

# Paranasal Sinuses

## Anatomy and normal variation

**Dr Maryam Foroozandeh**  
**Assistant professor of oral and maxillofacial radiology**



# *Learning Outcomes*

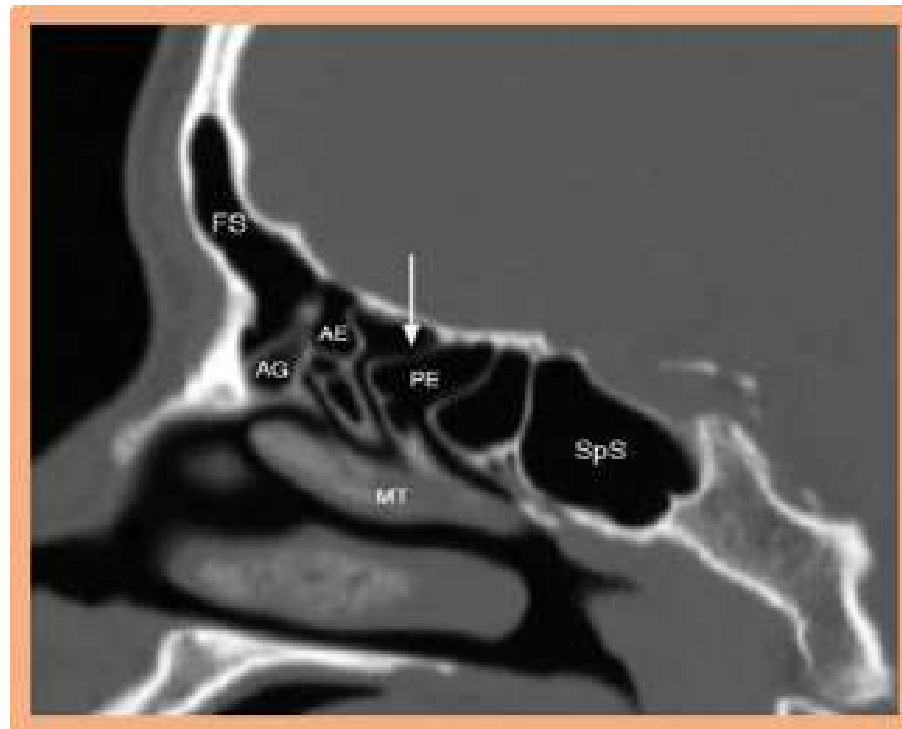
❑ *Anatomy and normal variation of the:*

❑ *Maxillary sinuses*

❑ *Ethmoid sinuses*

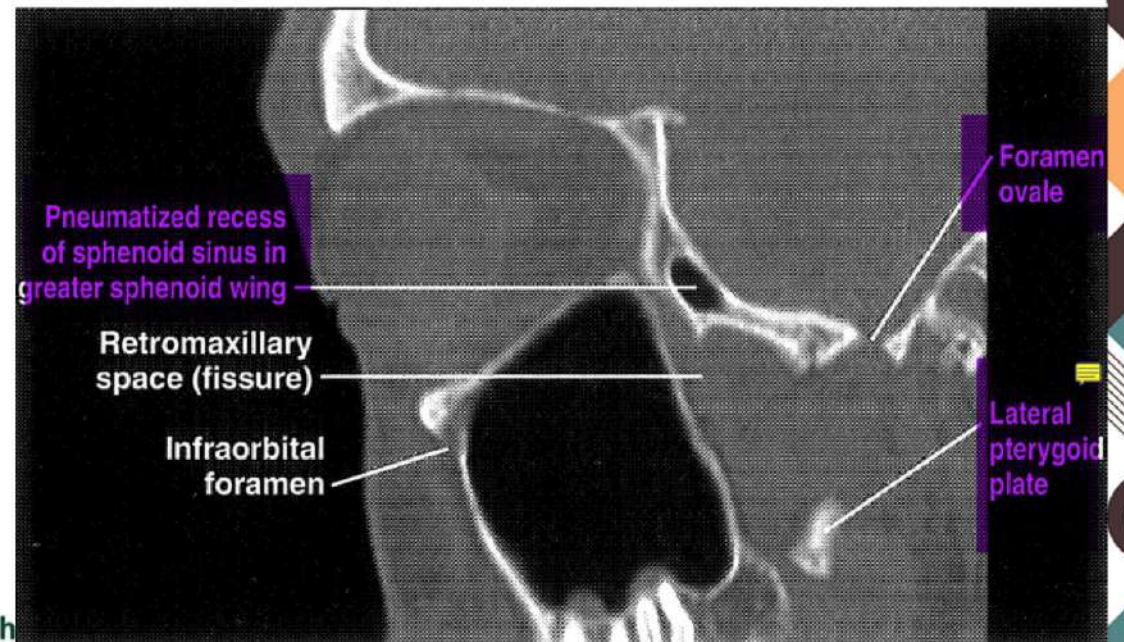
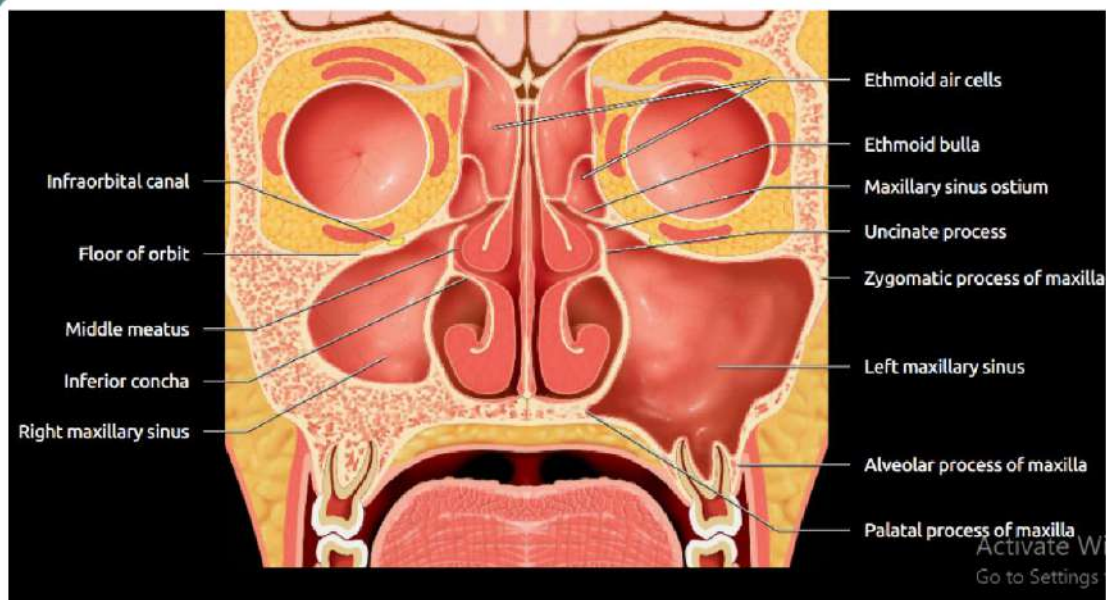
❑ *Frontal sinuses*

❑ *Sphenoid sinuses*

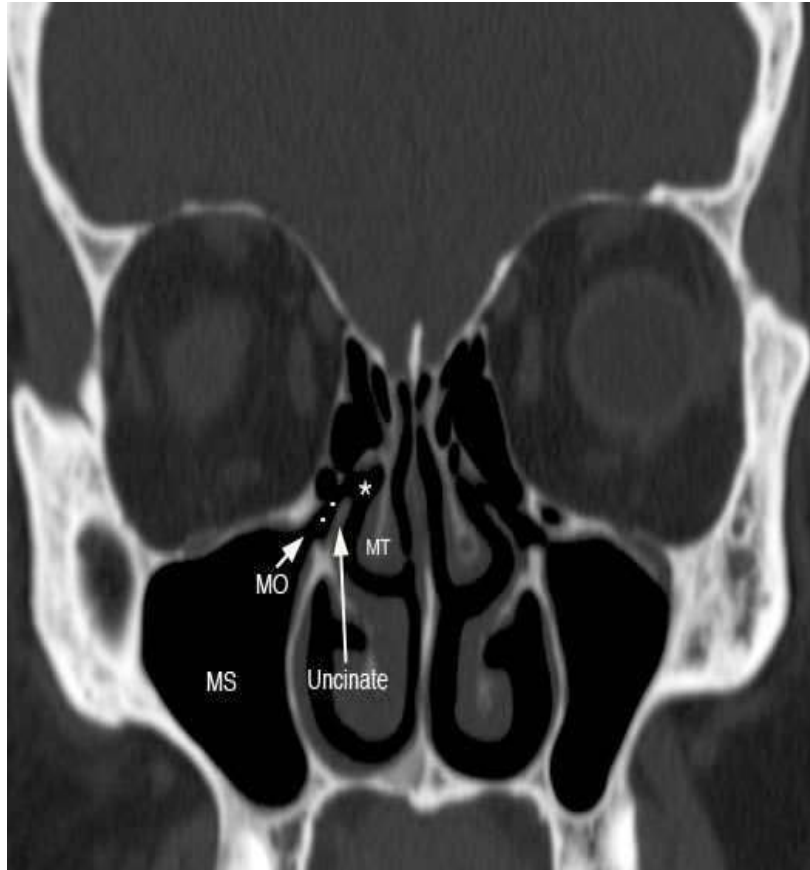


# *Maxillary sinus*

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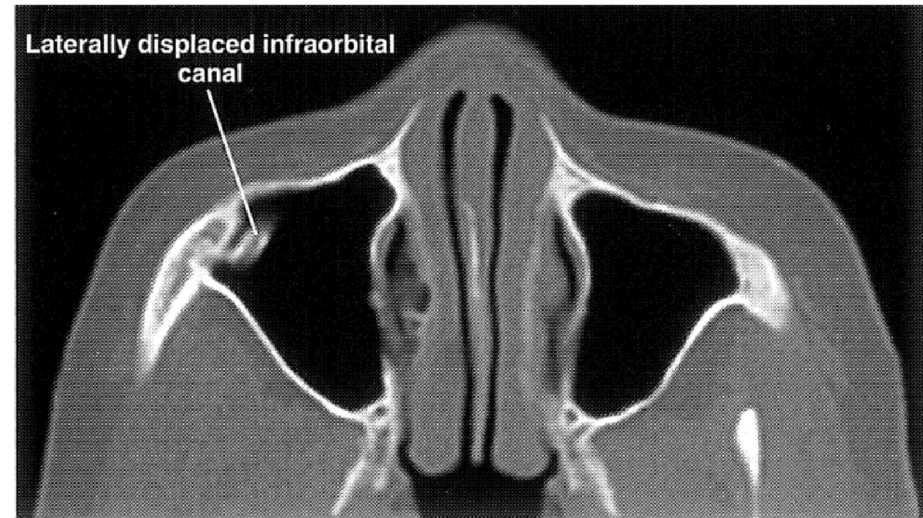
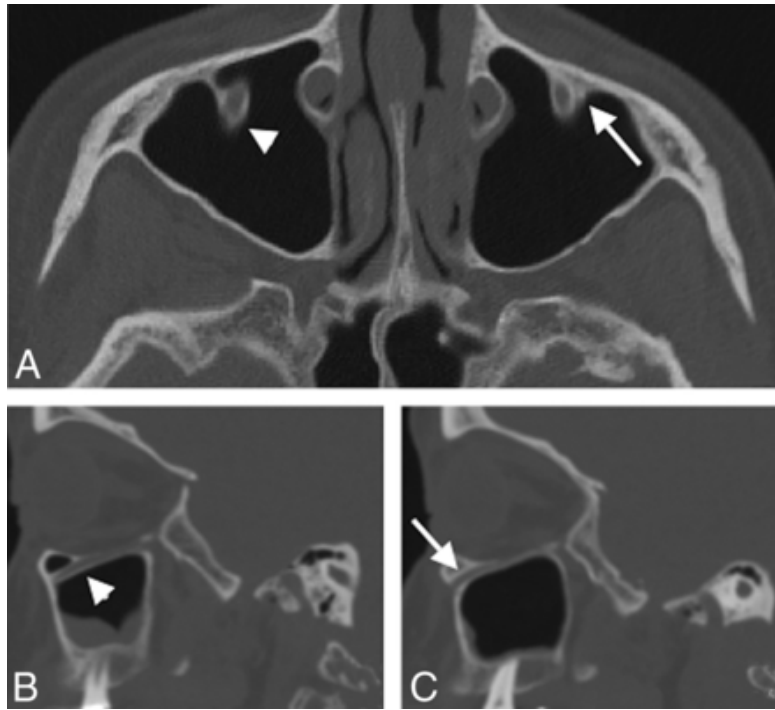
Seen high up in the medial wall •

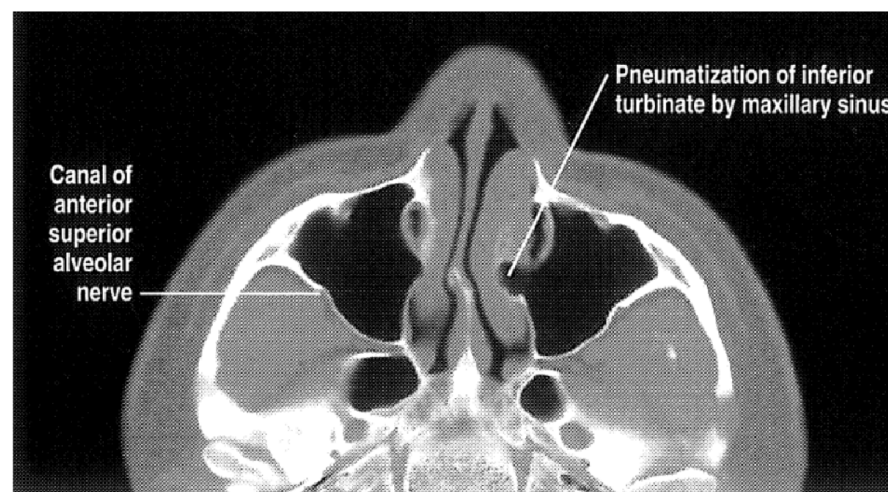
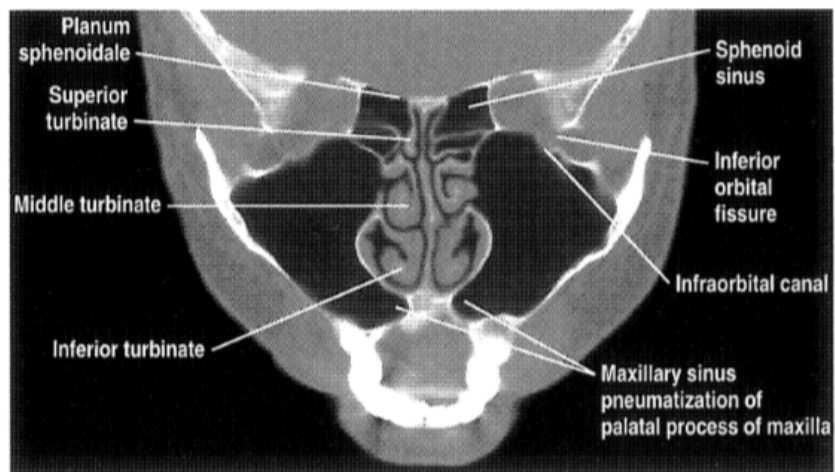
Does not open directly into the nasal cavity, •  
but opens into post. part of ethmoidal infundibulum, via hiatus semilunaris into middle meatus.

The **infundibulum** is the air passage •  
that connects the maxillary sinus ostium to the middle meatus.

Accessory ostium – 15-40 % cases •

## *Infraorbital canal*

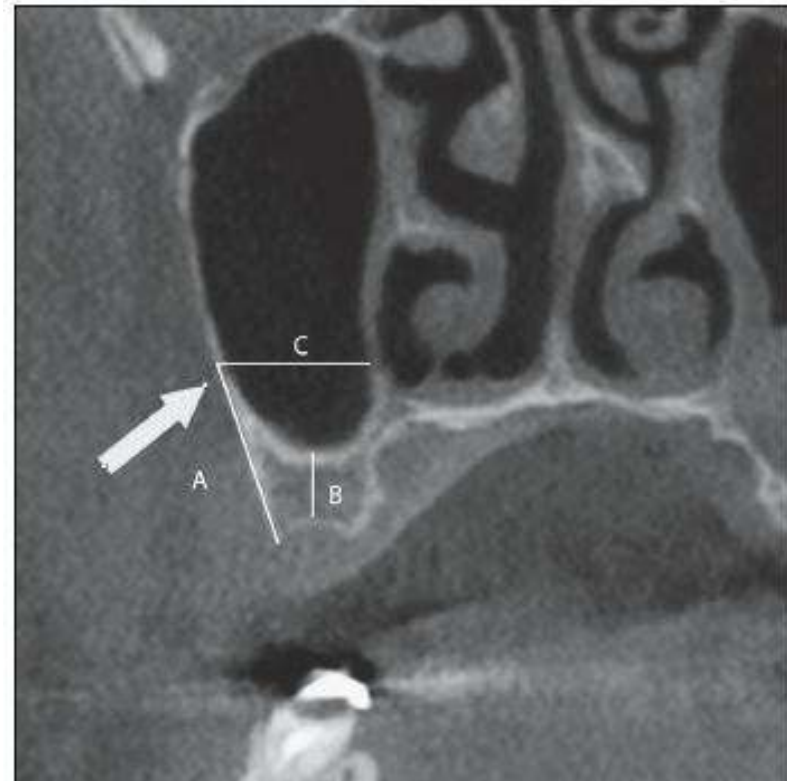
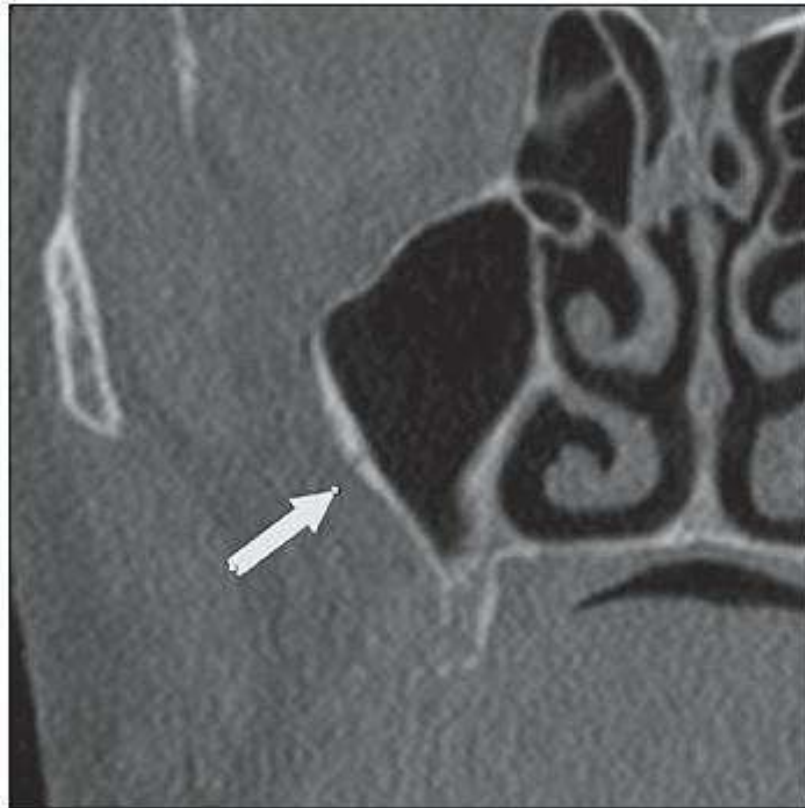






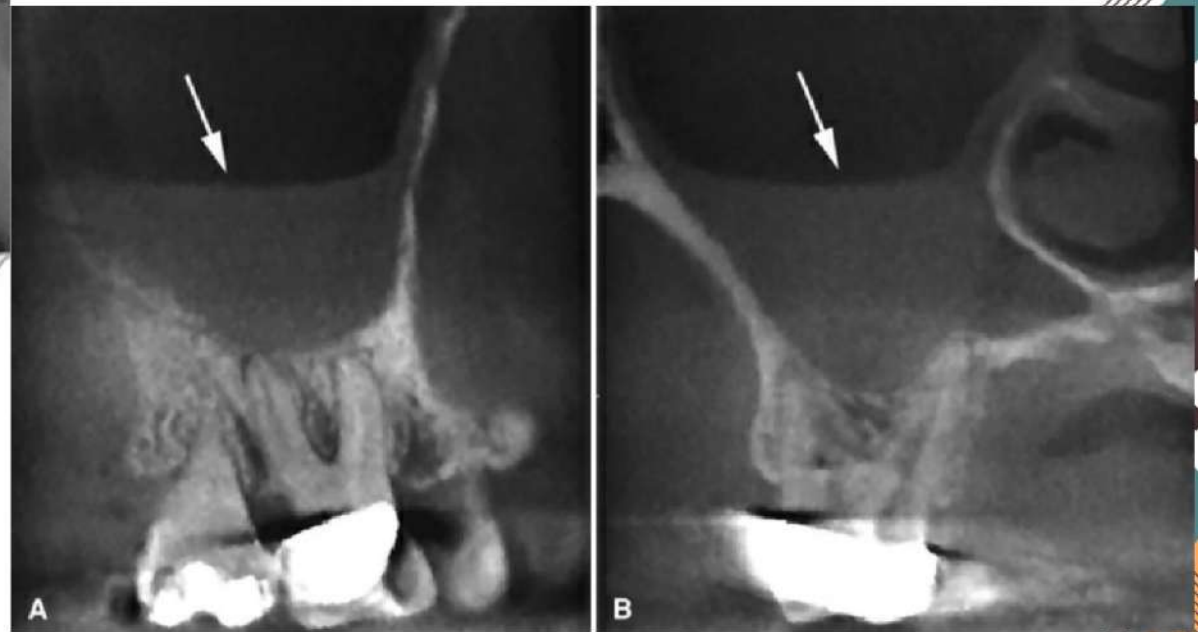
*PSA: resemble fracture*

The branches of the maxillary artery should be taken into consideration during sinus augmentation because of the potential risk of bleeding during the procedure owing to damage to the vascular supply in the lateral wall (6)

