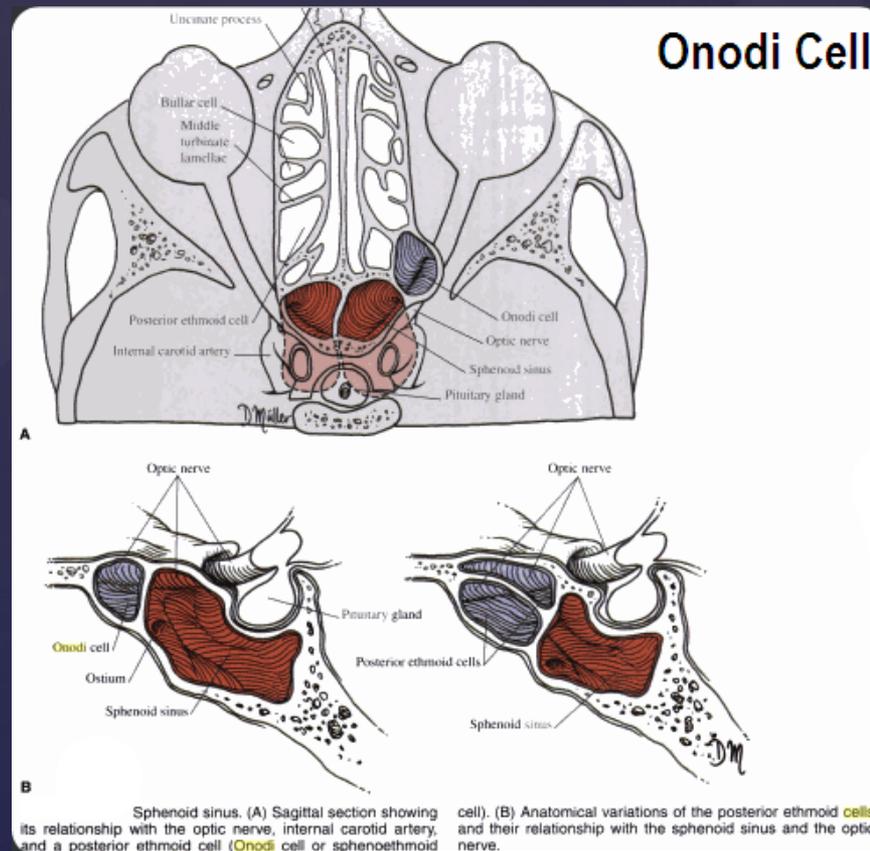


- *Ethmoidal Sinusitis* is often associated with infection of other sinuses. The pain is localised over the bridge of nose medial to the eye.
- As the ethmoidal sinuses are separated from the wall of the orbit only by a very thin plate of bone through *lamina papyracea*, can easily spread into the orbit producing *Orbital Cellulitis*.

Clinical co-relation

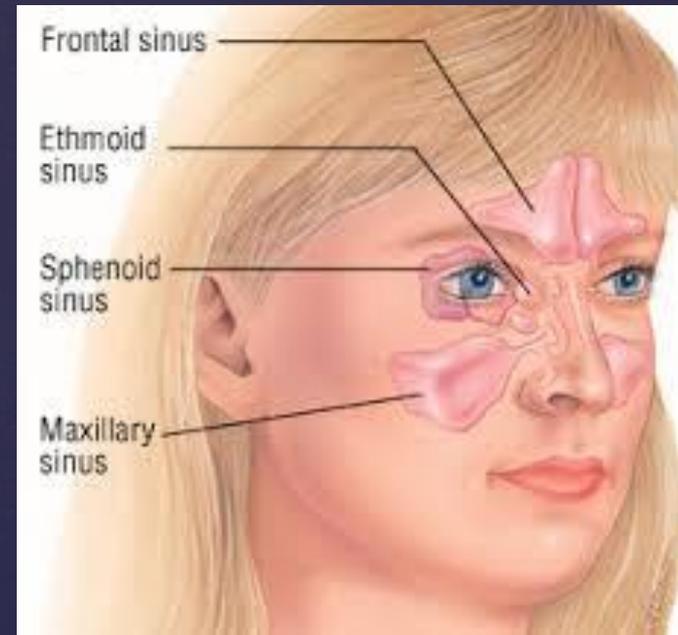


- ⌘ Important cells in anterior group- Agger nasi cells, ethmoidal bulla, supraorbital cells, frontoethmoid cells, Haller cells
- ⌘ Important cell in posterior group Sphenoethmoid or Onodi cell

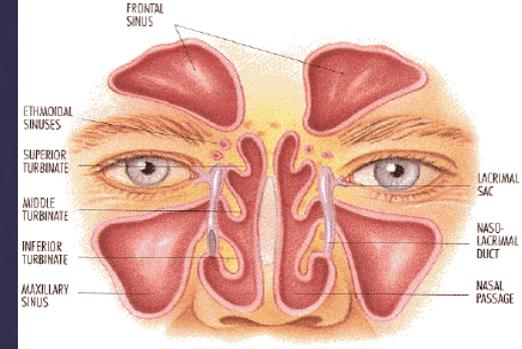


- Anatomical variations is the presence of *agger nasi air cells* - a large ethmoidal air cell just anterior to the antero-superior attachment of the middle turbinate.
- *Haller cells* are ethmoidal air cells belonging to the ant ethmoidal group, also known as infra orbital cells.

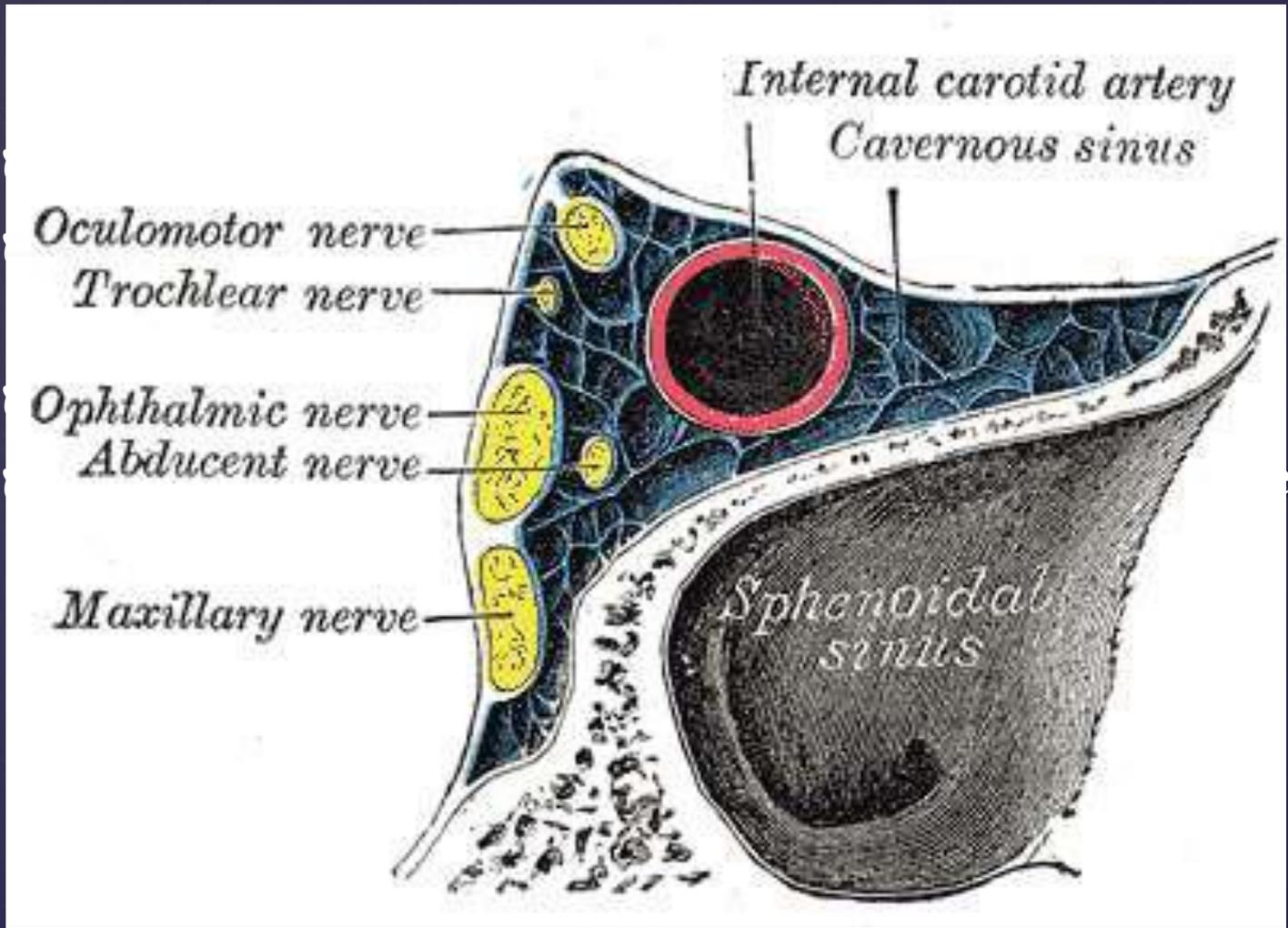
- ⌘ Within body of sphenoid bone
- ⌘ ⊙ Separated from each by thin bony septum
- ⌘ ⊙ Opens to sphenoidal recess
- ⌘ Relations:
 - ⌘ ⊙ Sup: Optic chiasma+ hypophysis cerebri
 - ⌘ ⊙ Lat: int carotid artery+ cavernous sinus