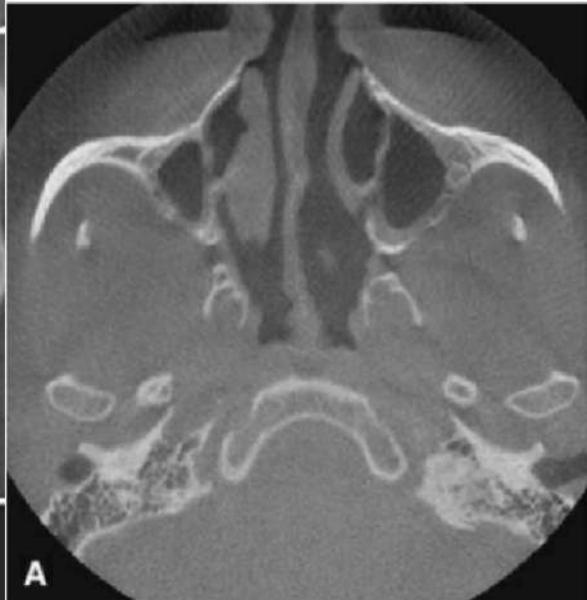
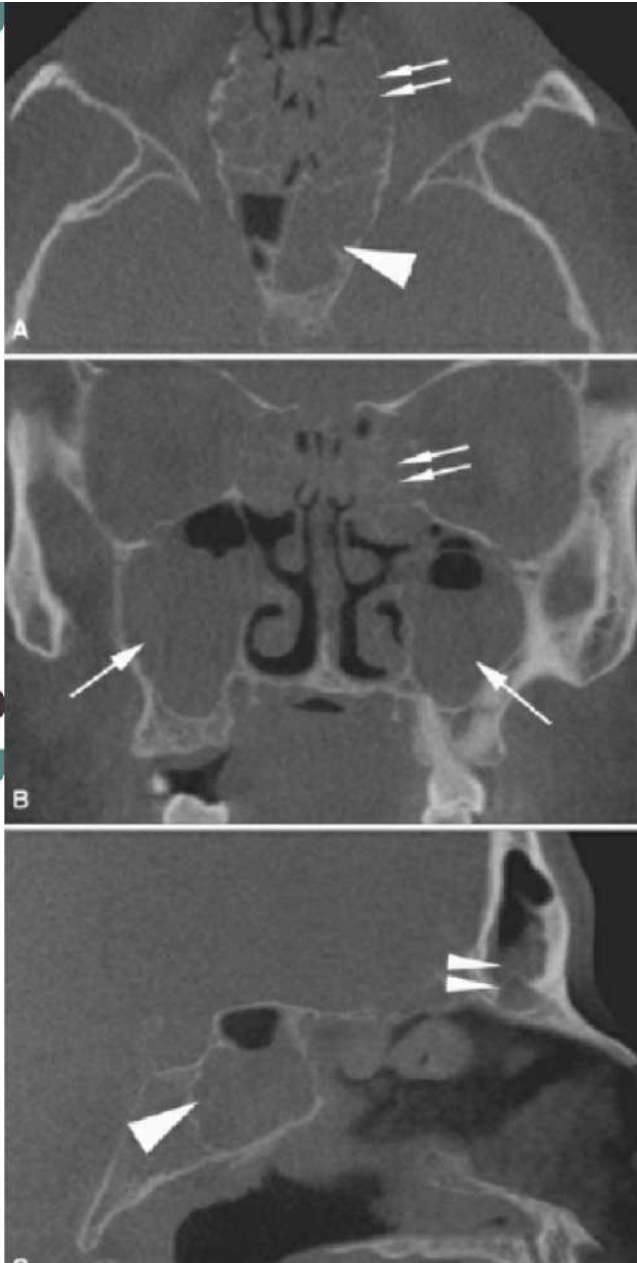




## *Air- Fluid Level*



## *Sinusitis*



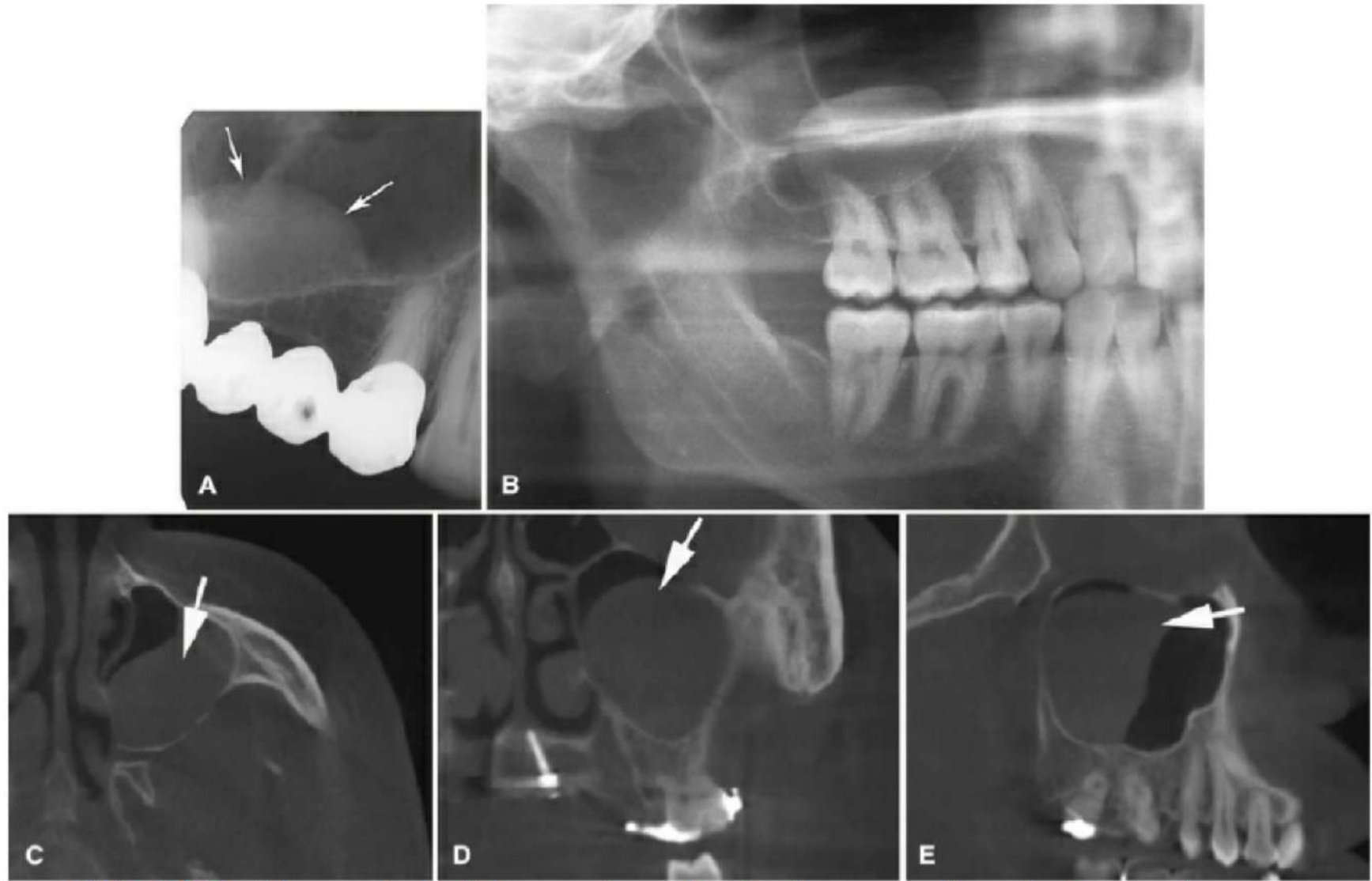
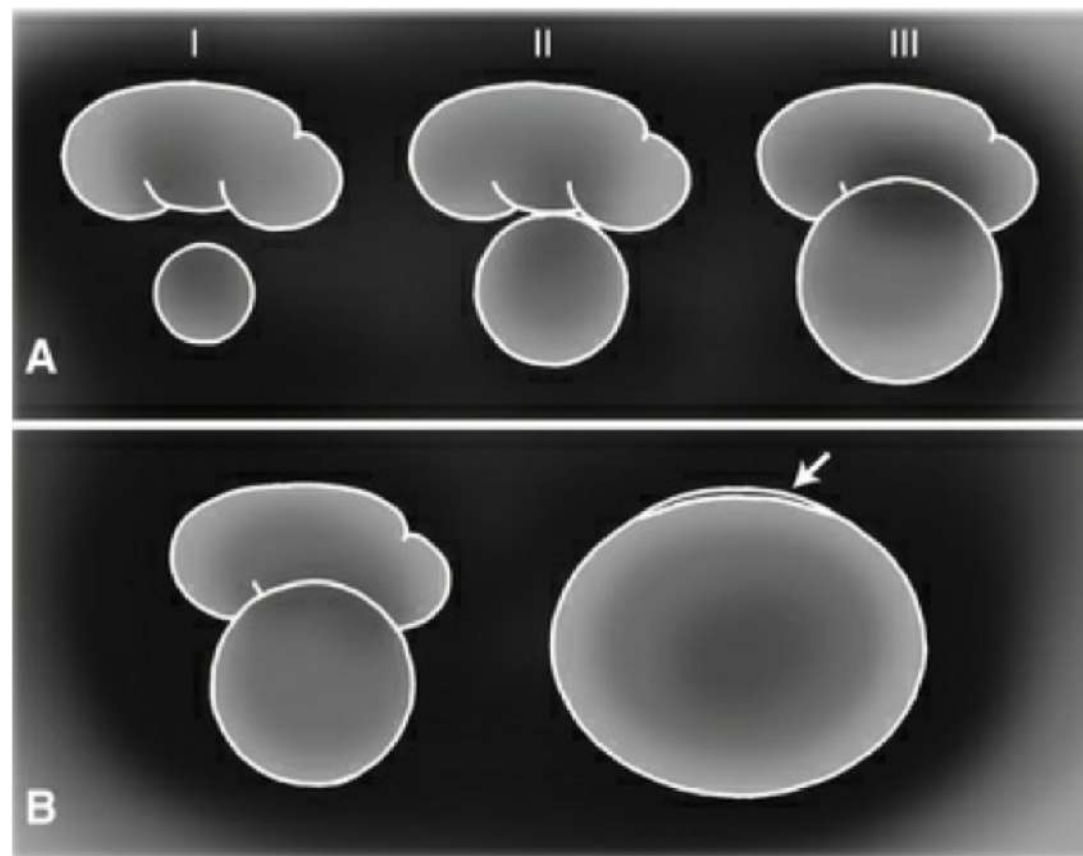
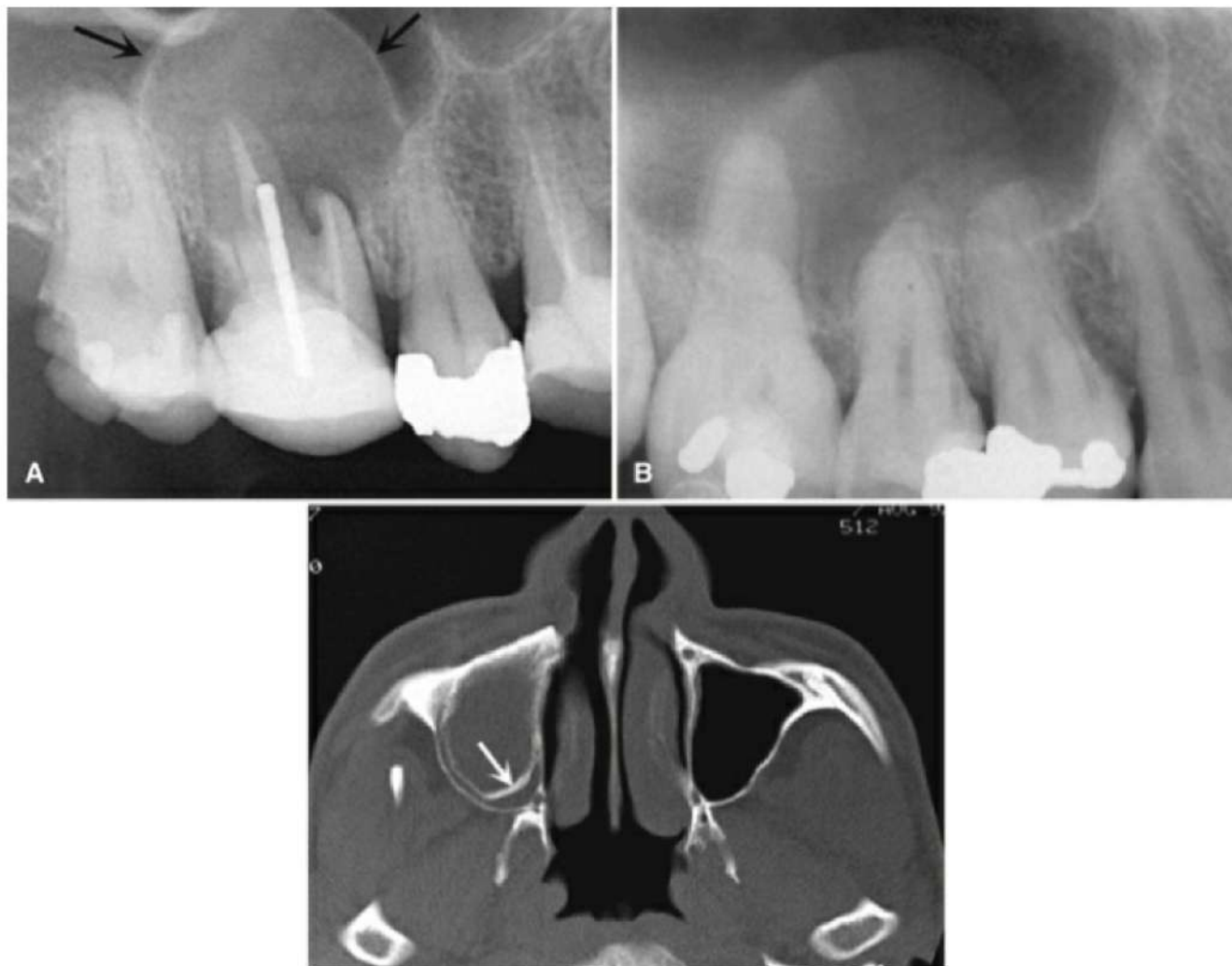


FIGURE 1. A: Radiograph of the tooth showing radiolucent areas in the periodontal space (arrows). B: Panoramic radiograph. C: Sagittal CT scan of the maxilla showing a lesion (arrowhead). D: Coronal CT scan of the maxilla showing a lesion (arrow). E: Coronal CT scan of the maxilla showing a lesion (arrowhead).

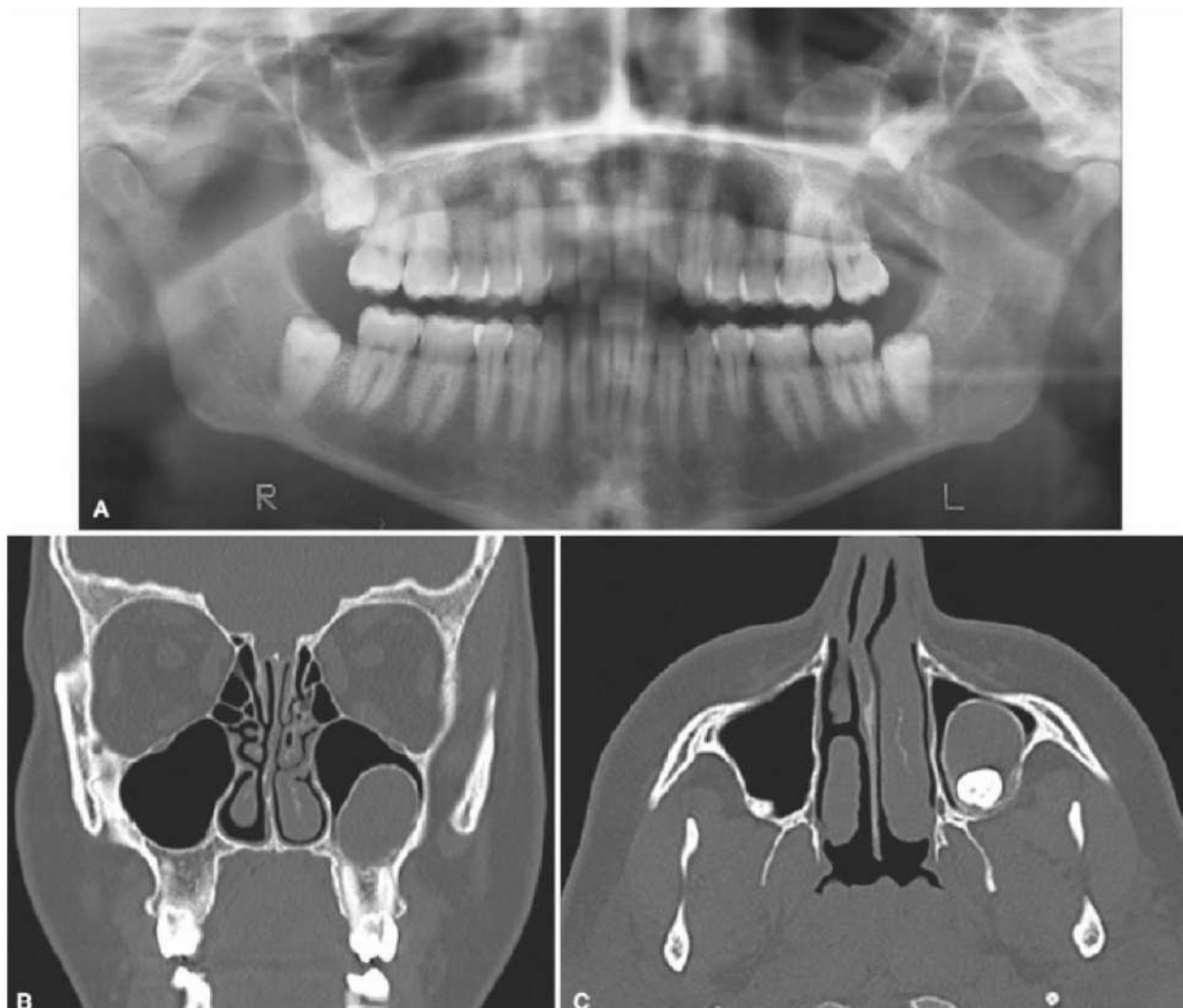




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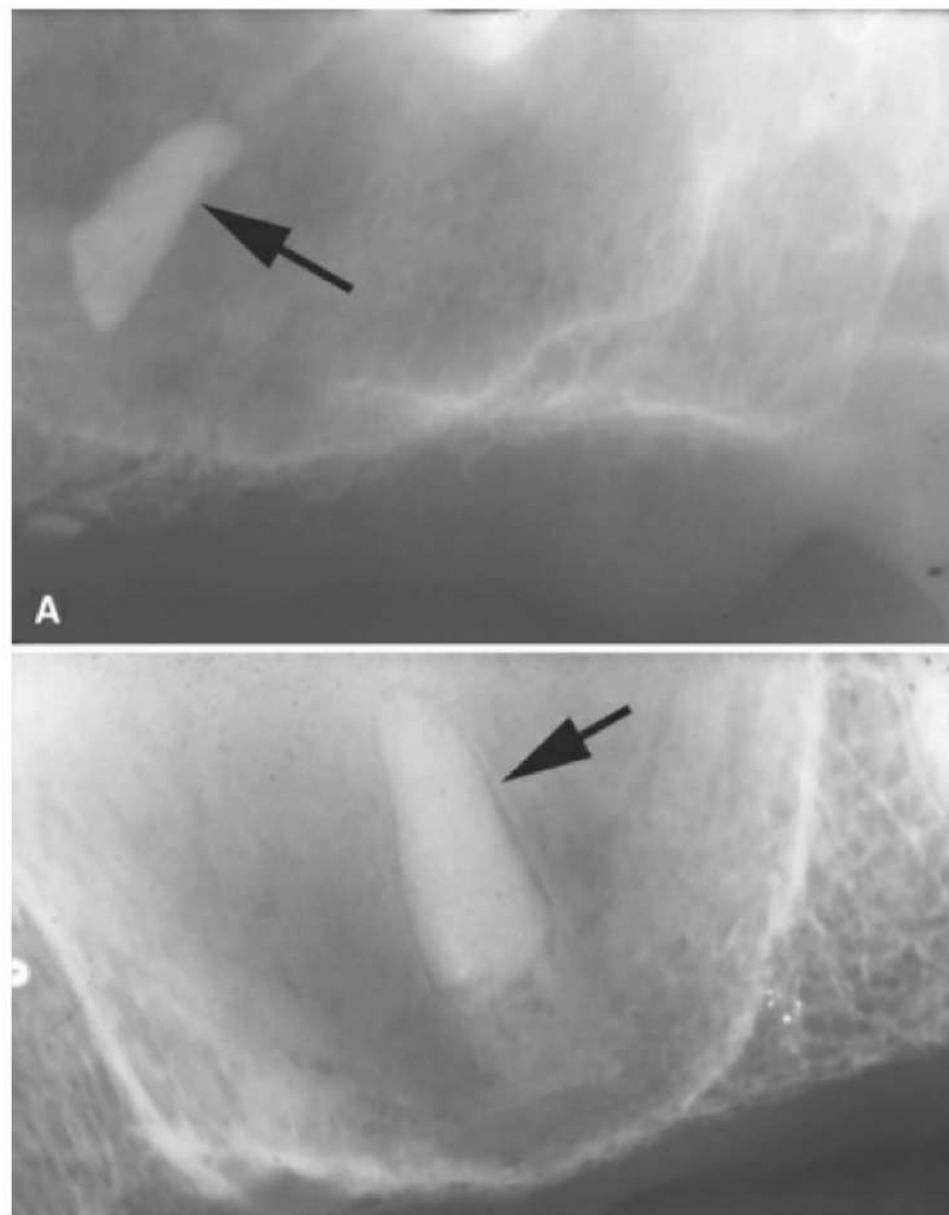


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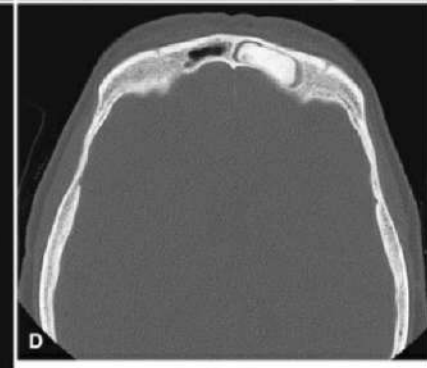
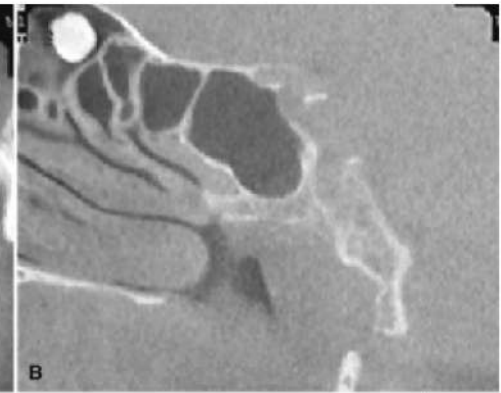
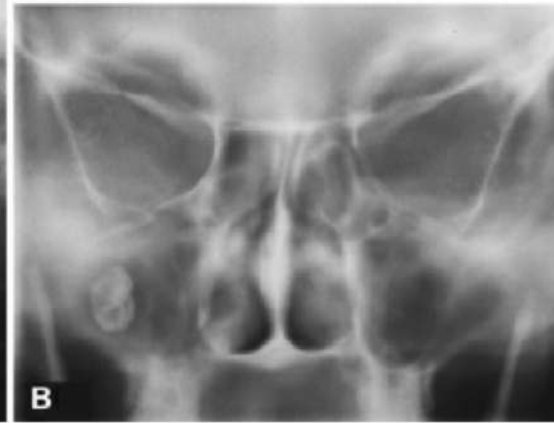
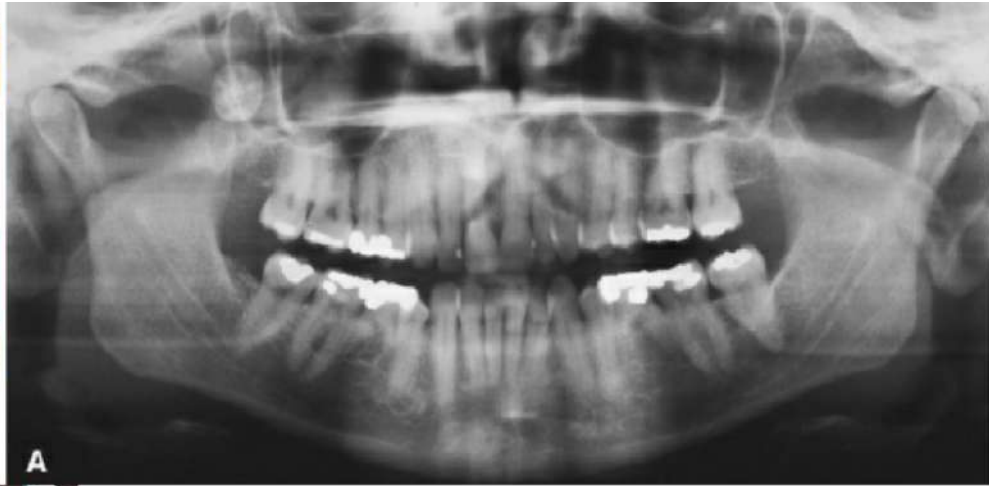