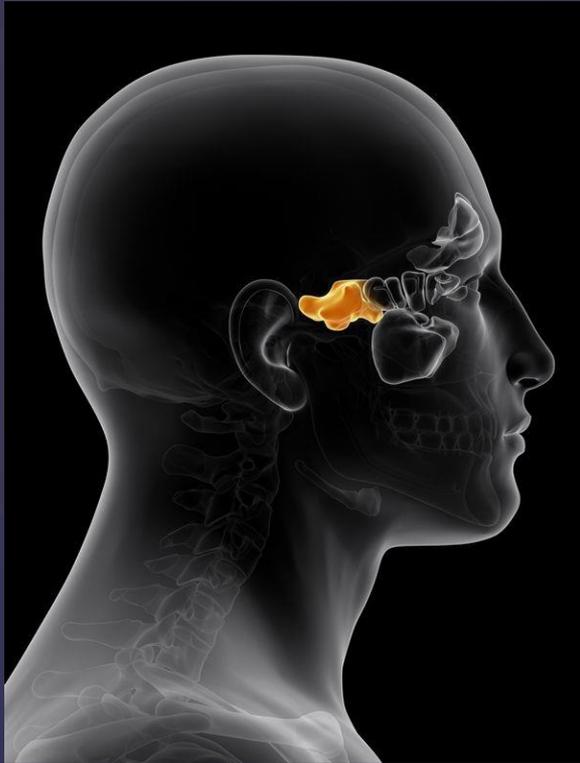


Sphenoid Sinus



- Located in the base of the base of the skull at the junction of anterior & middle cranial fossa.
- The sphenoid sinuses begin growth from the nasal cavity in the 4th fetal month as invaginations from the sphenoidal recesses of the nasal cavities.
- Right & left are separated by a septum & usually unequal in size.
- Pneumatization starts during the 4th yr of childhood and gets completed by the 17th yr.
- They drain through the superior meatus via a small ostium about 4mm in diameter.
- They are present as minute cavities at birth but main development takes after puberty.





- Isolated *Sphenoidal Sinusitis* is rare.
- It is usually a part of pansinusitis or is associated with the infection of posterior ethmoidal sinuses.
- The infection of sphenoidal air sinuses spreading upwards may affect the pituitary gland and optic chiasma.

Clinical correlation

HEALTHY SINUS

Frontal Sinus

Sphenoid Sinus

Ethmoid Sinus

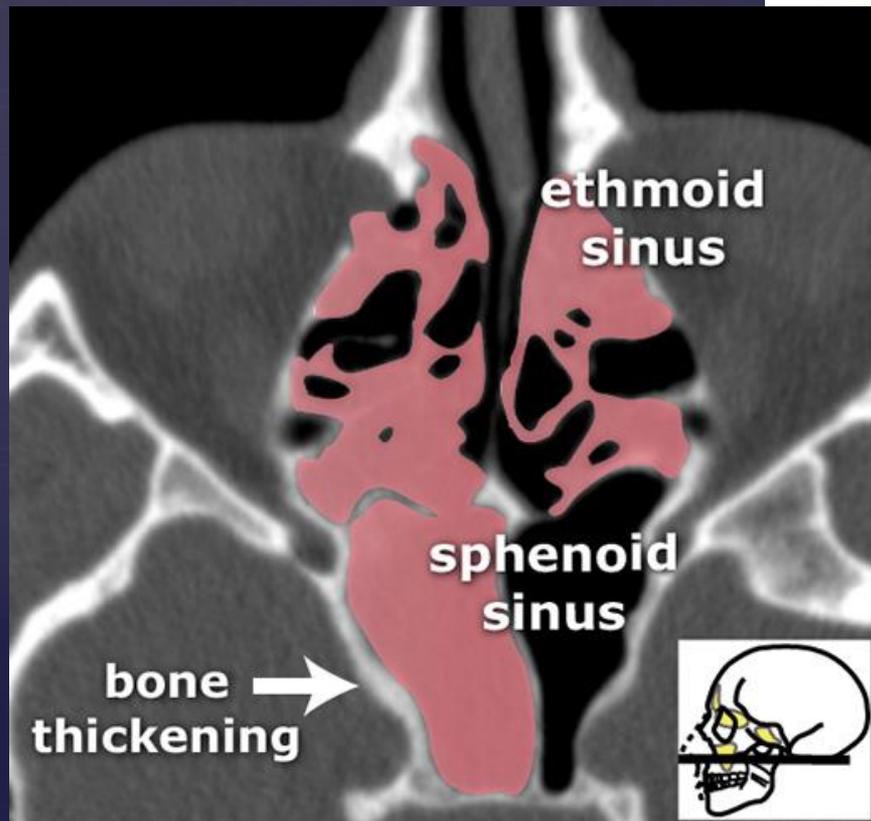
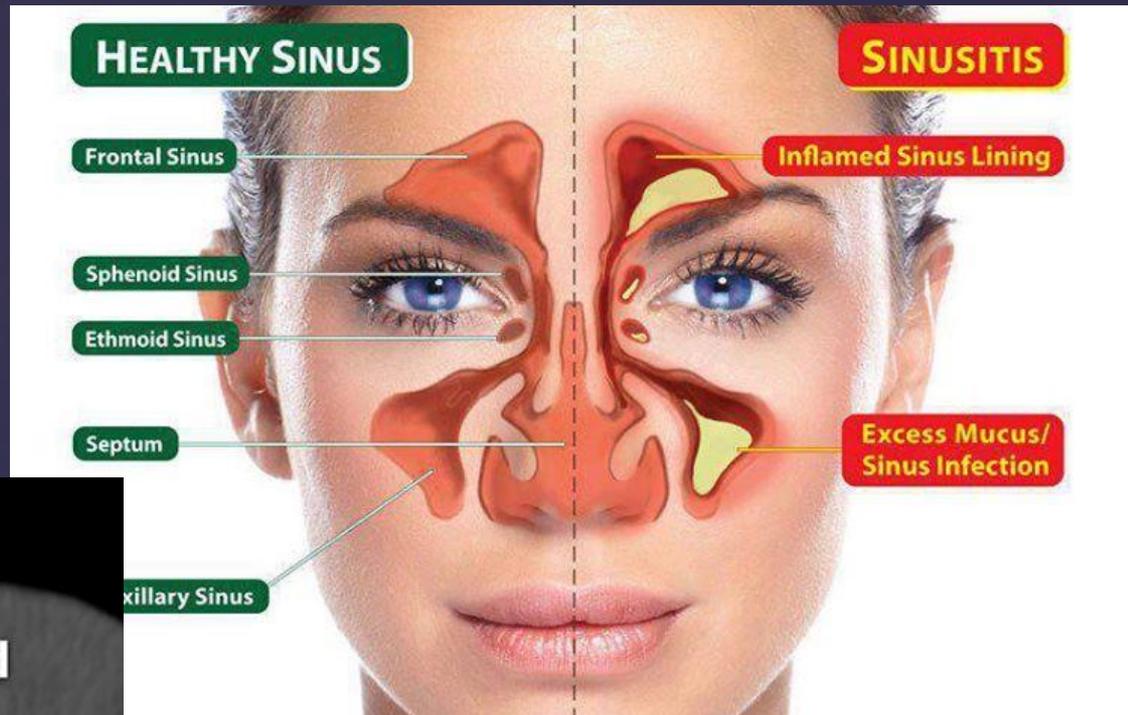
Septum