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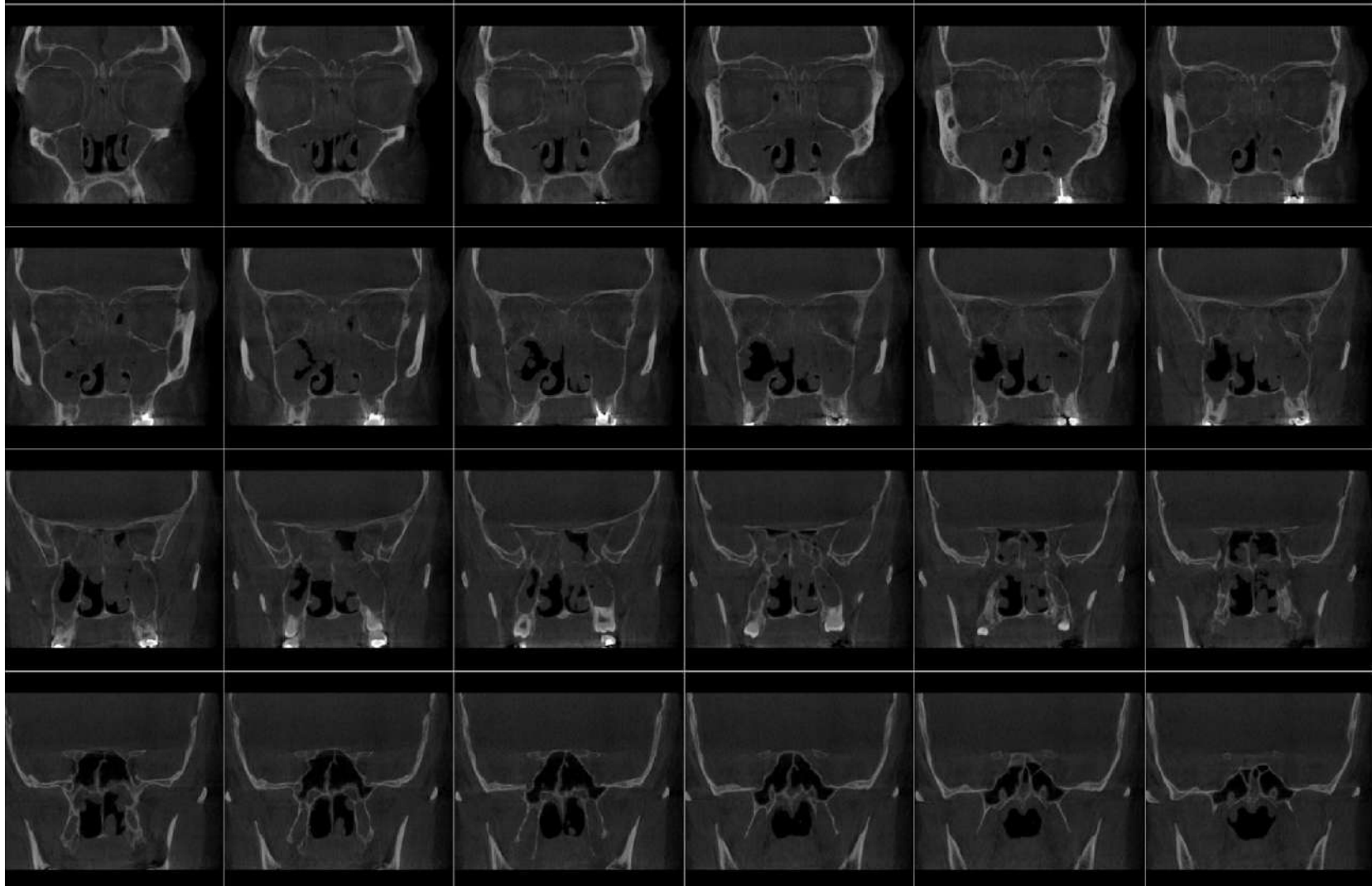
# *SCC*



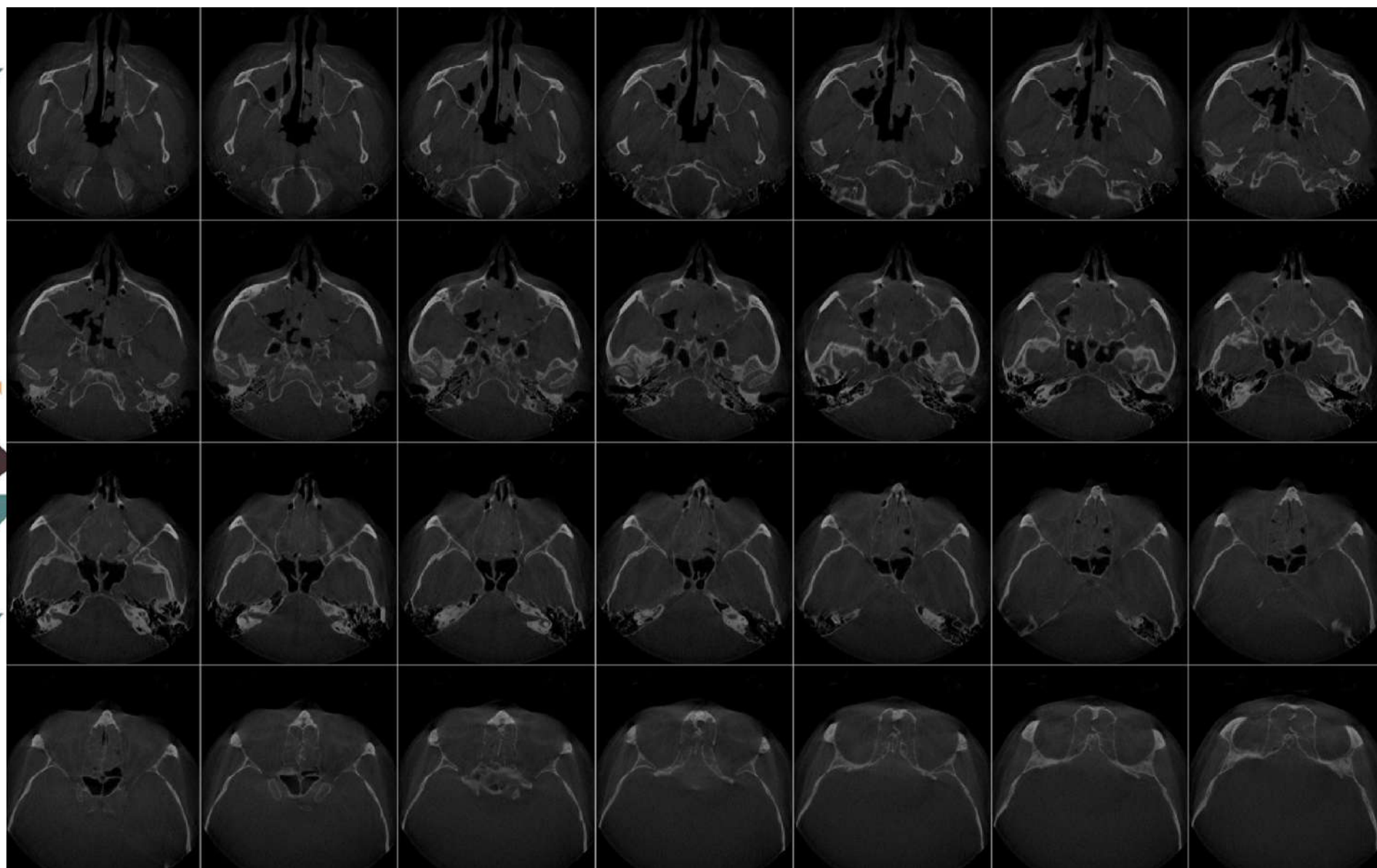
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# *Sinusitis*



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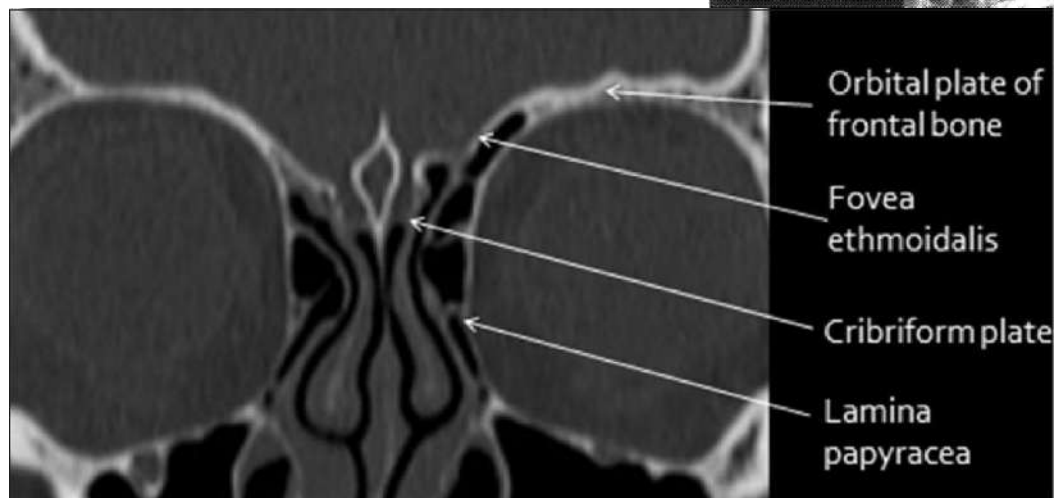
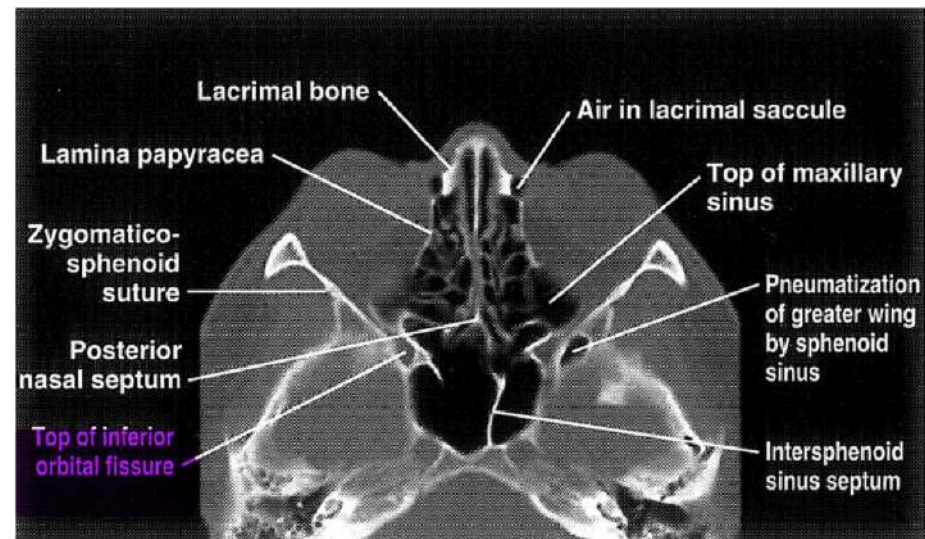


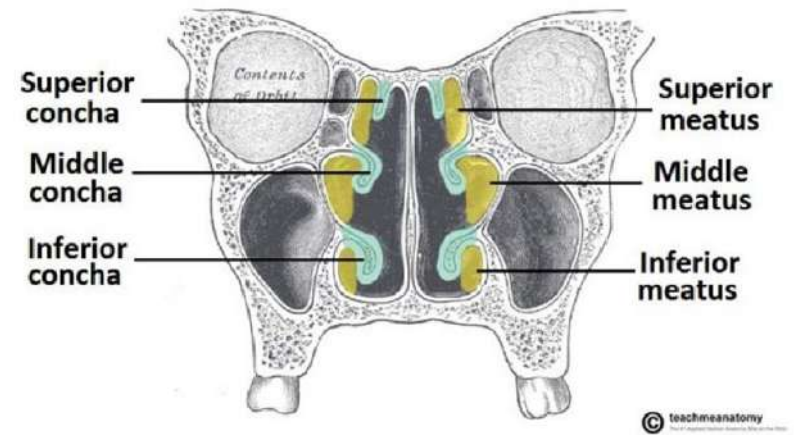
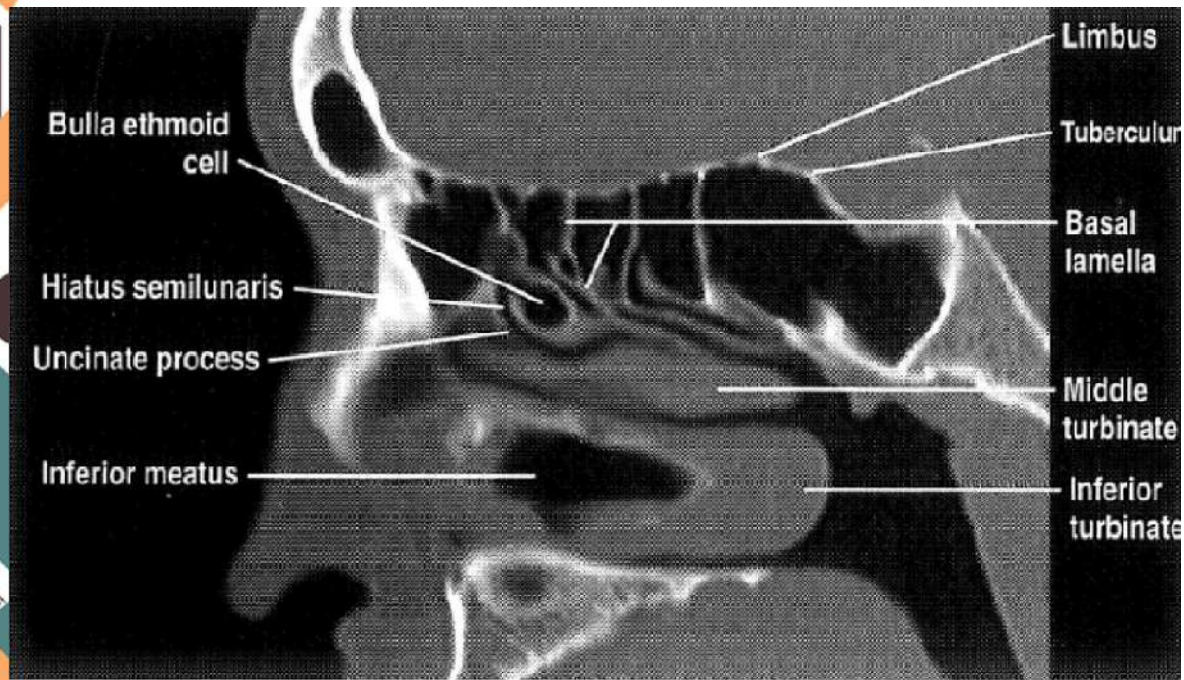
# *Ethmoid sinus*

- ❑ *First sinus develop*
- ❑ *Present at birth(only existing sinus in TALLASEMIA)*
- ❑ *3-5 inrauterus*
- ❑ *Thin walled air cavities in the lateral masses of the ethmoid bone*
- ❑ *Occupy the space between the upper third of the lateral nasal wall and the medial wall of orbit*
- ❑ *Clinically divided into anterior ethmoidal air cells & posterior ethmoidal air cells, by basal lamella (pos. attachment of middle turbinate to lamina papyracea)*



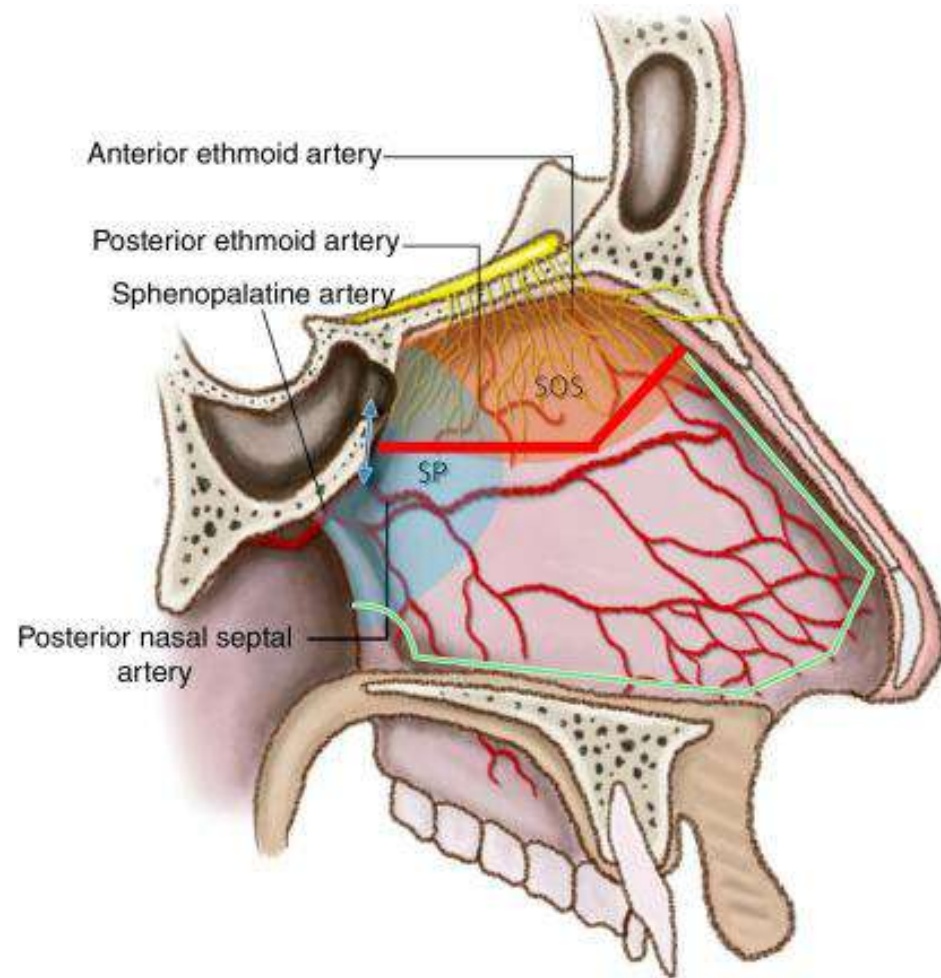
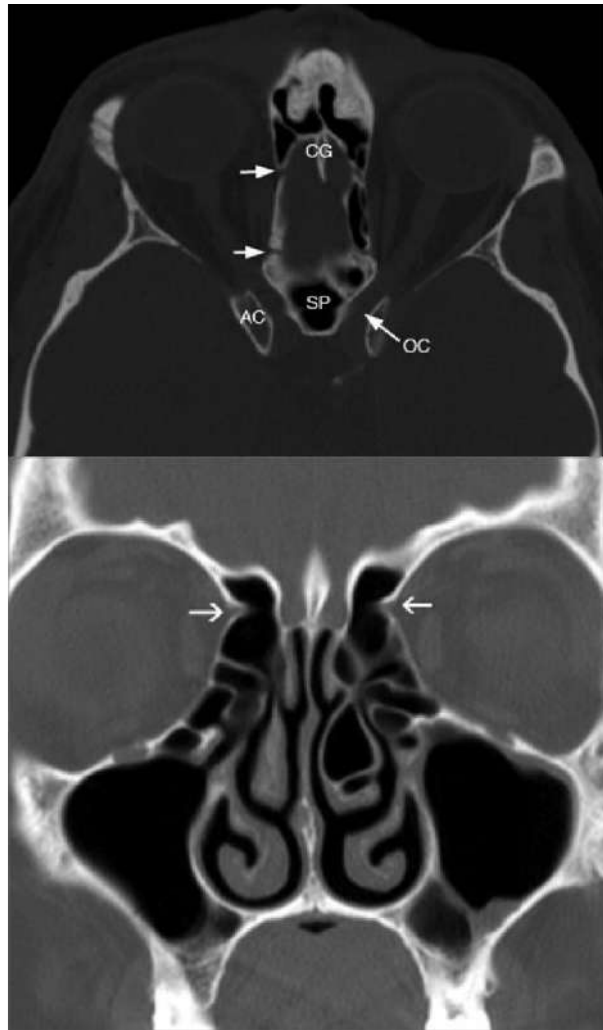
## *Ethmoid sinus*