Maxillary Sinus

SINUSITIS

Inflamed Sinus Lining

Excess Mucus/
Sinus Infection



Lymphatic drainage of PNS

↳ FRONTAL SINUS

SUBMANDIBULAR NODES

↳ MAXILLARY SINUS

SUBMANDIBULAR NODES

↳ ETHMOIDAL SINUSES

SUBMANDIBULAR NODES

↳ SPHENOIDAL NODES
NODES

RETROPHARYNGEAL

Development and growth of PNS

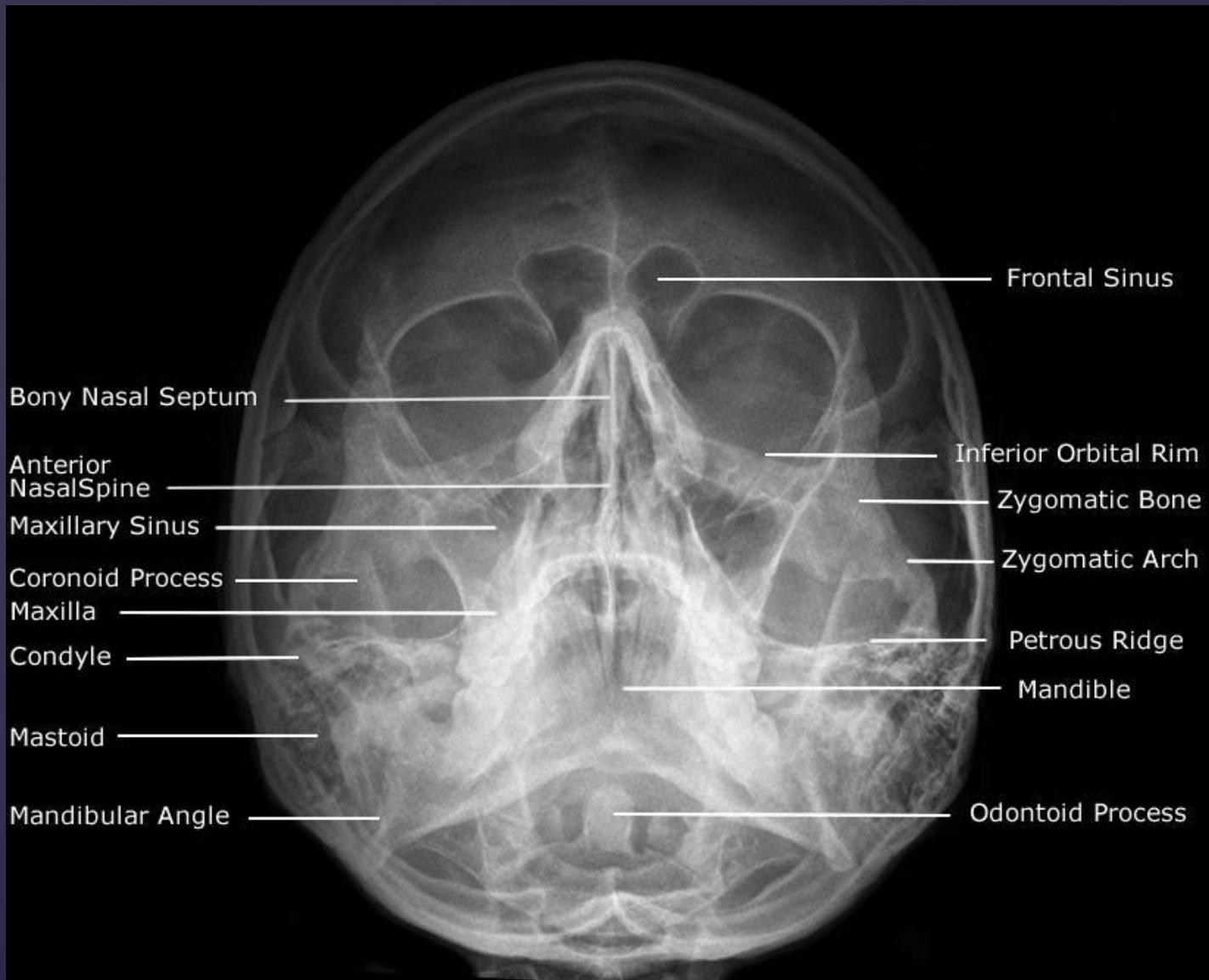
Sinus	Status at birth	Growth	First radiologic evidence
Maxillary	At birth; Vol:6-8mL	Rapid growth from birth-3years; from 7-12years.	4-6months after birth.
Ethmoid	At birth; Ant grp:5x2x2mm Post grp:5x4x2	Reaches adult size by 12 years.	1 year
Frontal	Not present	Invades frontal bone at 4 years. Increases until teens. Till 20y.	6 years.
Sphenoid	Not present.	Reach sella turcica 7years, dorsum sellae late teens, basisphenoid adult	4 years.

Imaging of PNS

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Paranasal sinuses

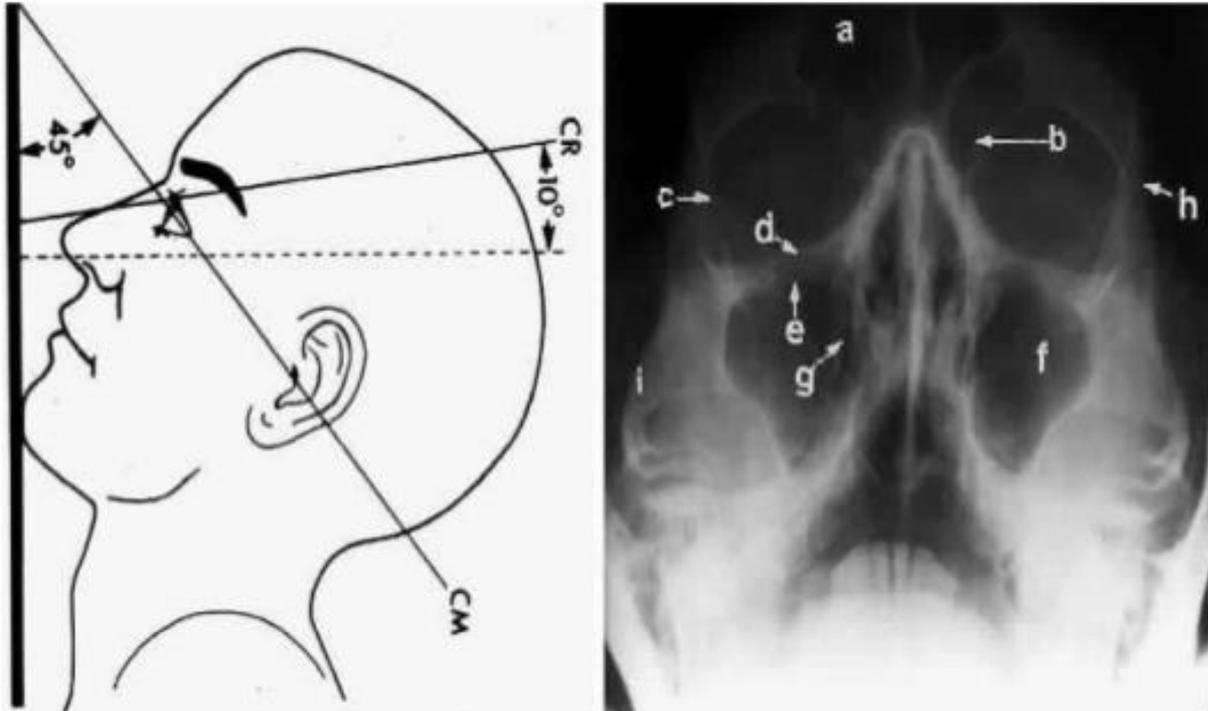


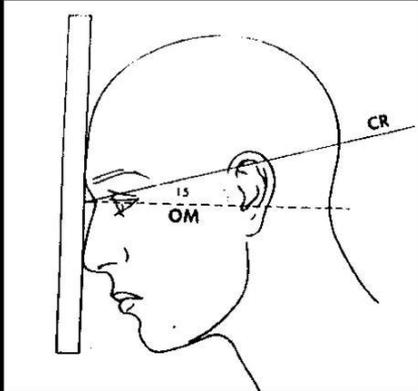
Water' s view



Caldwell view

WATERS VIEW: Waters projection is created by placing the chin of the patient on the x-ray cassette with the canthomeatal line (the line that connects the lateral canthus and the external auditory meatus) at 37 degrees to 45 degrees