## *Anterior and posterior Ethmoidal Artery*





# ETHMOID SINUS

## ❑Anterior cells drain into:

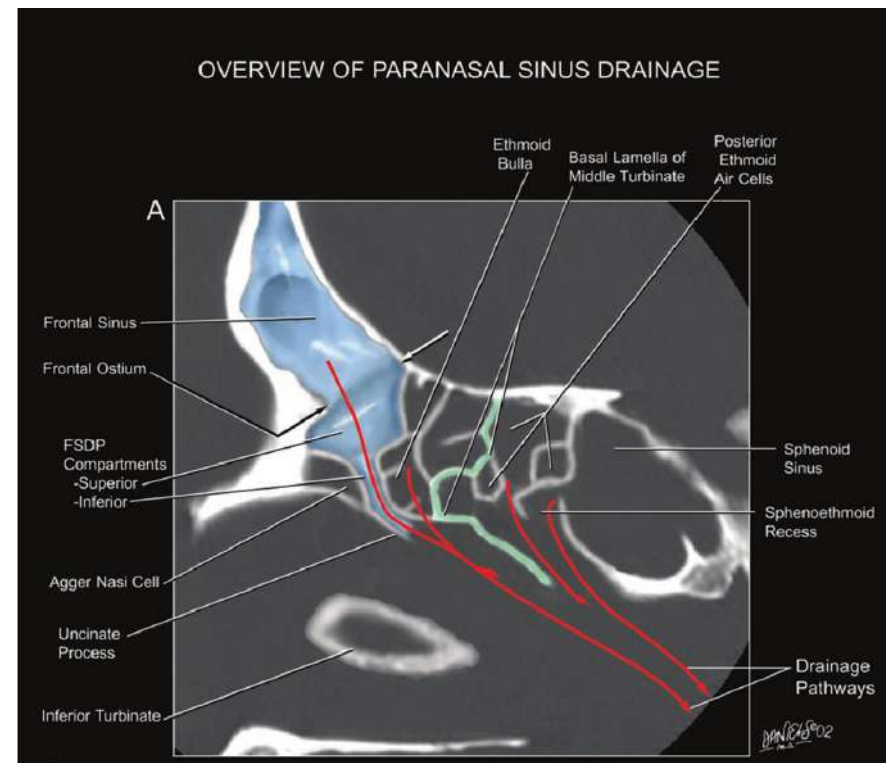
Frontal recess cell/ Frontal recess

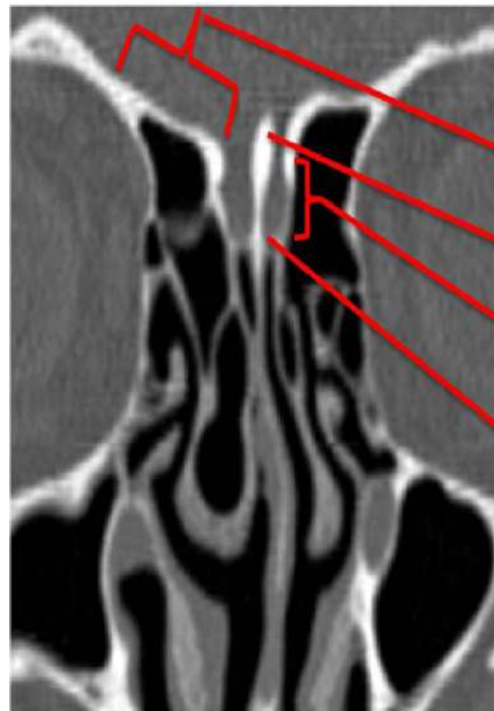
Infundibulum cell /semi-lunaris hiatus

Bulla cell/ Superior hiatus

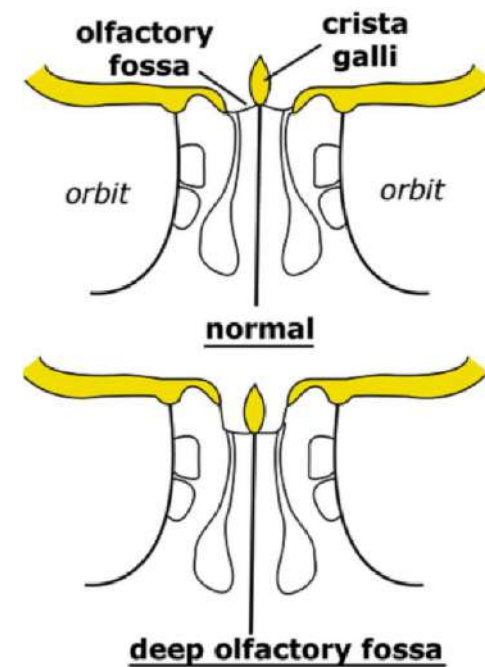
## ❑Posterior cells drain into:

Sphenoethmoidal recess





Fovea  
Crista galli  
Lateral lamella  
Cribriform plate





Keros classification. A: Type 1 (lateral cribriform lamella of 1 – 3 mm, the cribriform plate and the ethmoid cell roof are practically parallel to each other). B: Type 2 (lateral lamella of 4-7 mm, cribriform plate is much below the nasal cavity as compared with the ethmoid roof). C: Type 3 (lateral lamella of cribriform plate of 8 – 16 mm, ethmoid cell roof is located much above the plate)



*Coronal CT scan shows that the ethmoid roofs are almost in the same plane as the cribriform plate (double arrow) - Keros type I*

*Coronal CT reveals the olfactory fossae are deeper and the lateral lamellae are longer (double arrow) - Keros type II*

*Coronal CT shows that the olfactory fossae are very deep (double arrow) - Keros type III*



## *Aeration*

- ❑ *Agger nasi*
- ❑ *Supra orbital cell*
- ❑ *Concha bullosa*
- ❑ *Haller cell*
- ❑ *Onodi cell*
- ❑ *Pneumatization of maxillary sinus(double antrum)*
- ❑ *Extramural: frontal, maxillary, Sphenoid sinuses/ lacrimal/ Maxilla...*



## (reference: 3)

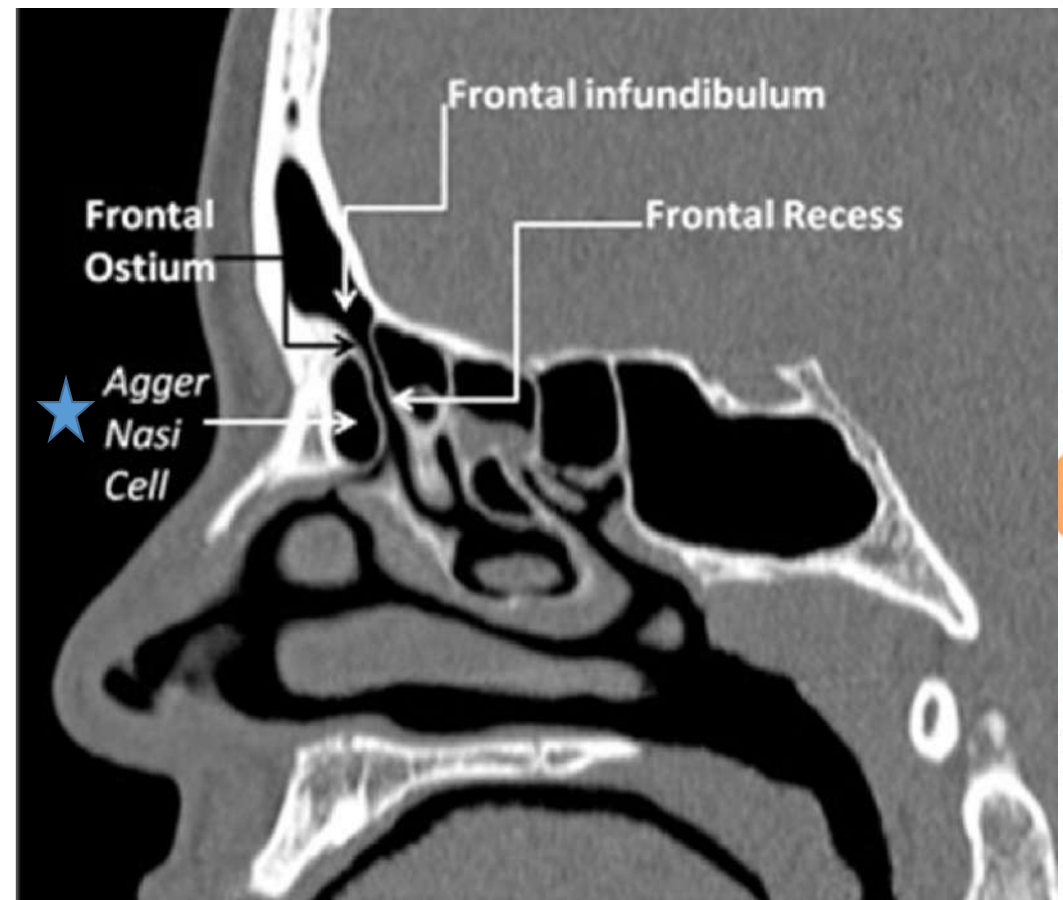
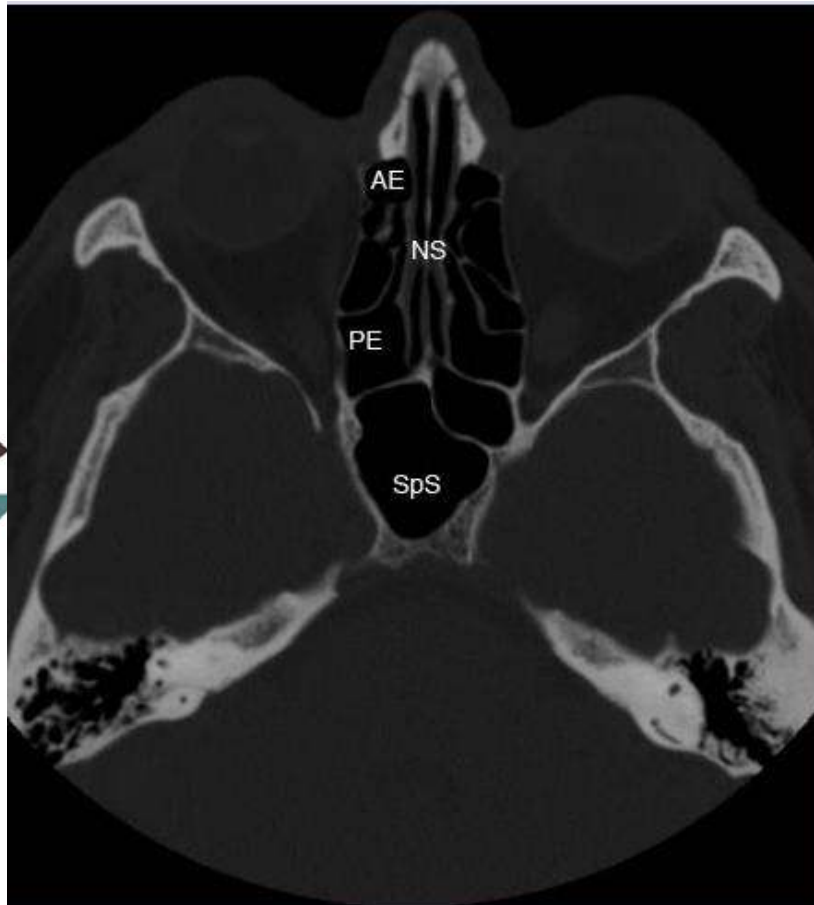
Correlation between anatomic variants of sinonasal region with symptoms of sinusitis.

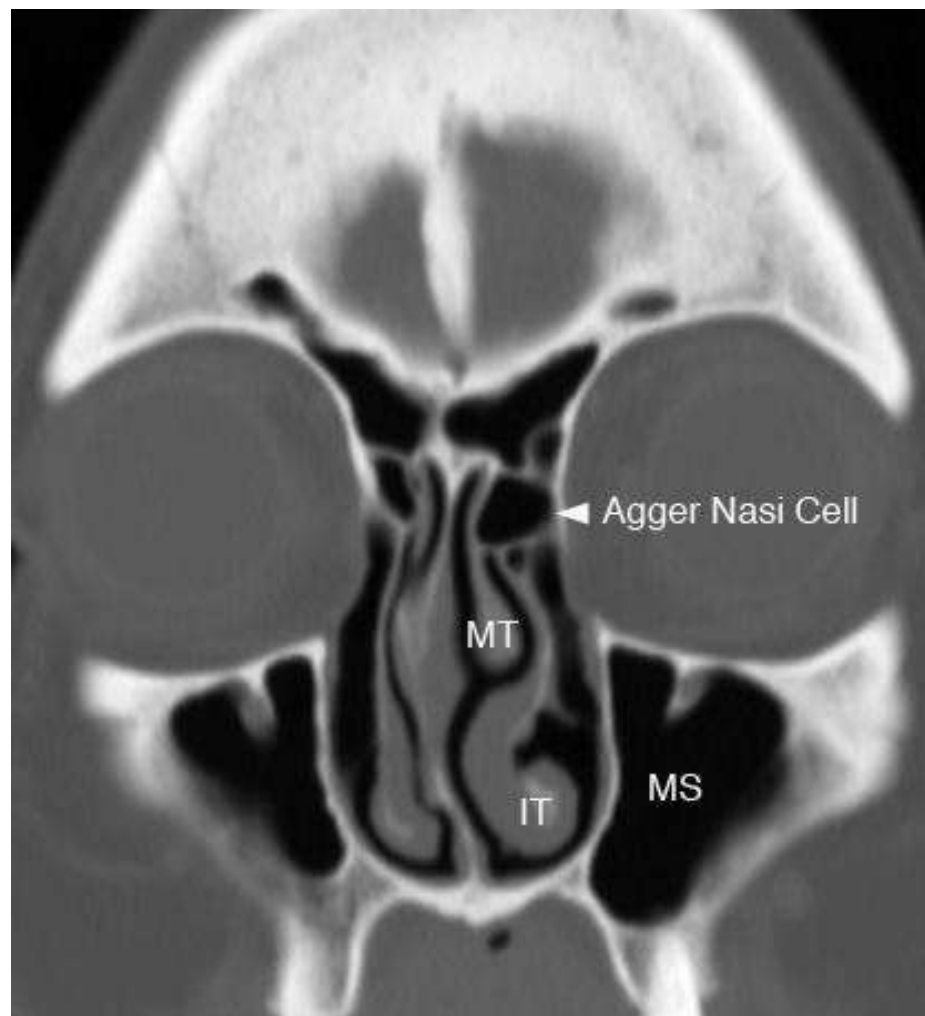
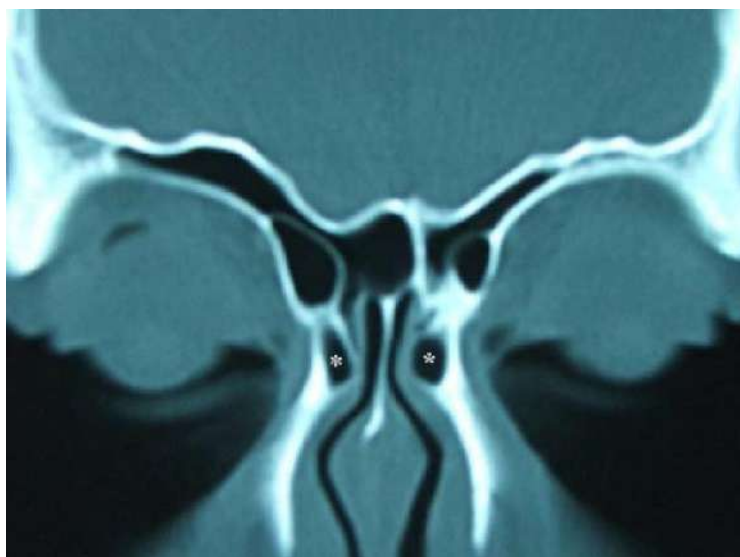
Variable		Nasal Obstruction		Facial-pain		Rhinorrhea	
		$\rho$	p-value	$\rho$	p-value	$\rho$	p-value
Nasal Septum	Septal Deviation	-0.075	0.603	-0.184	0.200	-0.242	0.091
	Septal Bony Spur	0.062	0.667	-0.079	0.586	-0.124	0.932
Turbinates	Superior CB	0.229	0.110	-0.042	0.771	-0.048	0.743
	Middle CB	0.229	0.110	-0.124	0.390	-0.174	0.227
	Paradoxical Middle Concha	-0.089	0.538	-0.042	0.771	-0.048	0.743
Uncinate Process	Deviation of Upper Edge	-0.127	0.378	-0.060	0.678	-0.068	0.639
	Pneumatization	-0.089	0.538	-0.042	0.771	-0.048	0.743
Ethmoid Air-Cells	Agger-Nasi	-0.275	0.54	-0.240	0.094	-0.167	0.247
	Haller	-0.059	0.682	-0.098	0.497	-0.111	0.442
	Onodi	-0.208	0.147	-0.098	0.497	-0.111	0.442
Other Variants	Maxillary-Septa	-0.089	0.538	-0.042	0.771	-0.048	0.743

p-value significant at  $\leq 0.05$ ;  $\rho$ =rho=Pearson correlation co-efficient.

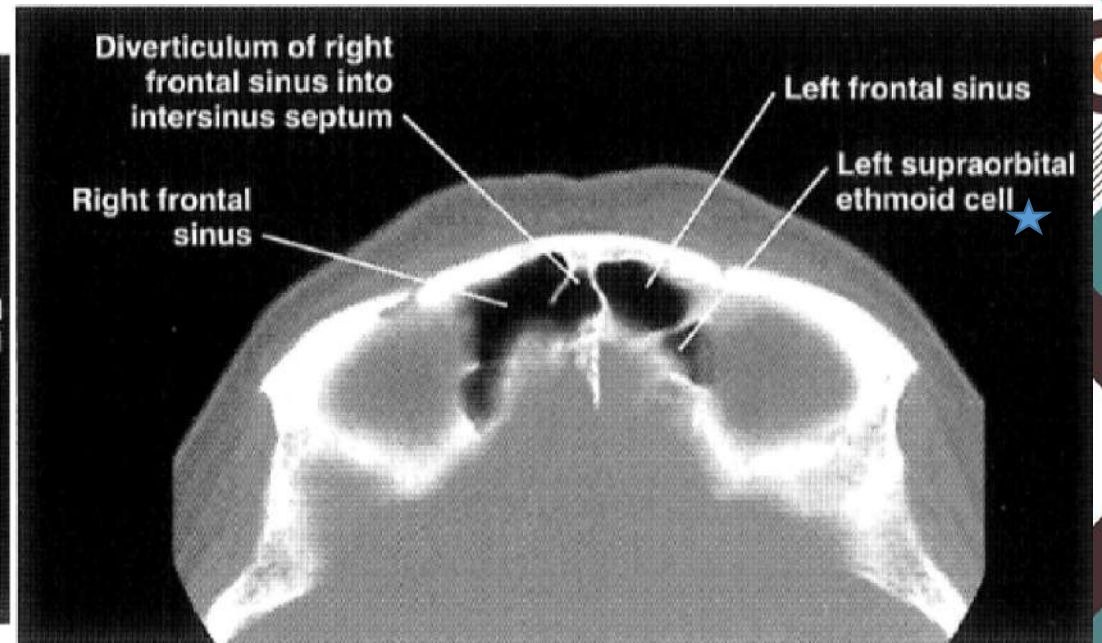


## *Agger nasi cell:*

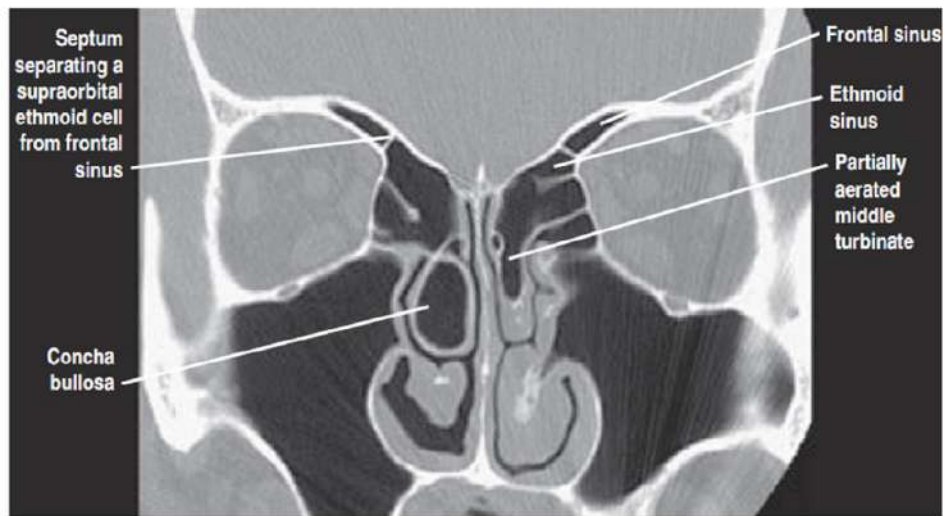




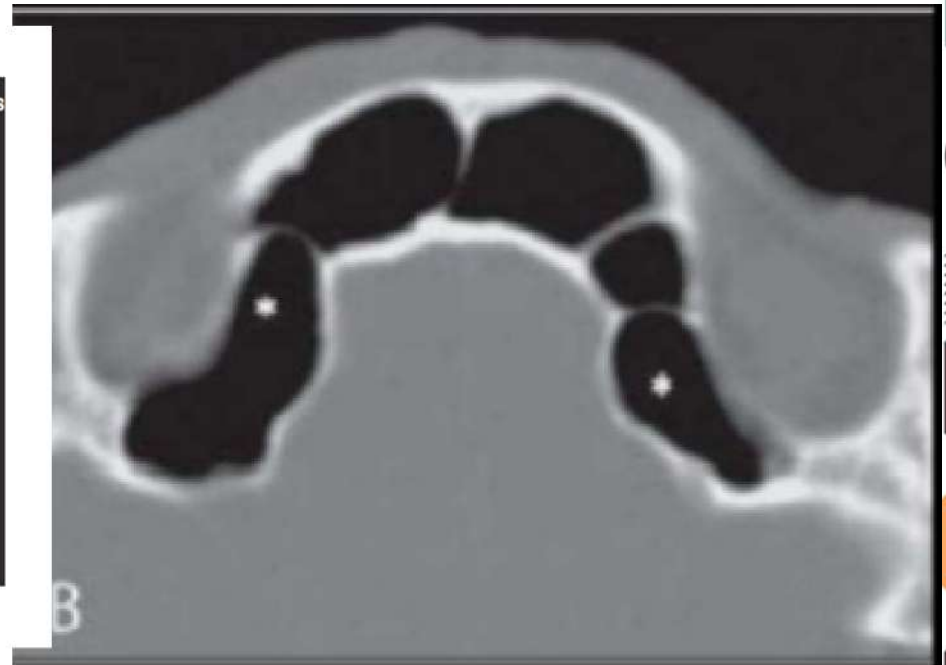
## *Supraorbital cell:*

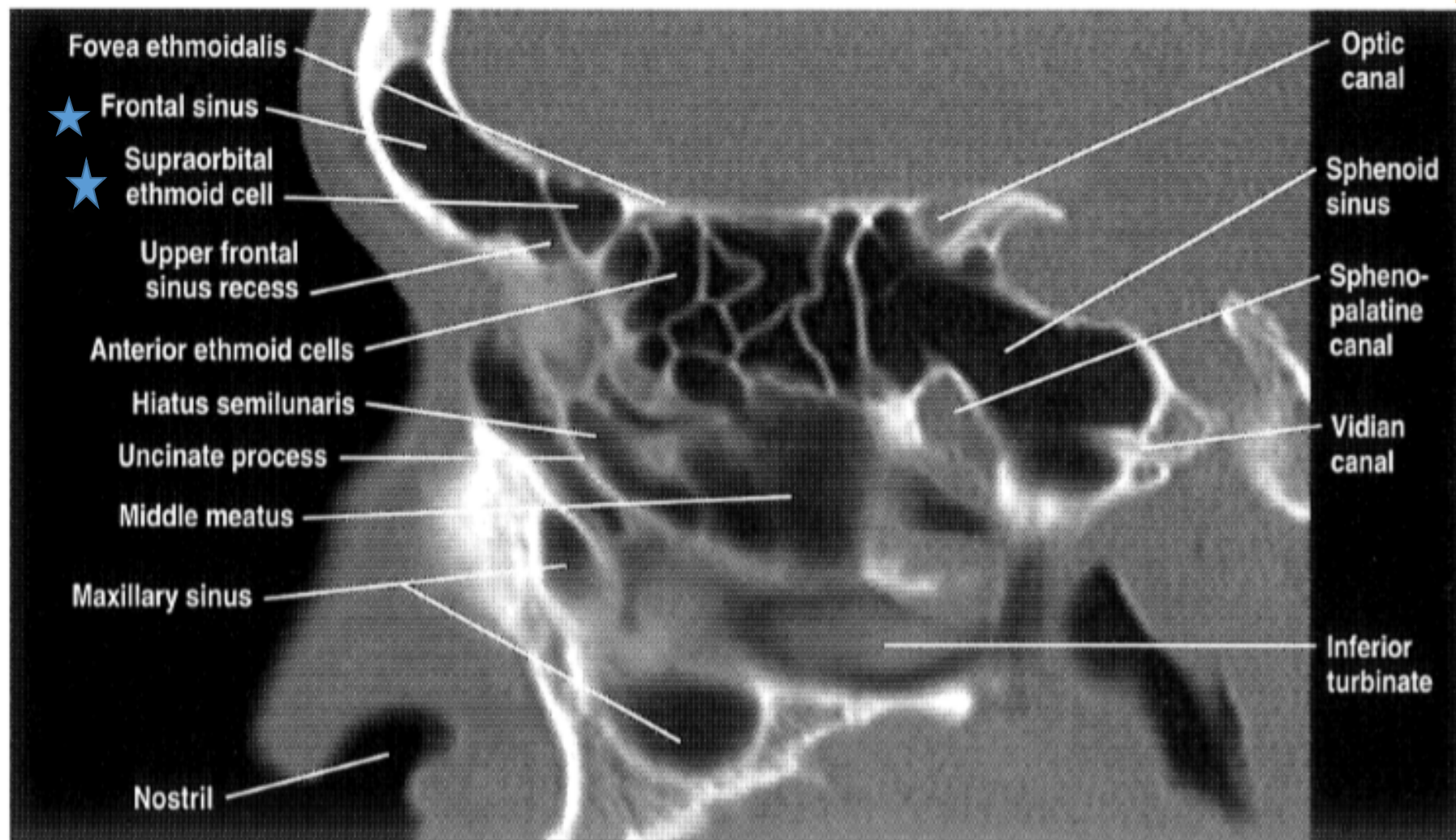






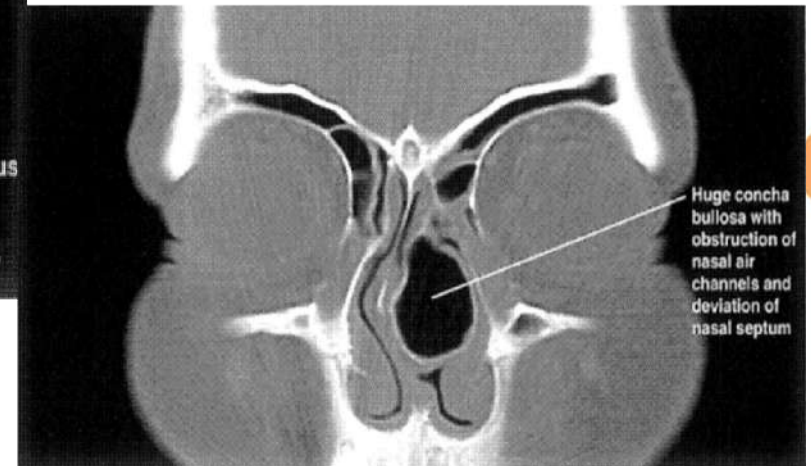
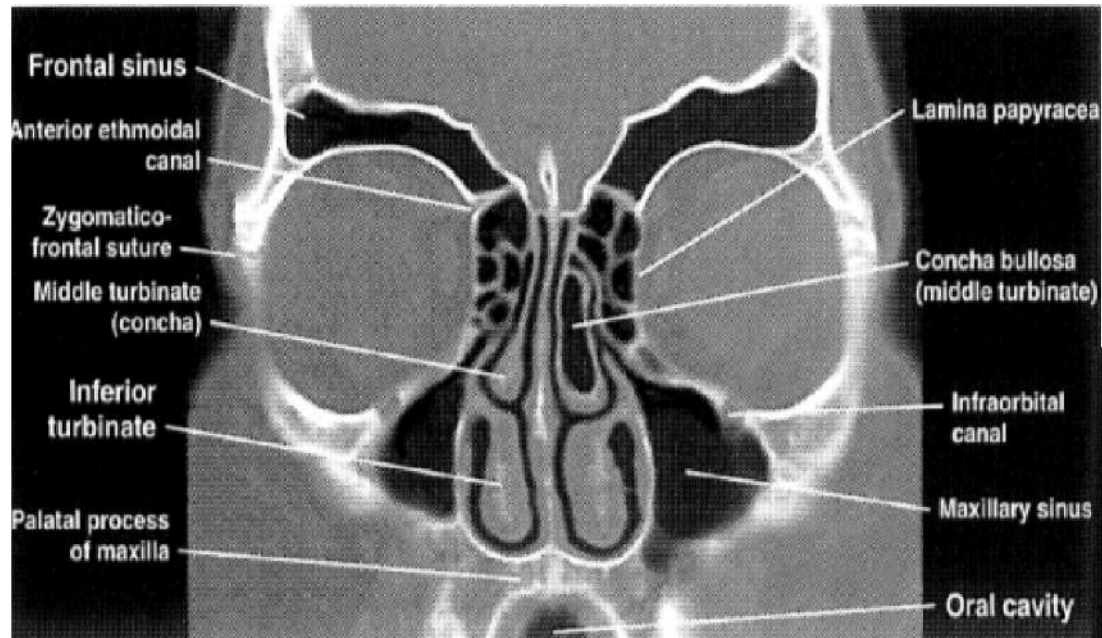
Coronal 31



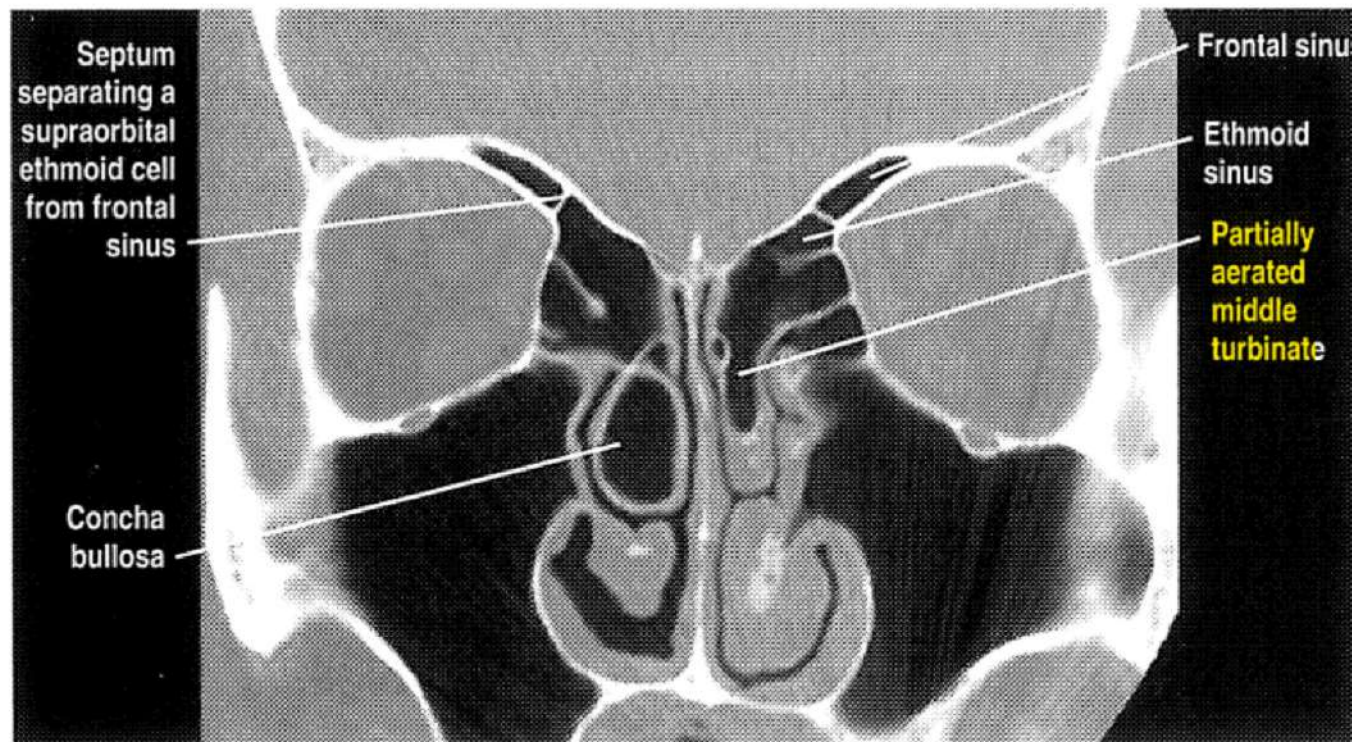




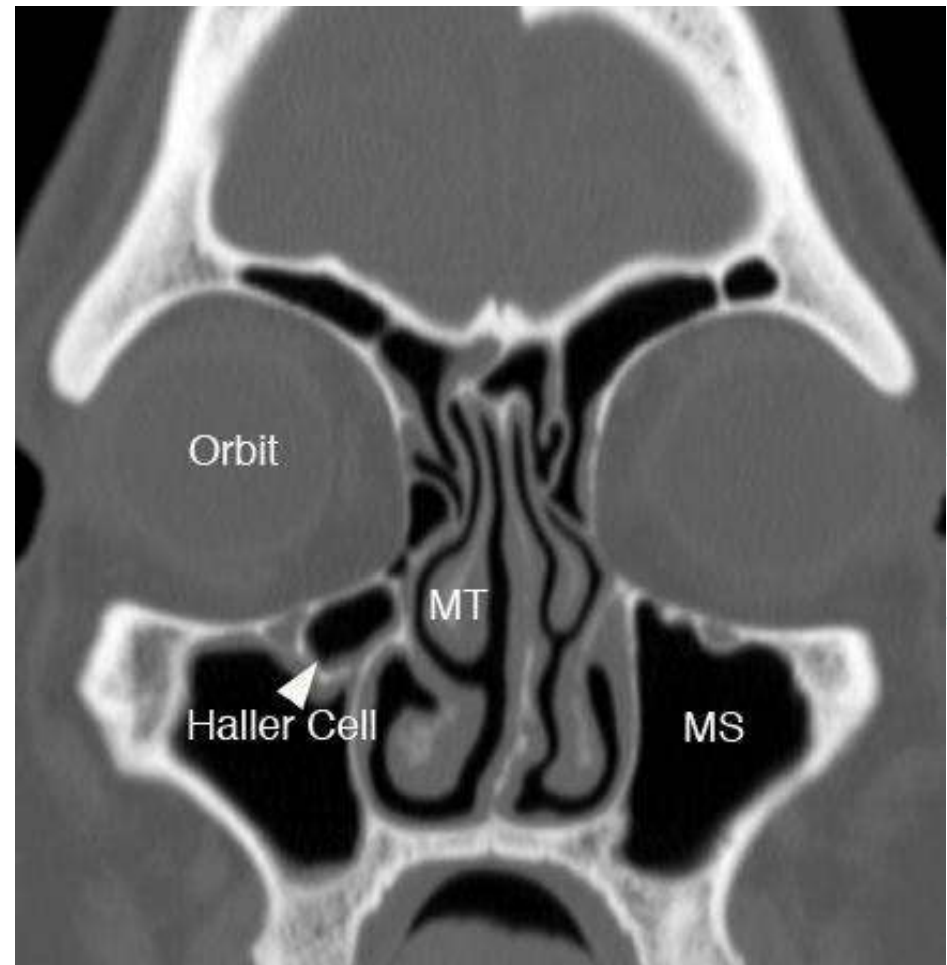
## *Conchae bullosa:*



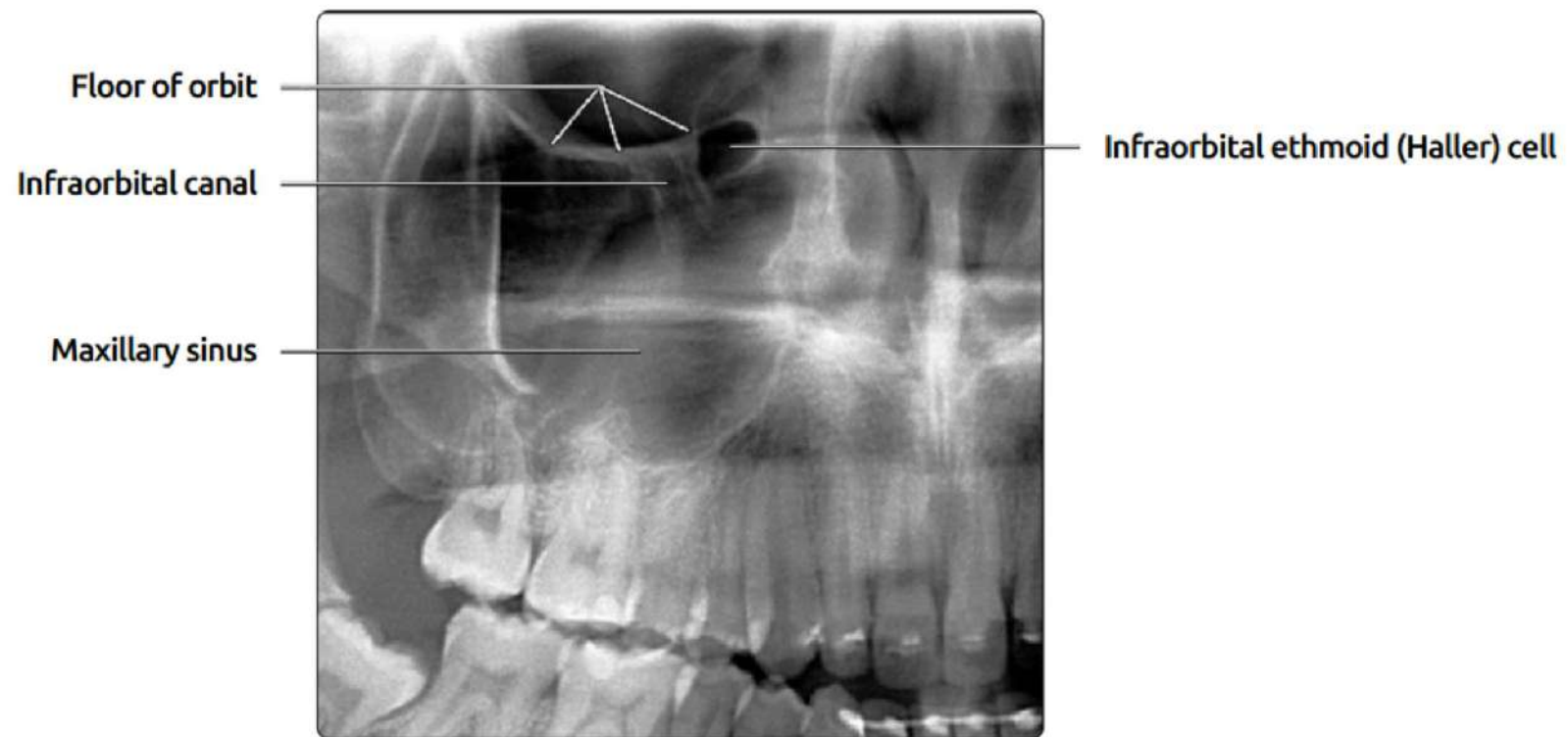




## *Haller cell:*

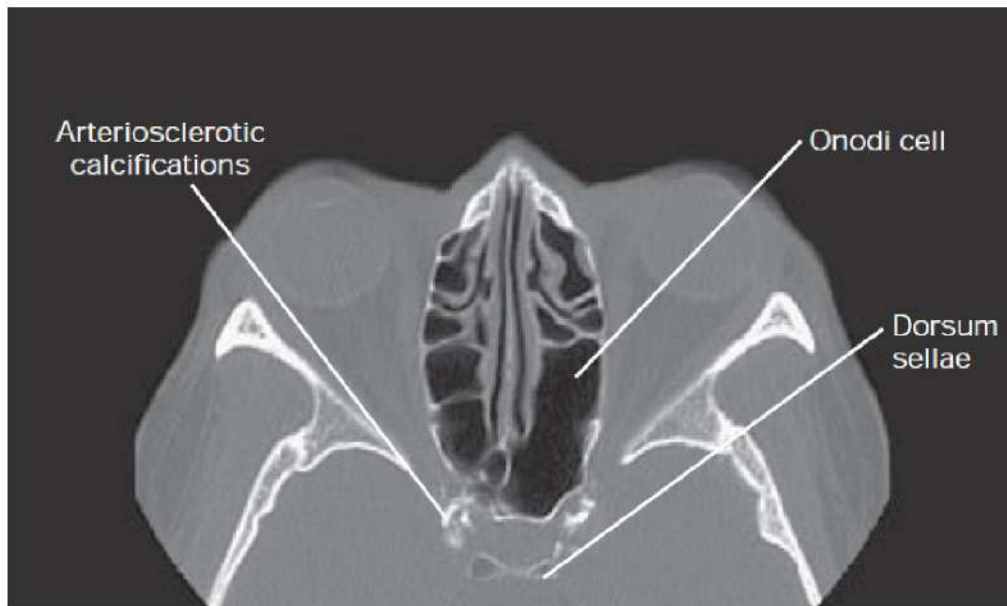








## Onodi cell:

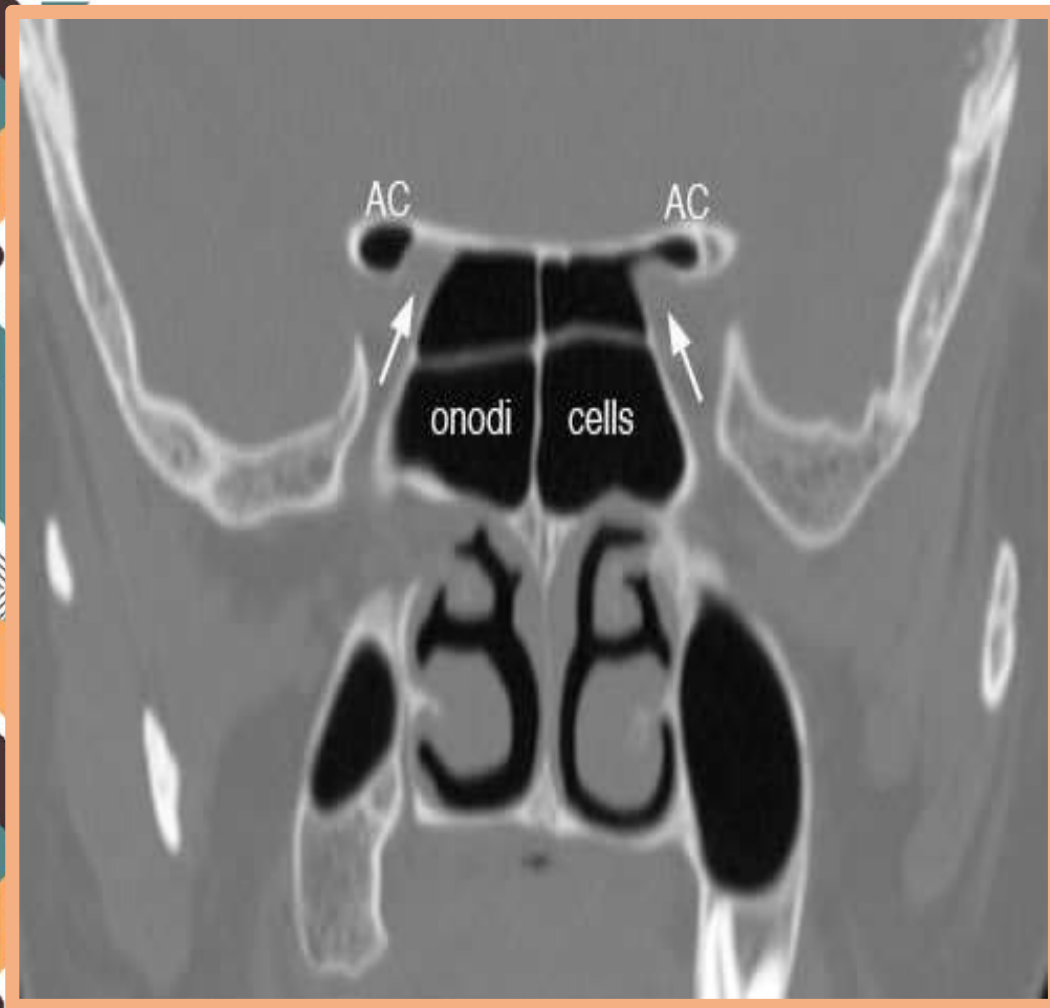


Axial 16

- Lateral and posterior extensions of the posterior ethmoid air cells, **superolateral** to the sphenoid sinus/bone
- Lie in close relation to the optic nerve/ internal carotid

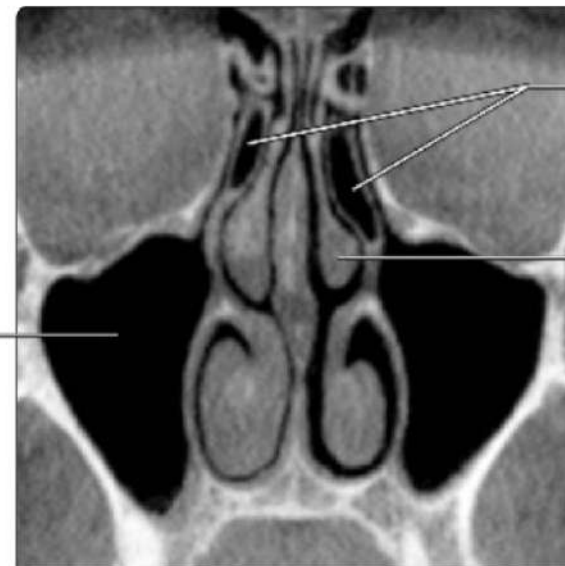
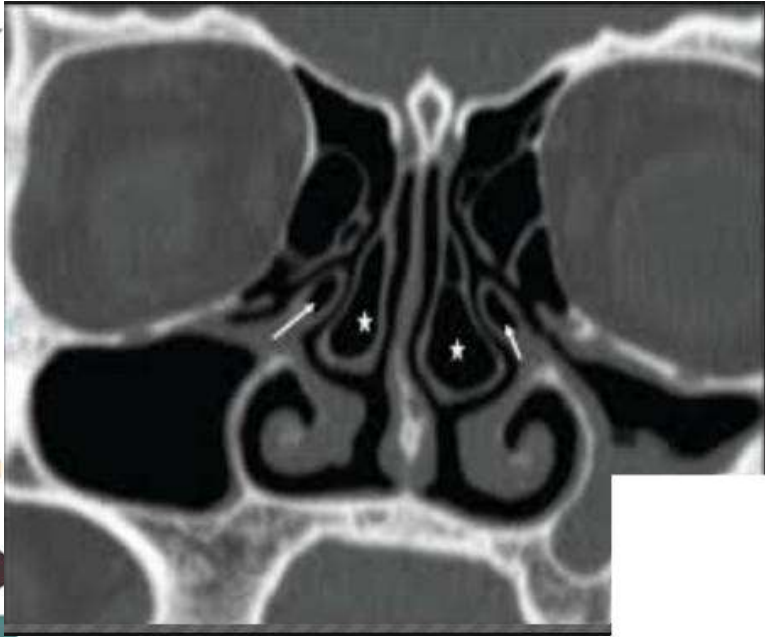