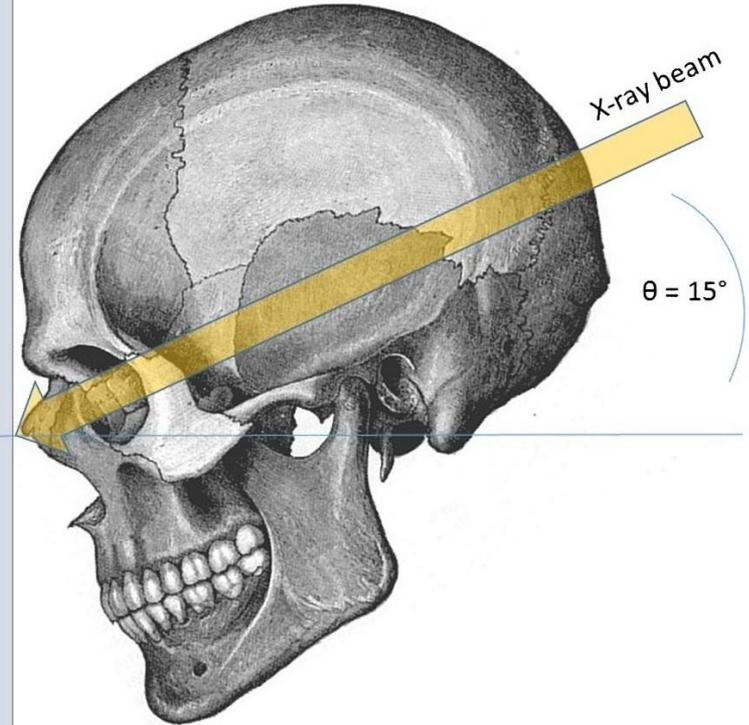


Caldwell view

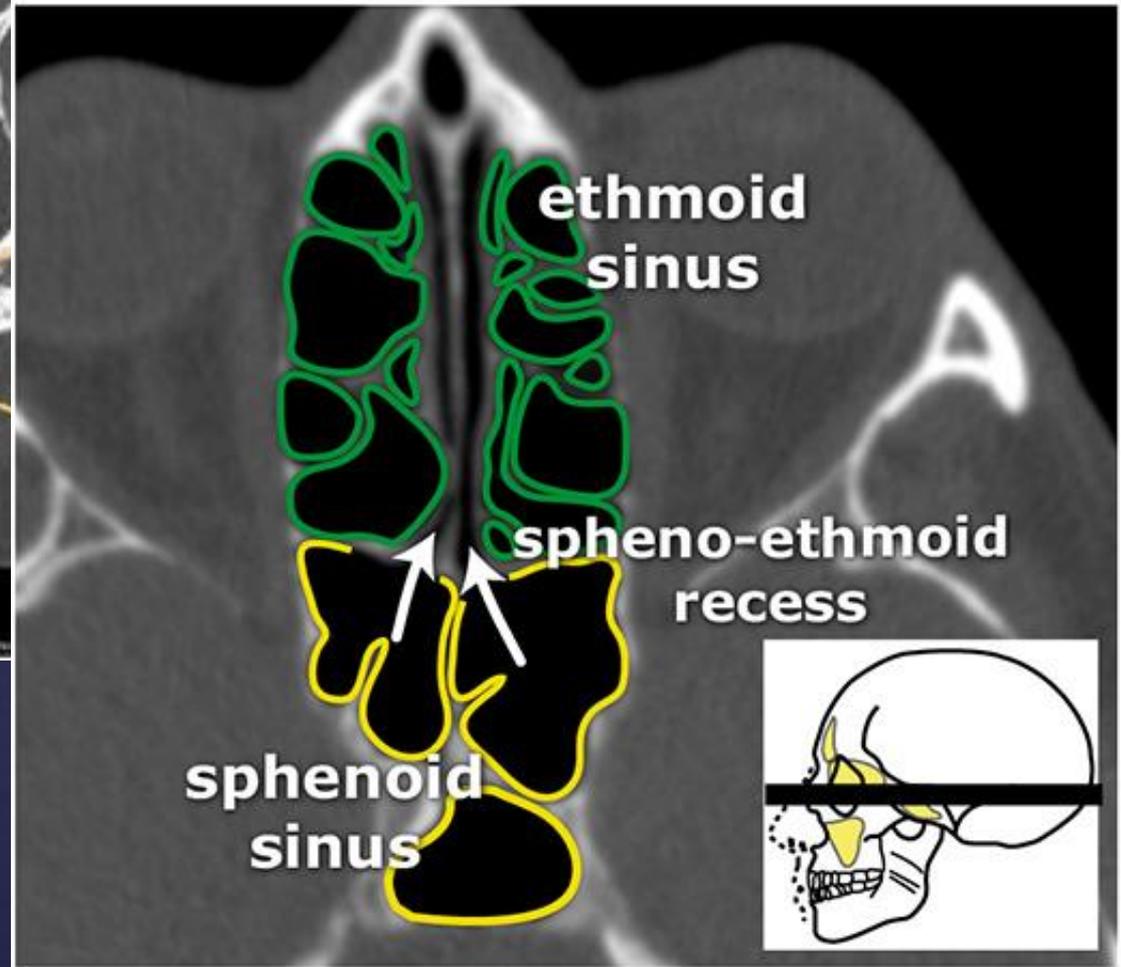
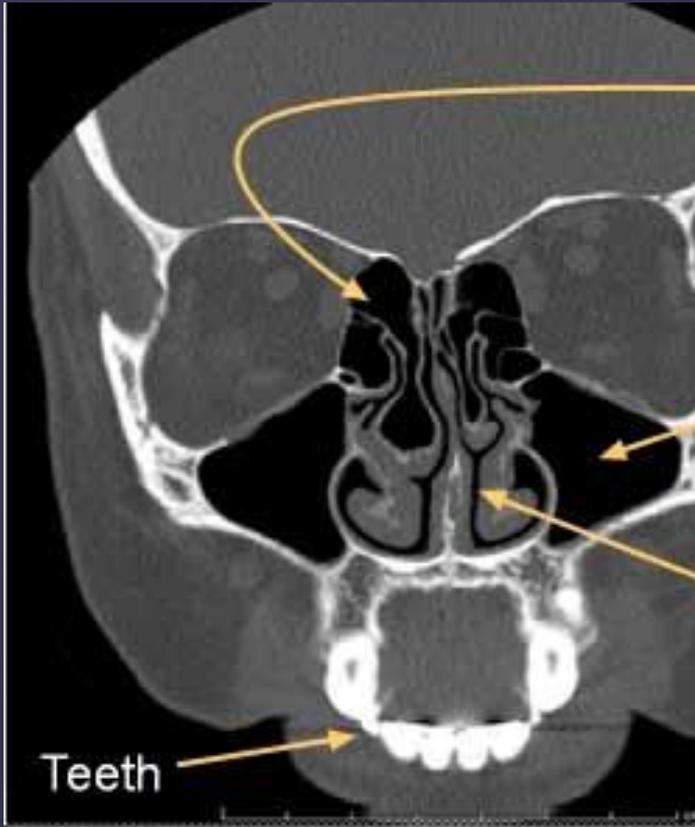