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## *uncinated bulla:*



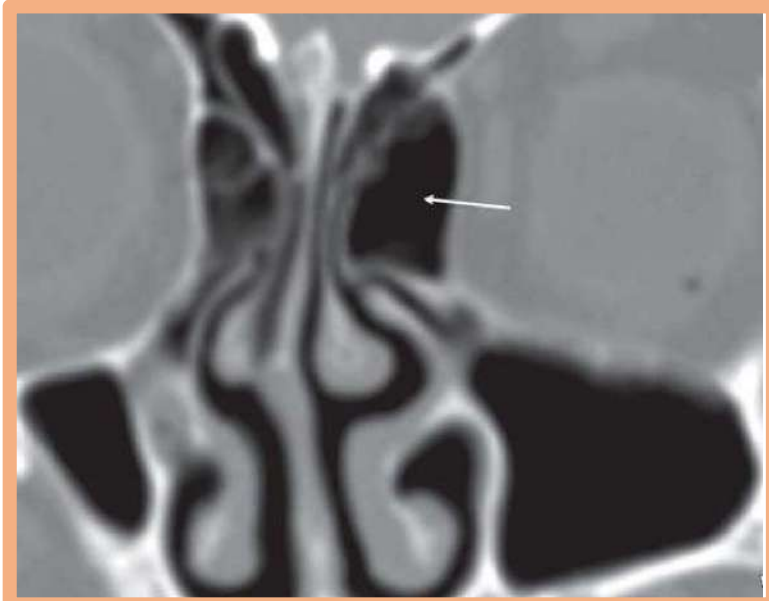
Maxillary sinus

Uncinate processes (aerated)

Middle turbinate

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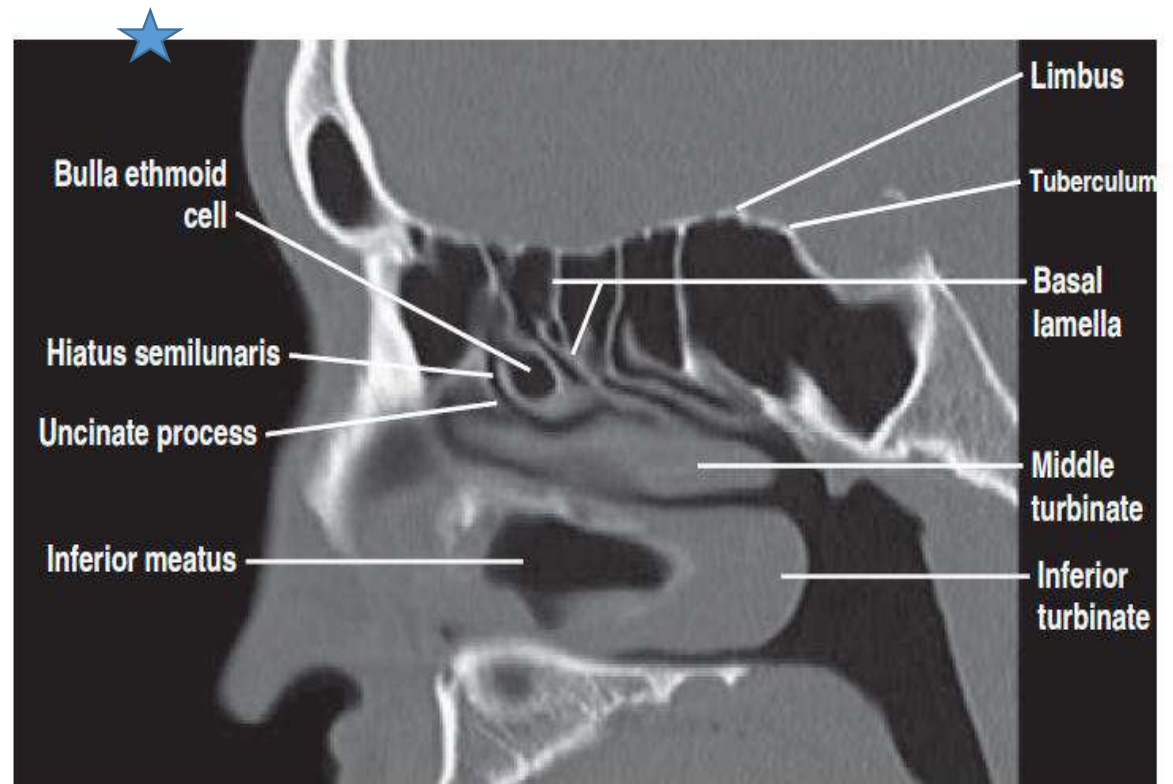
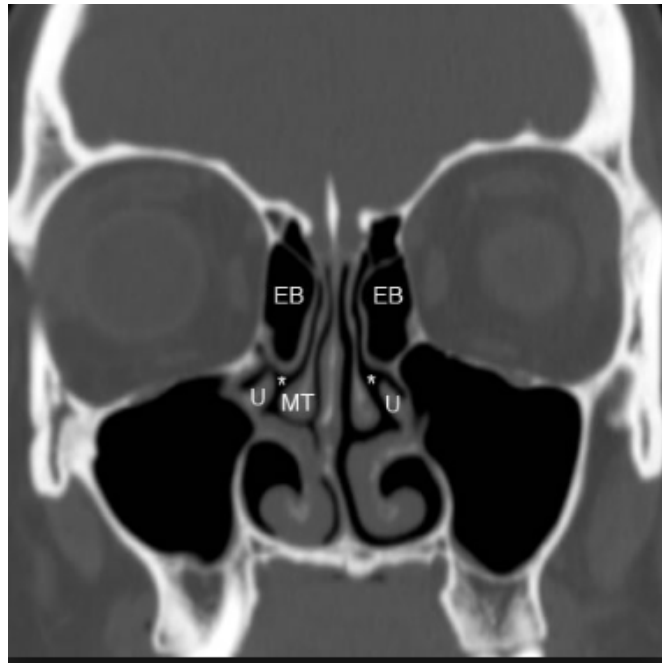
# Ethmoid Bulla



Largest of the Ant. ethmoid air cells

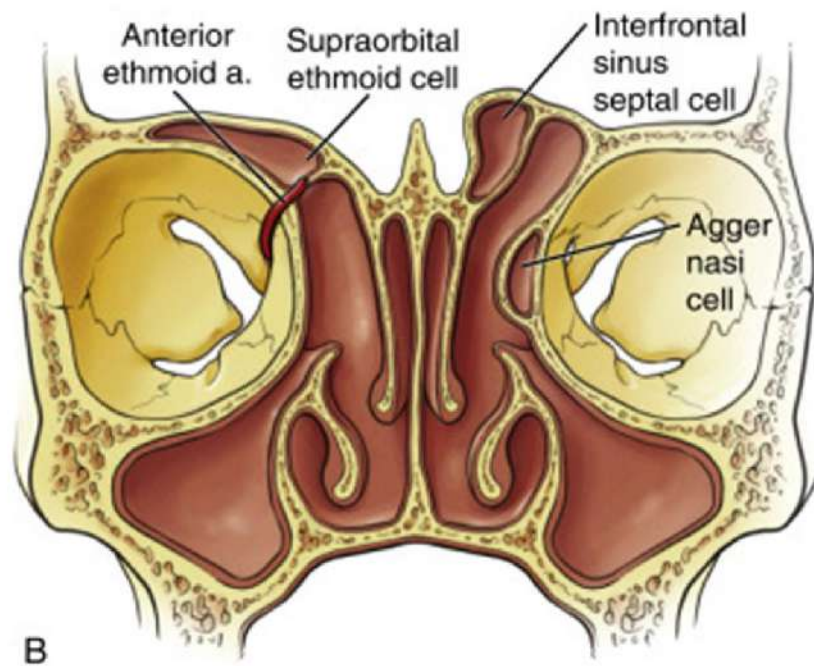
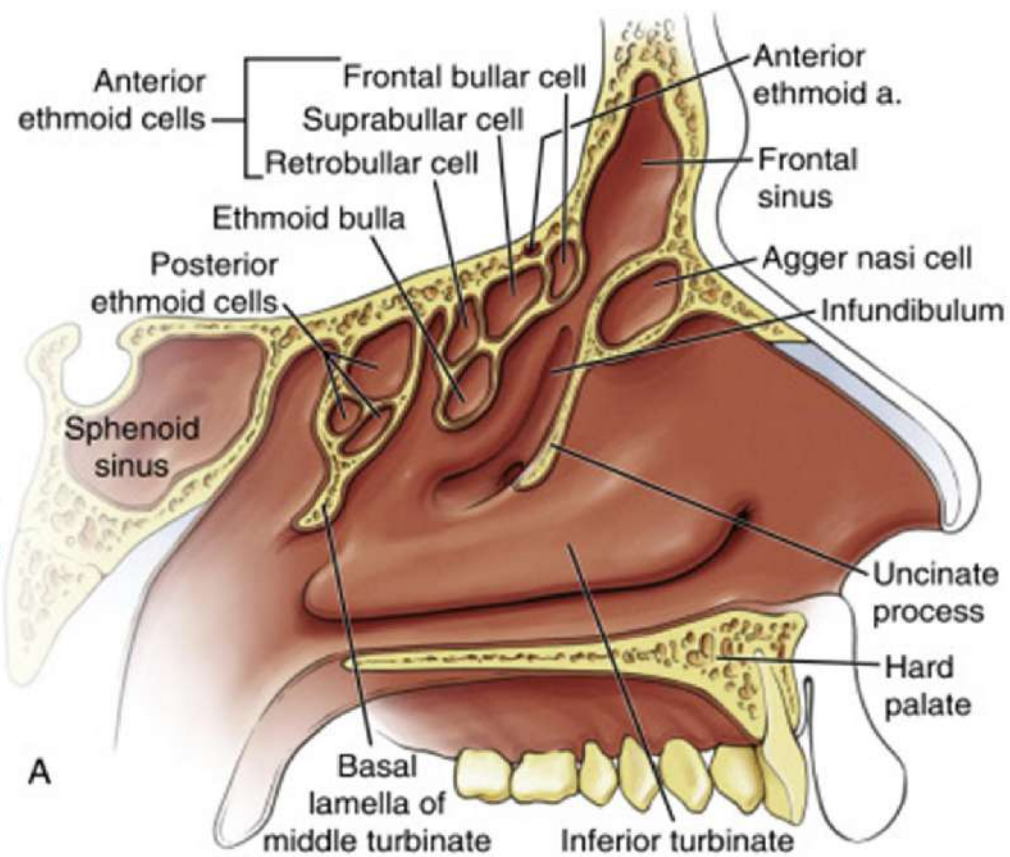
- Could Obstruct the Osteomeatal complex

## *Ethmoid bulla:*

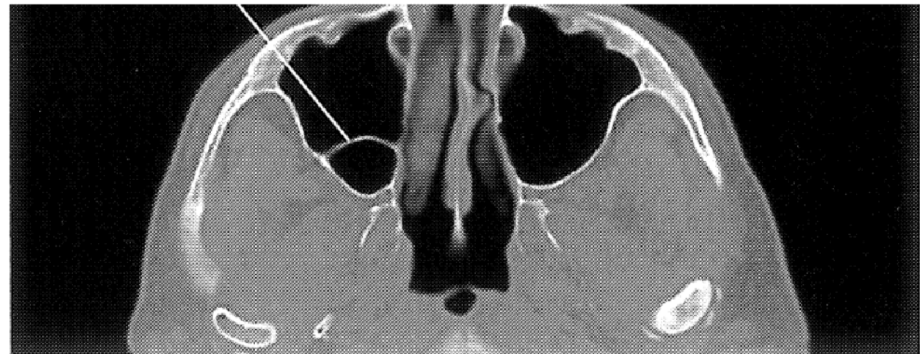
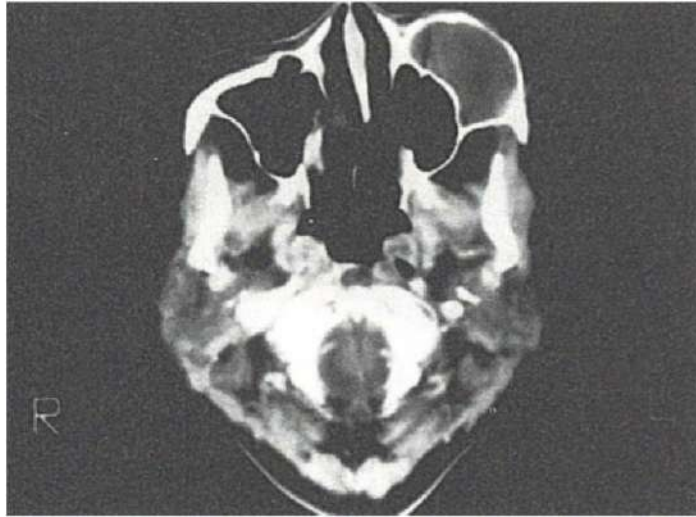


Sagittal 13





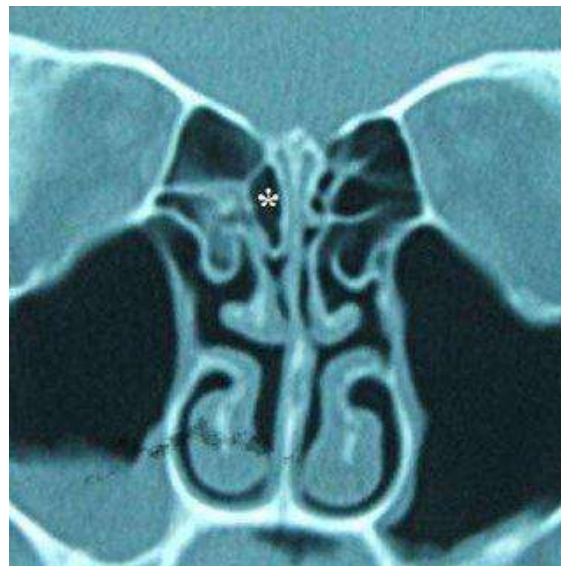
## *Double Antrum*





## *Pneumatization of superior turbinate*

Pneumatized superior concha causing migrainous headache is a rare finding. Endoscopic surgery may provide permanent relief of symptoms





*Bifid middle turbinate*  
*Perpendicular palate Aaeration*

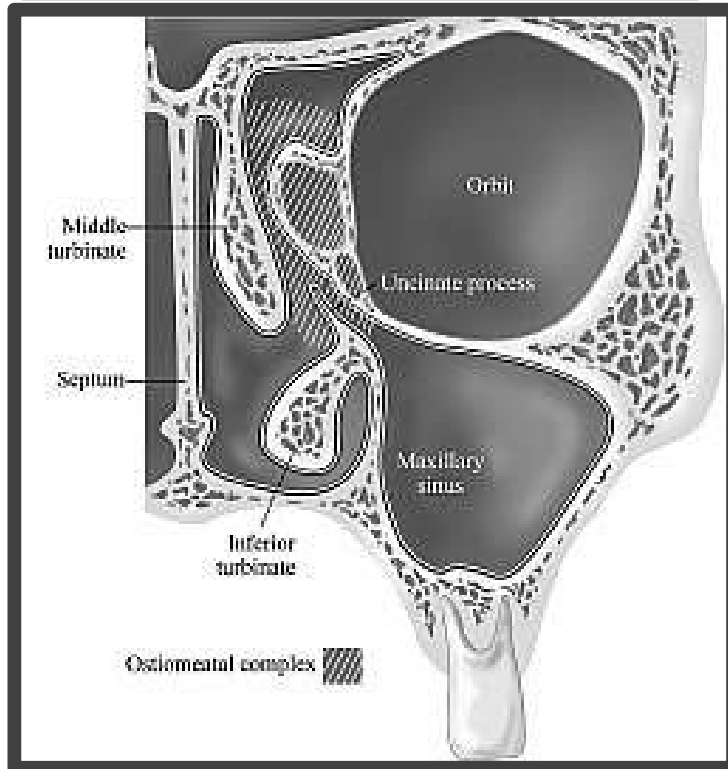




## *Osteomeatal complex:*

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## OSTEOMEATAL COMPLEX



- Key anatomic area for surgeons
- Blockage prevents mucociliary clearance – stagnation of secretions – recurrent or chronic sinusitis
- Mid meatus/uncinate process/ infundibulum/ max ostium/ ethmoid bulla/ frontal recess/ ant ethmoid ostium



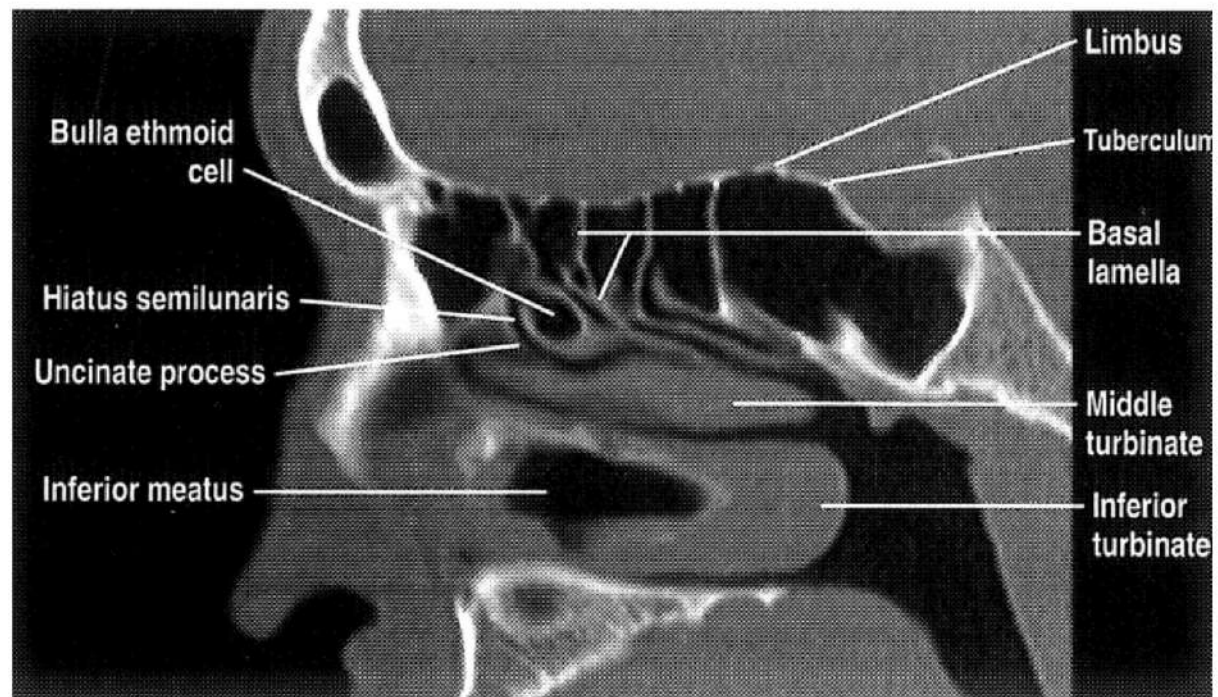
# Osteomeatal complex

- The ostiomeatal complex (or unit) is a common channel that links the *frontal* sinus, *anterior ethmoid* sinuses and the *maxillary* sinus to the middle meatus.
- The ostiometal complex is composed of five structures:

**Maxillary ostium** - drainage channel of the maxillary sinus

**Infundibulum** -common channel that drains the ostia of the maxillary and ethmoid sinuses to the hiatus semilunaris

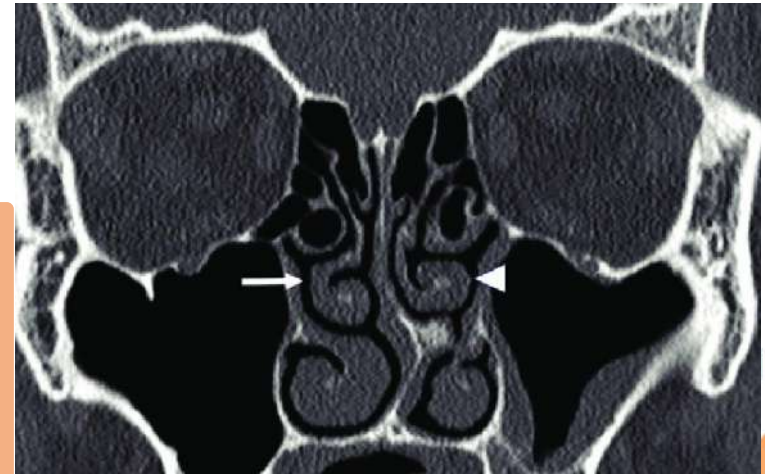
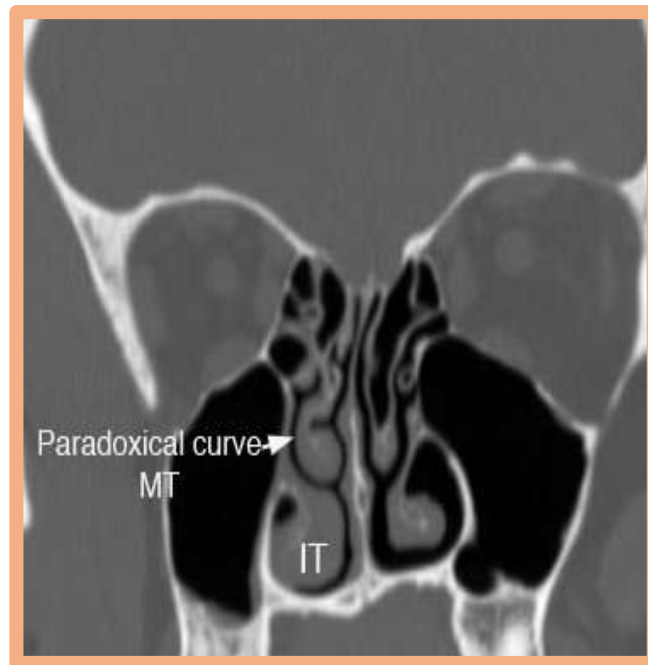
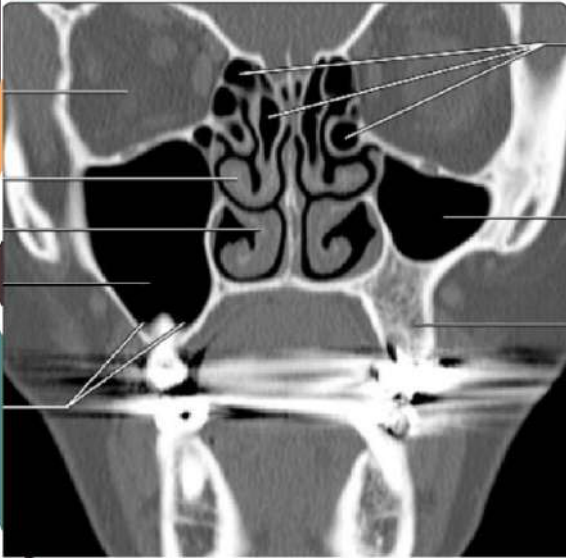
- **Ethmoidal bulla:** *the largest anterior ethmoidal cell*
- **Uncinate process** - *hook-like process that arises from the posteromedial aspect of the nasolacrimal duct and forms the anterior boundary of the hiatus semilunaris*
- **Hiatus semilunaris** - *final drainage passage; a region between the ethmoidal bulla superiorly and free-edge of the uncinate process*



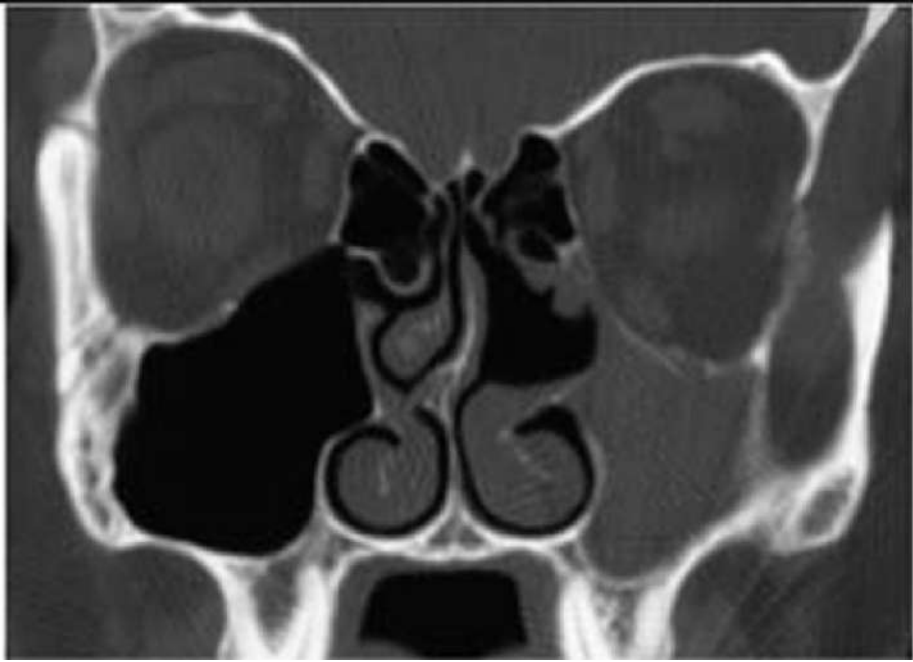


## *Paradoxical middle turbinate*

- Middle turbinate project **laterally** narrowing middle meatus



## *Silent sinus*

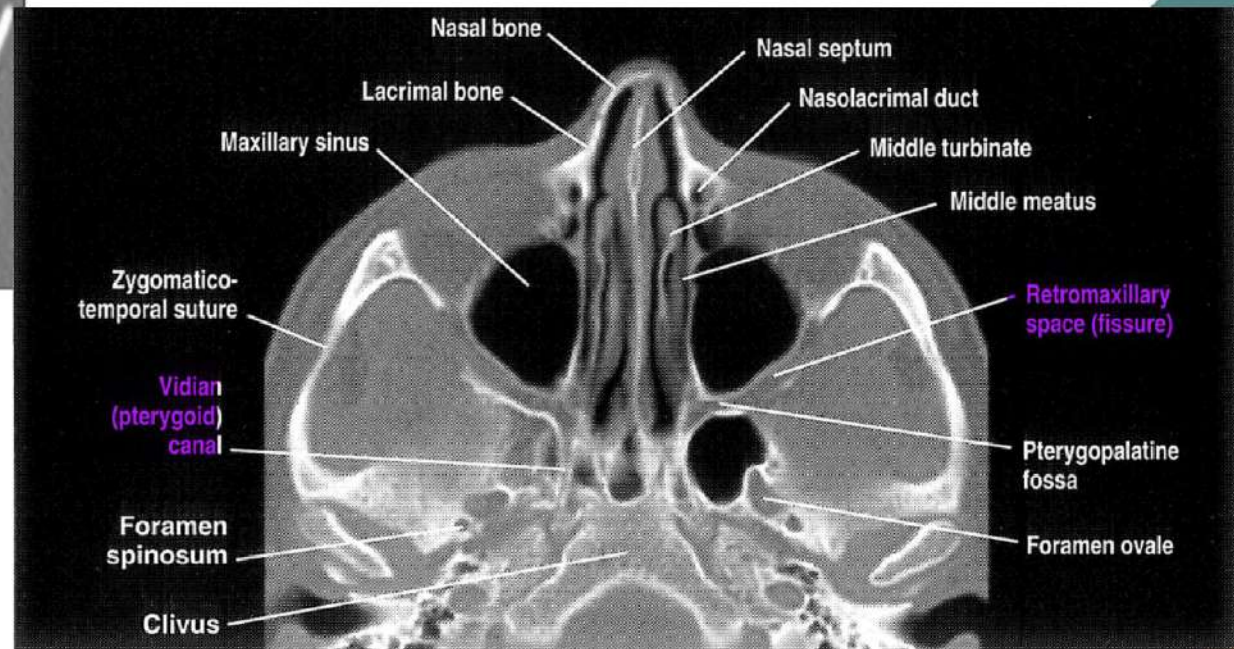
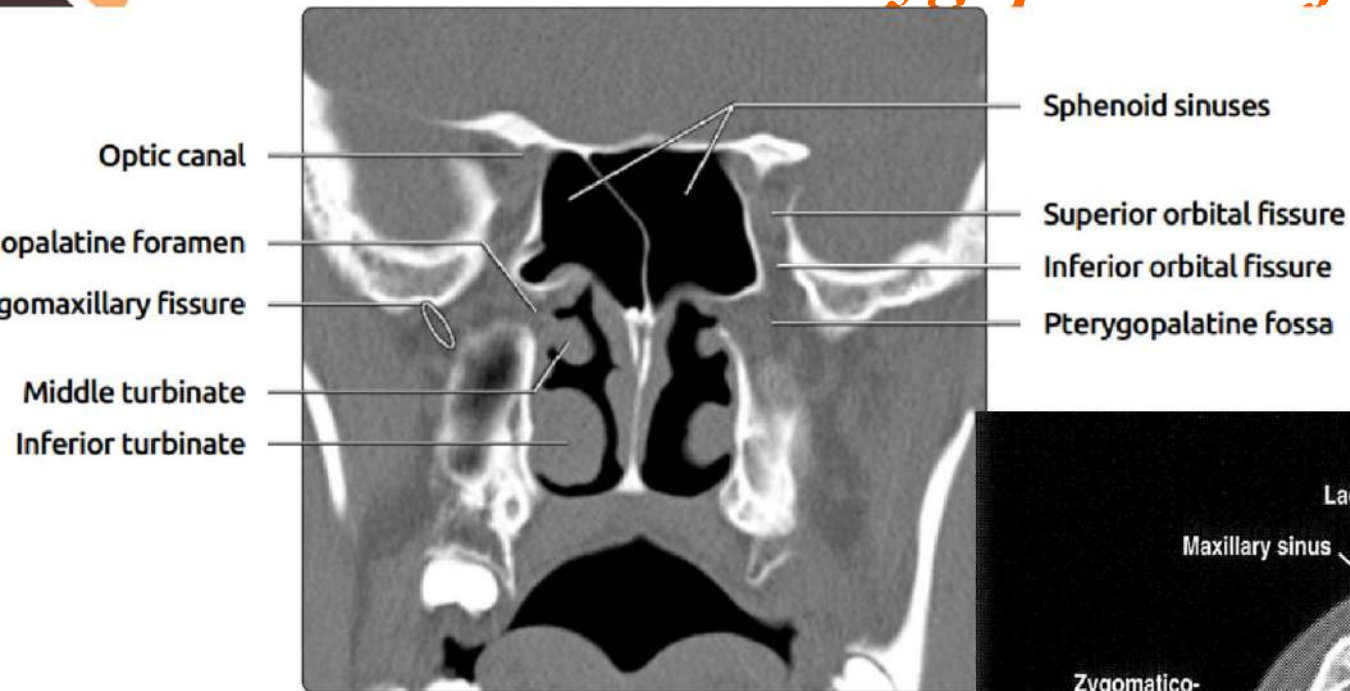


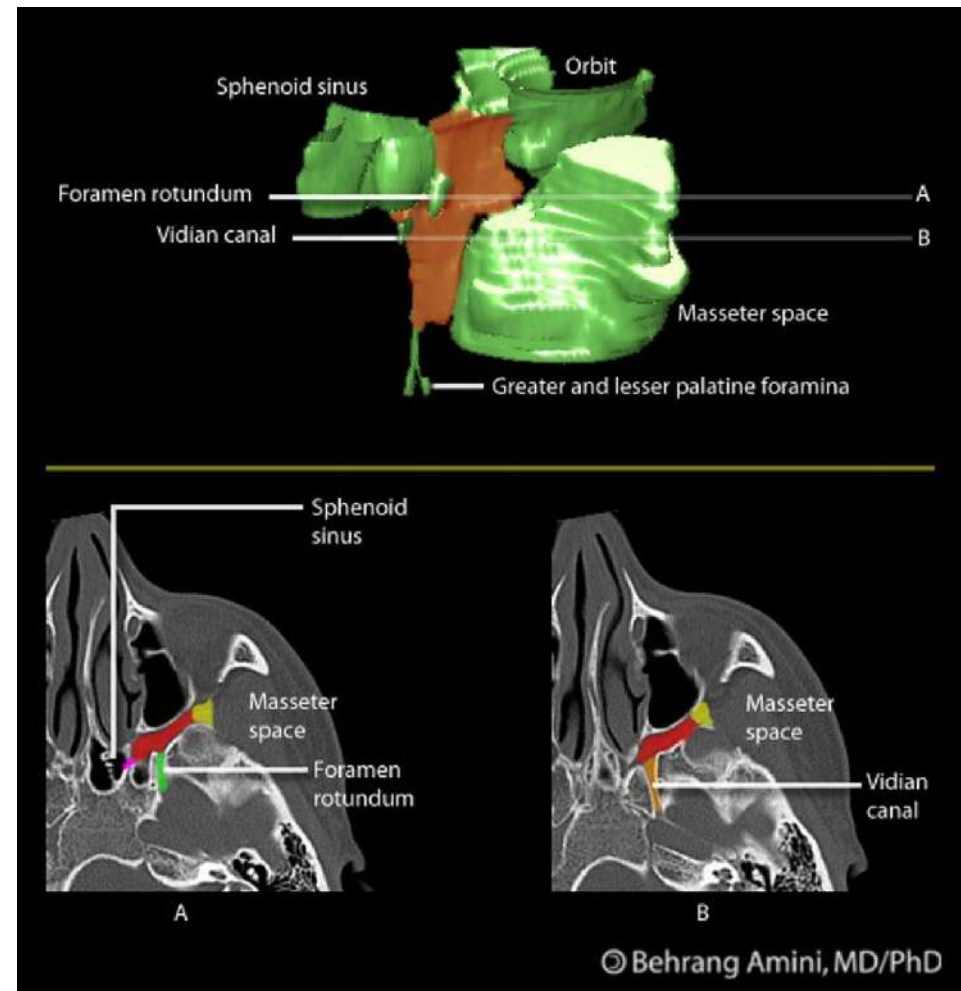
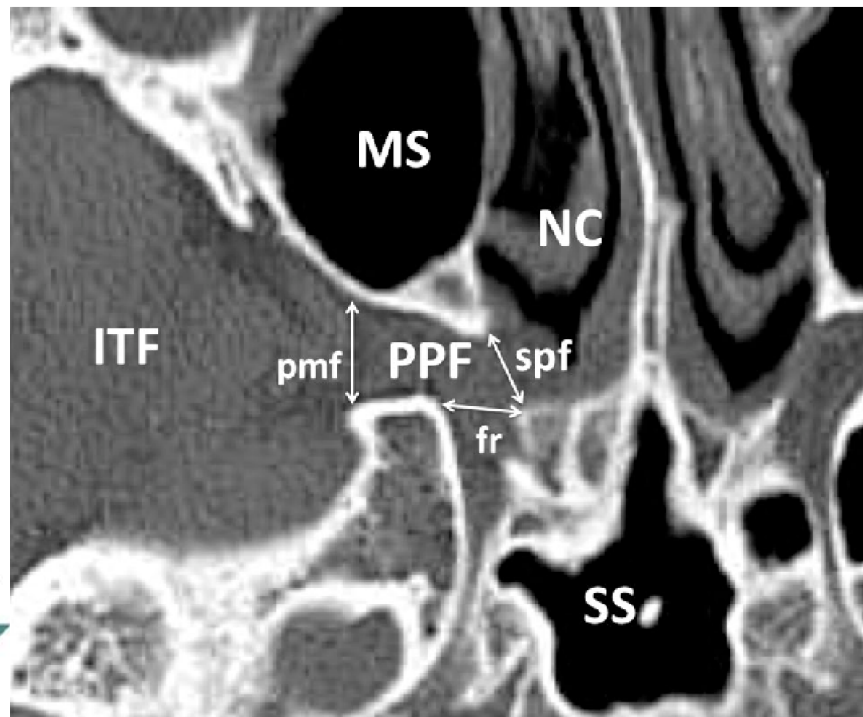
## *Atelectatic UP*



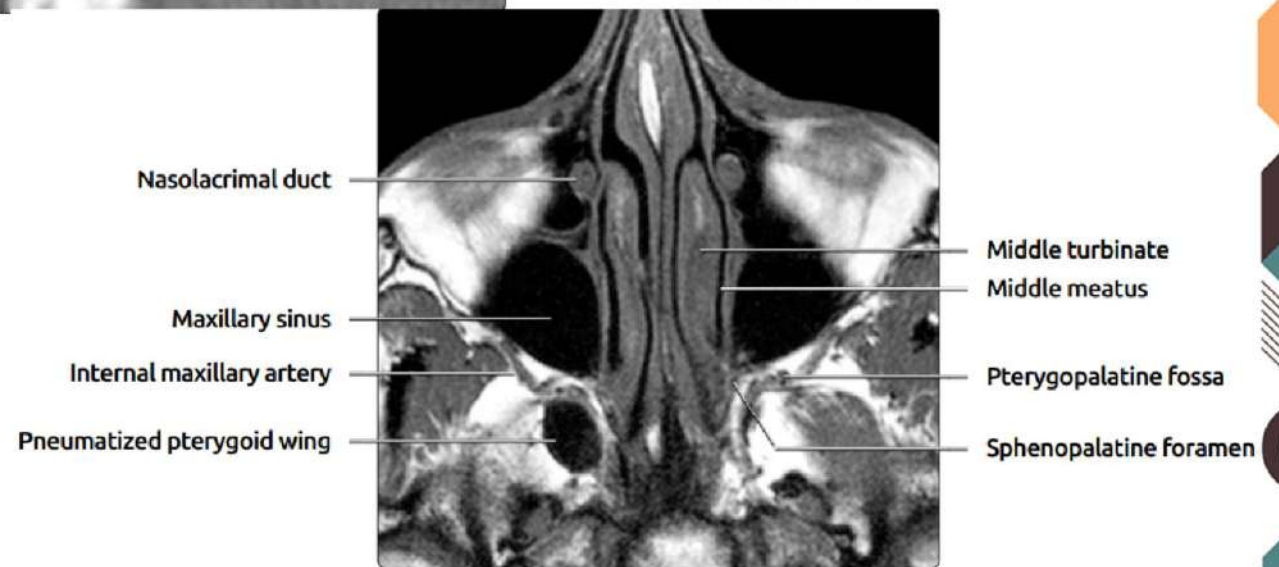
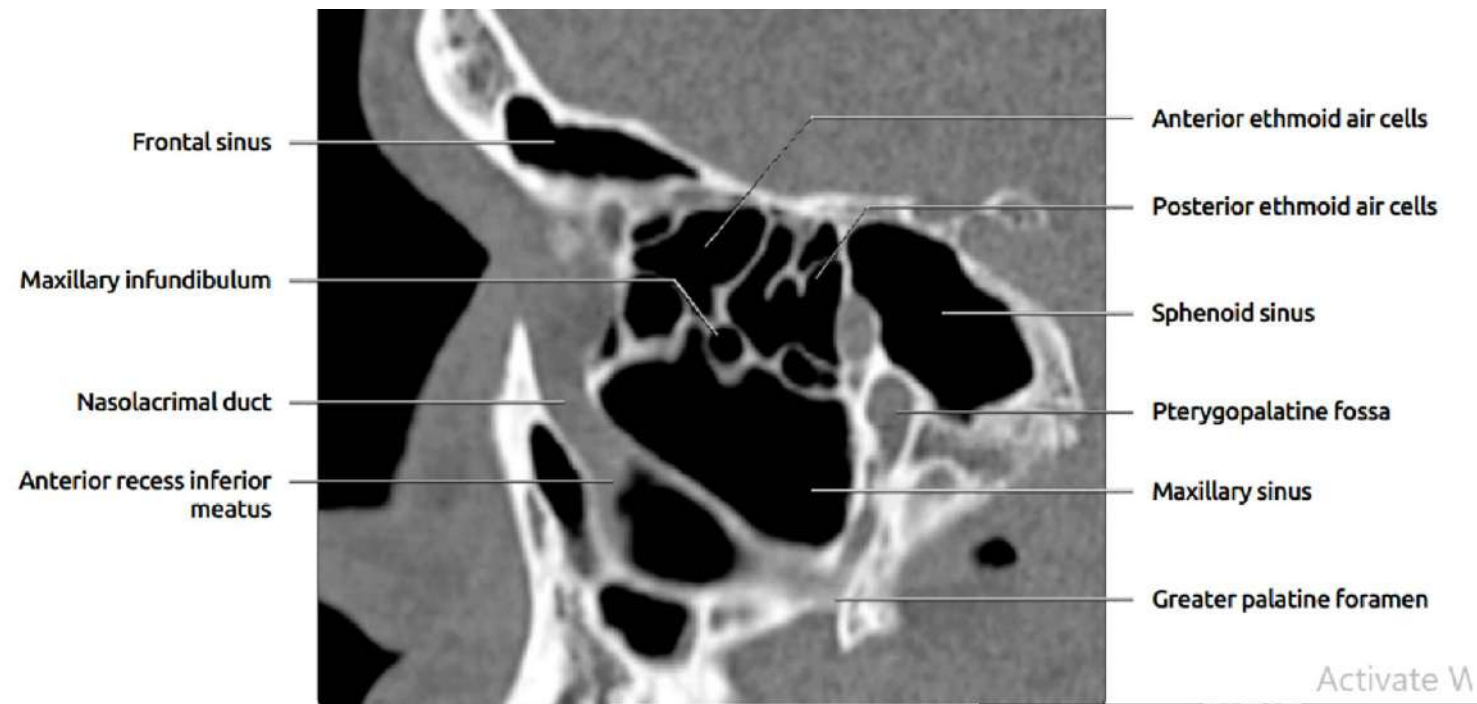


# *Pterygopalatine fossa*







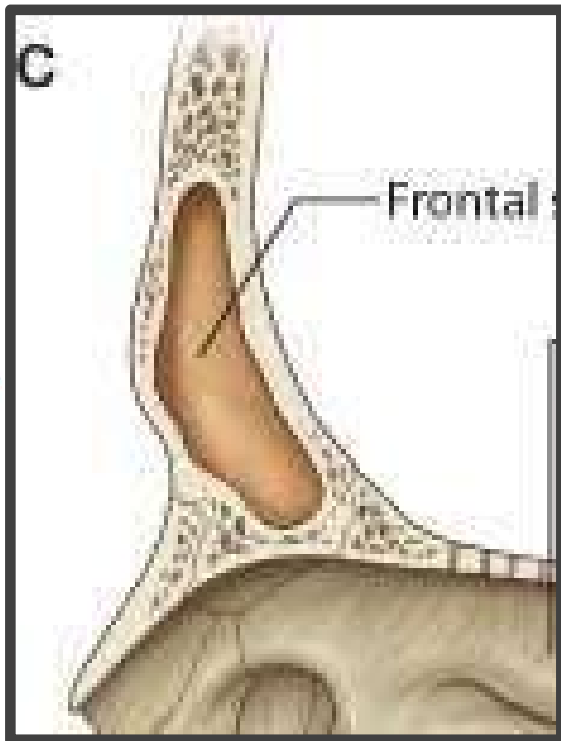




# Frontal sinus

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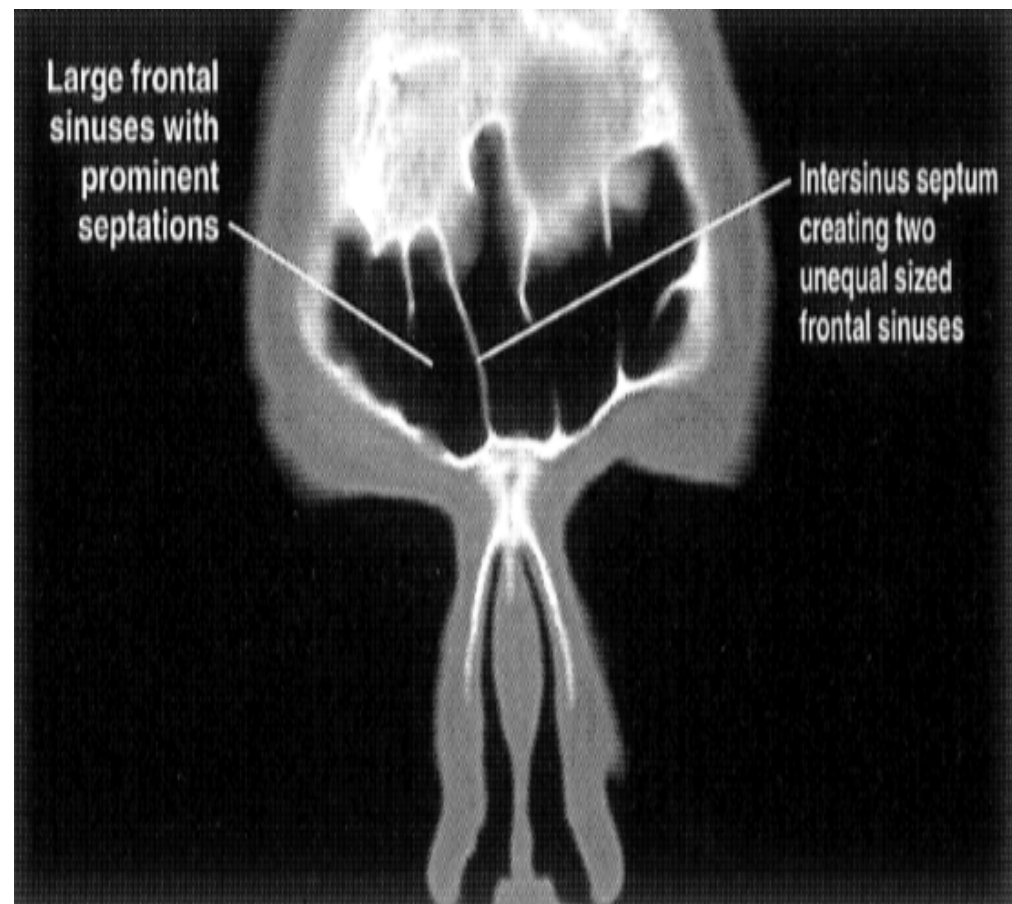
## FRONTAL SINUS



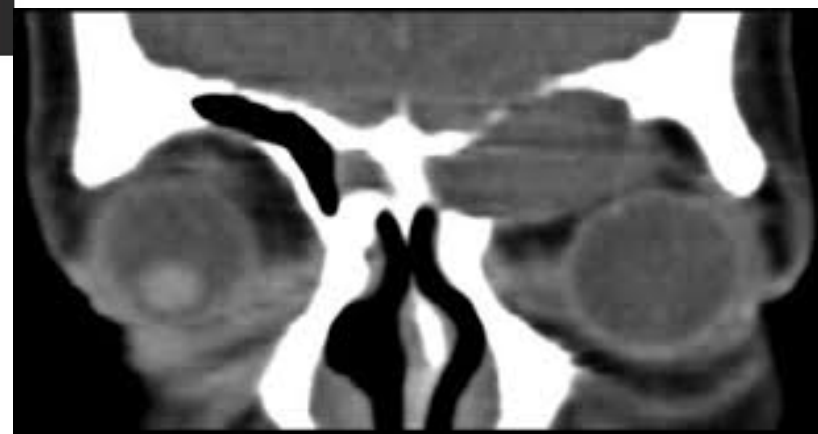
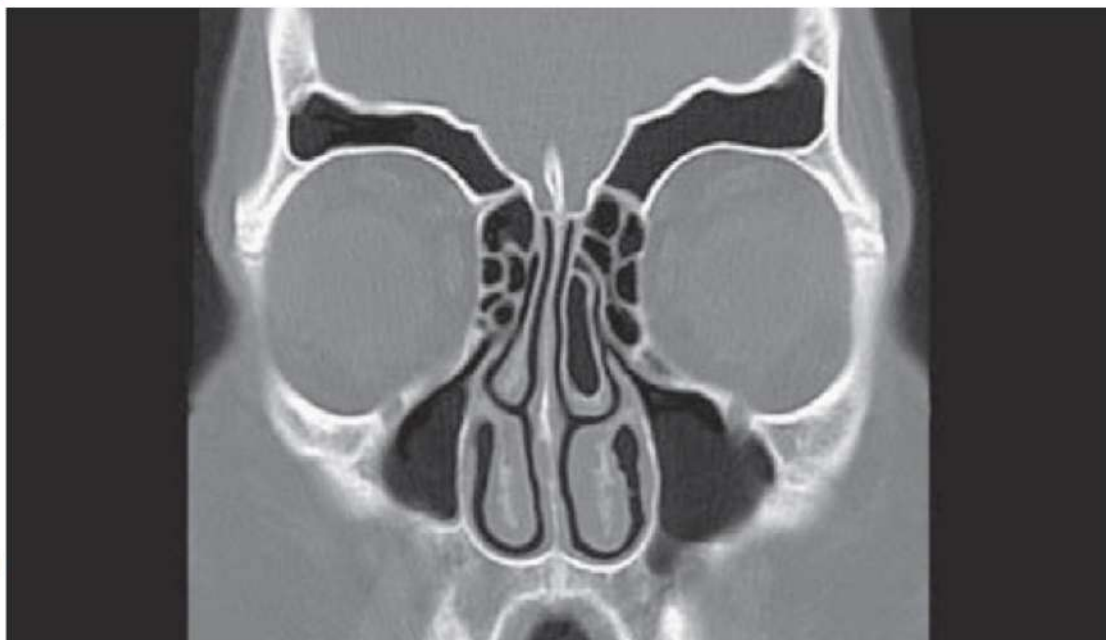
the third to fourth fetal month with the appearance of the frontal recess in the lateral nasal cavity wall.