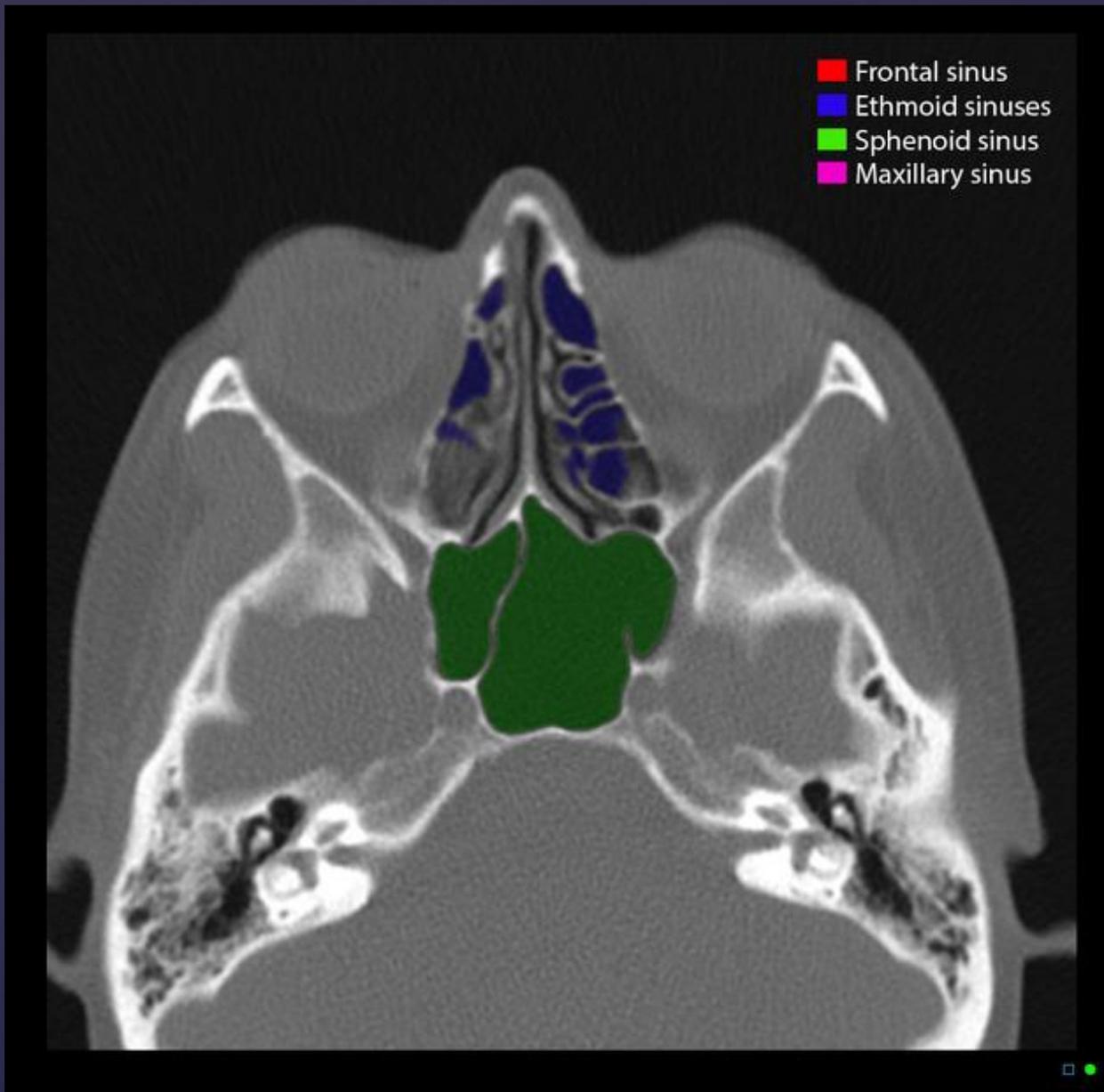
- Orbital wall
- Frontal and ethmoid sinuses
- Mandible

X-ray detector



Coronal CT section



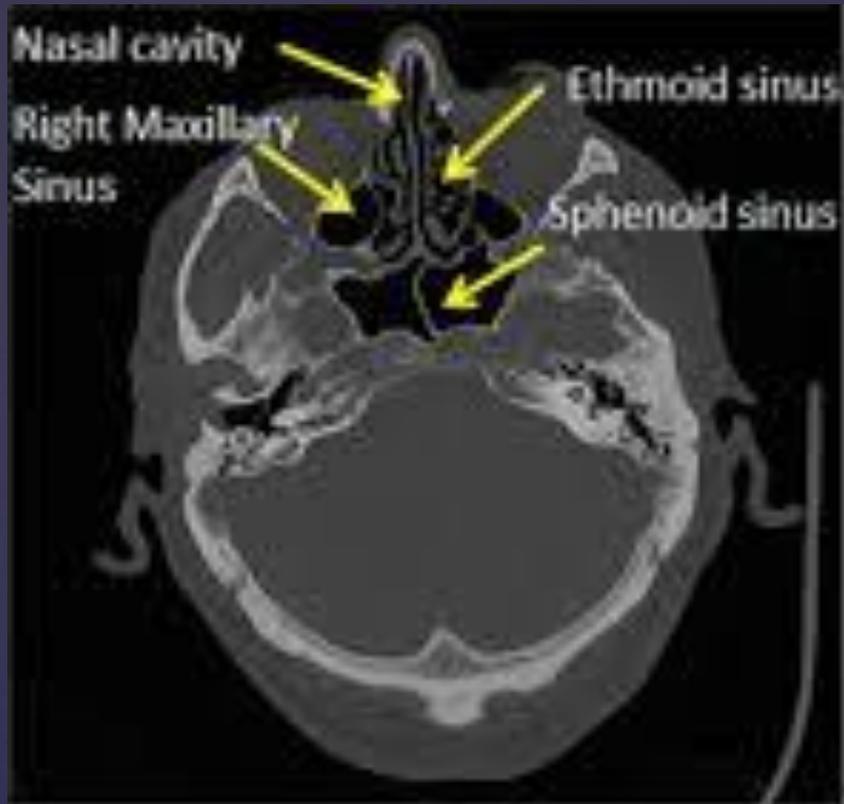


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Dr Sowmya GV, OMDR

5/26/2020

Axial CT Section



(a) Axial view



(b) Sagittal view