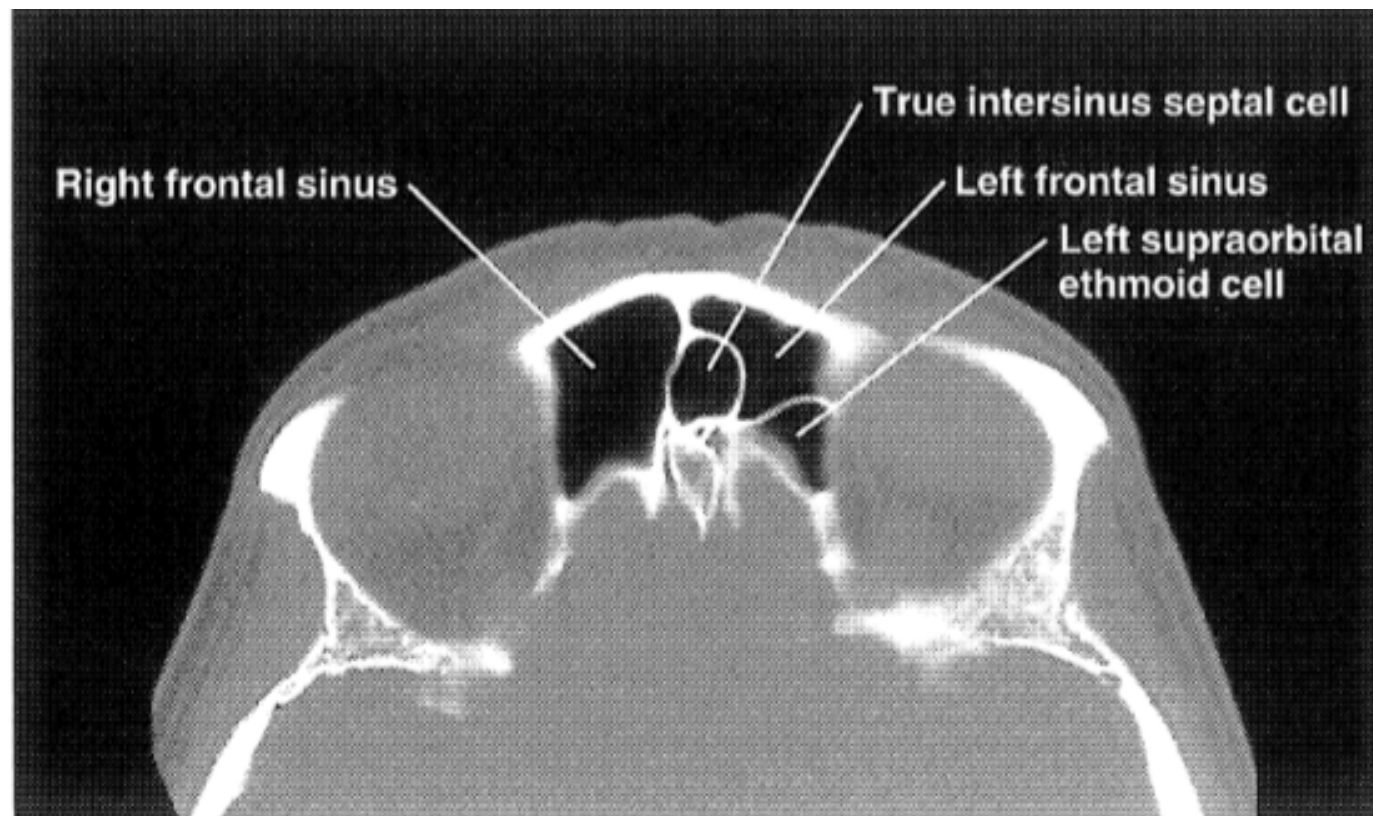
As the frontal sinuses do not extend into the frontal bone until about 6 years of age, these sinuses are essentially the only paranasal sinuses that are absent at birth.

fail to develop in 4% of the population.



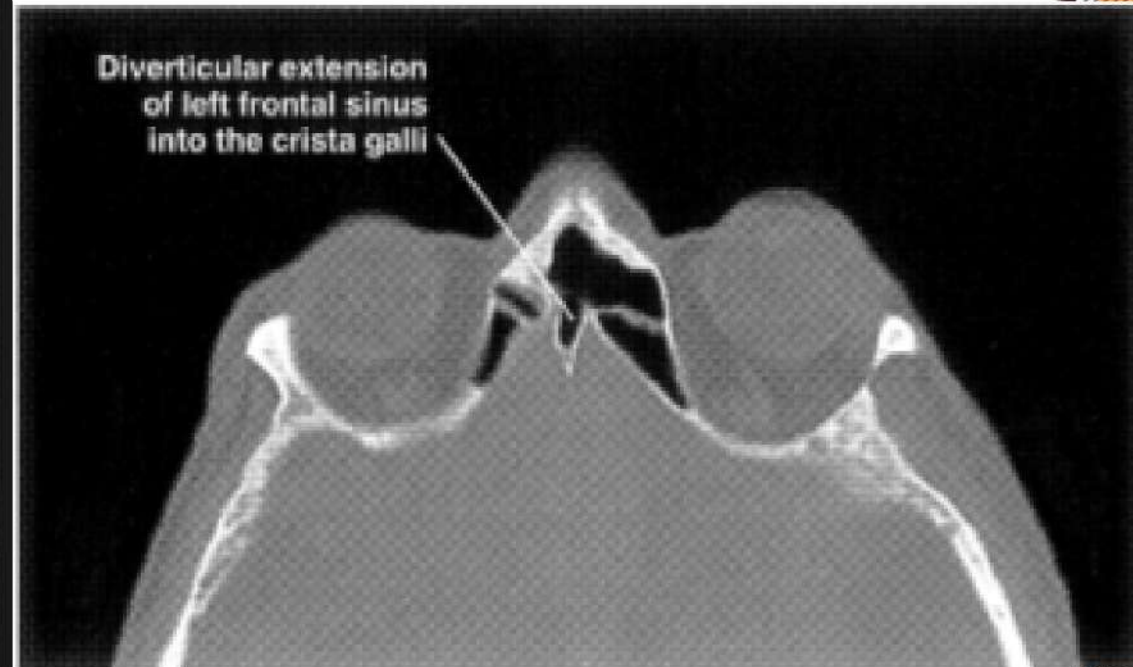




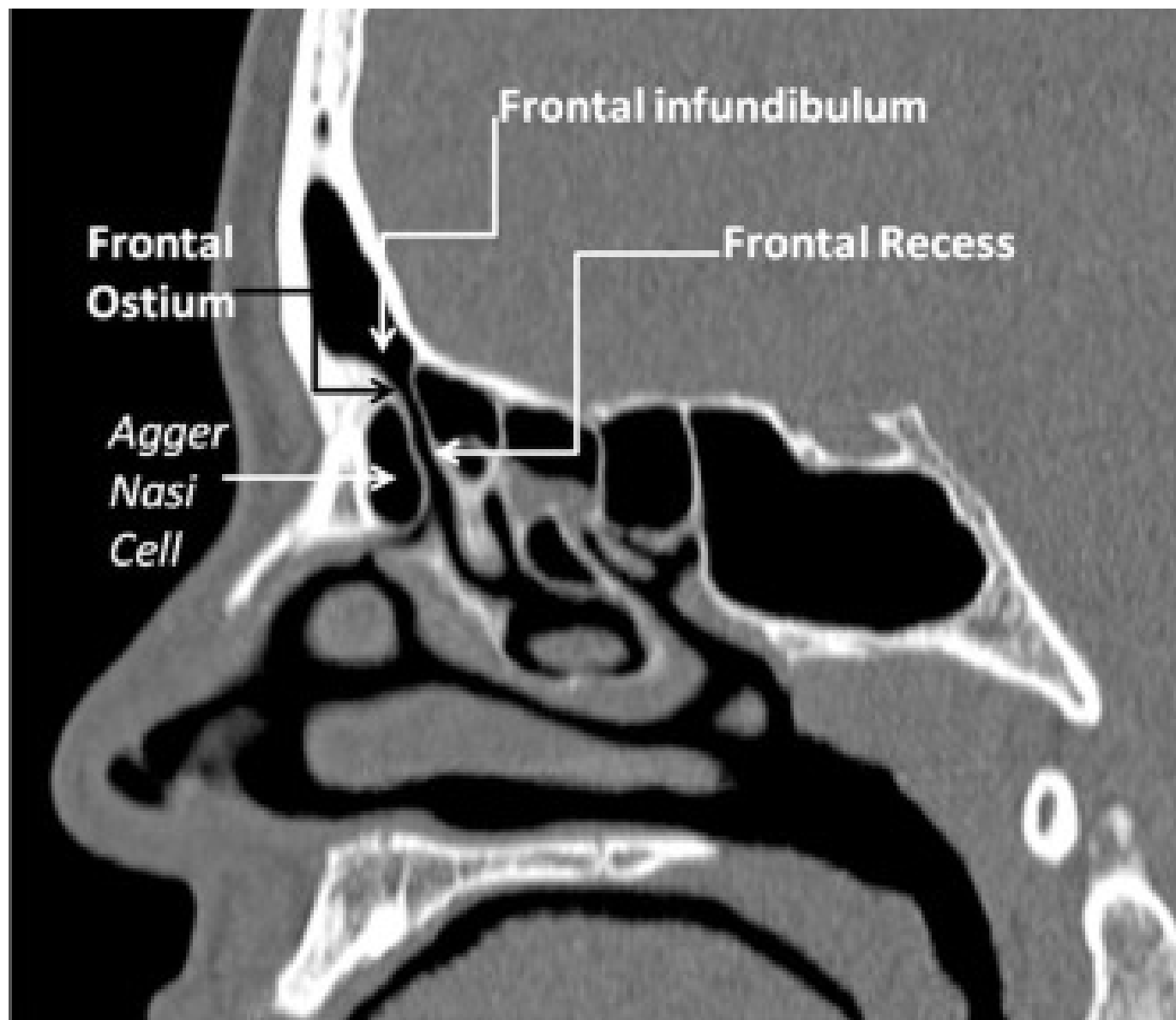


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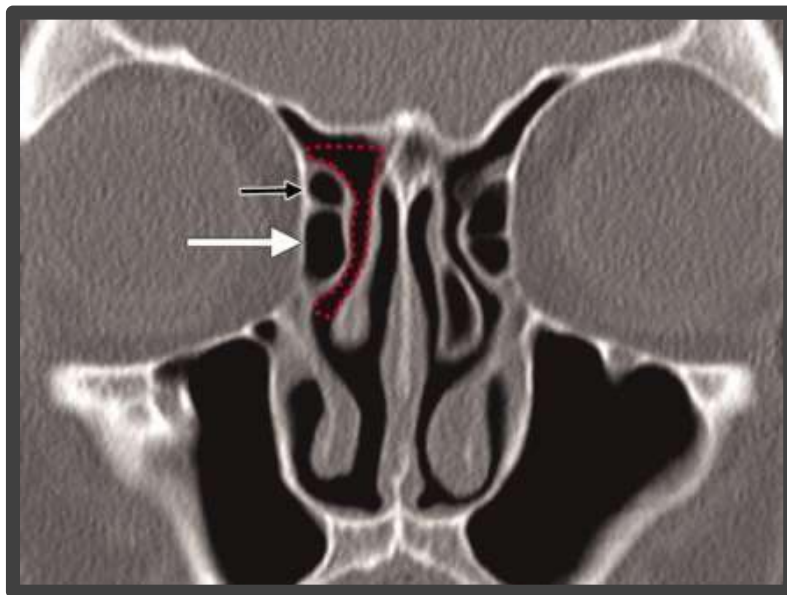
## *Pneumatization of cristagalli:*





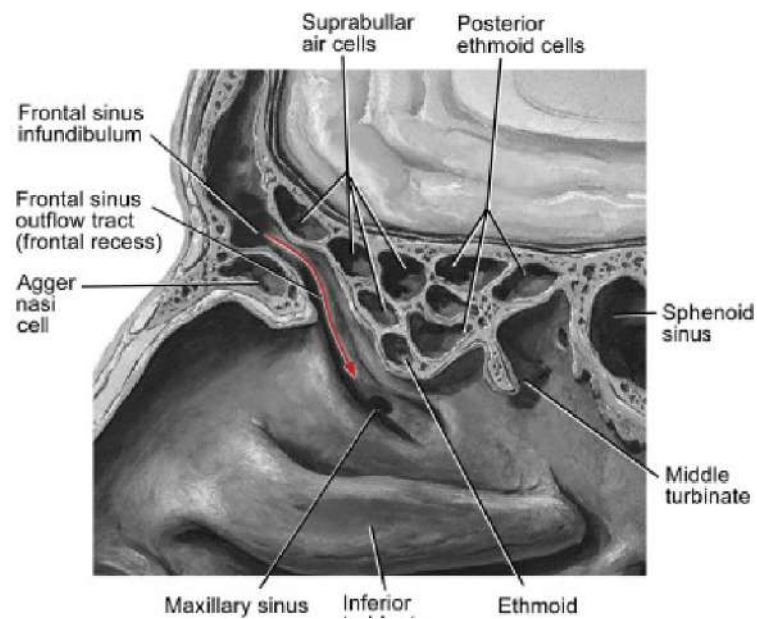
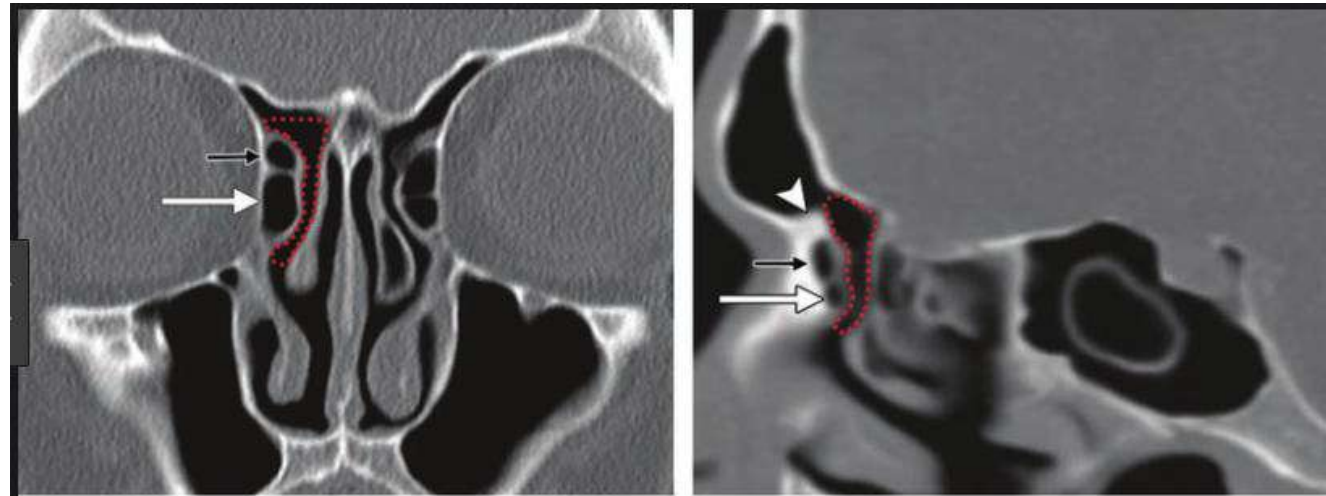


# *FRONTAL RECESS*



- Hour glass like narrowing
- Narrowest anterior air channels – prone for infection
- obstruction subsequently results in loss of ventilation and mucociliary clearance of the frontal sinus
- Lacrimal bone

## *Frontal recess:*



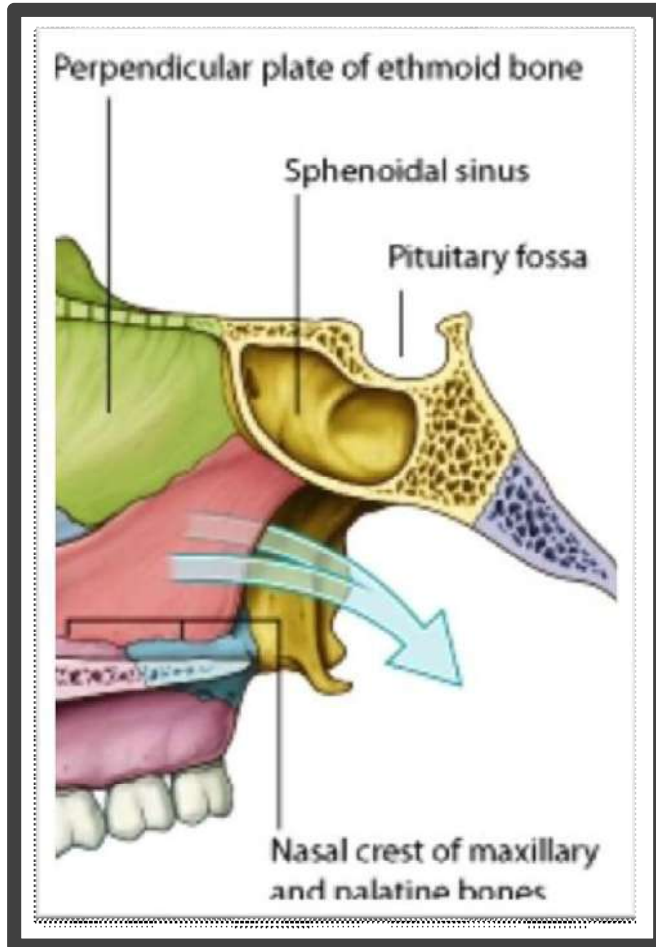




## *Sphenoid sinuses:*

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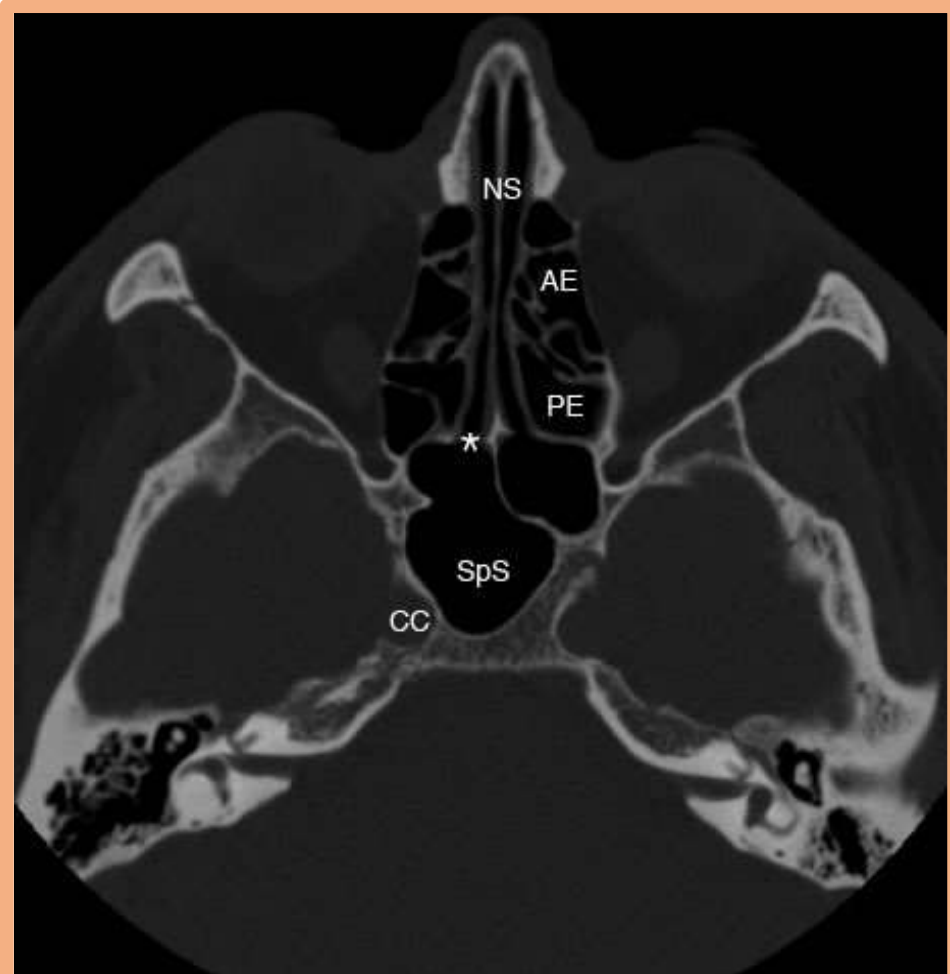
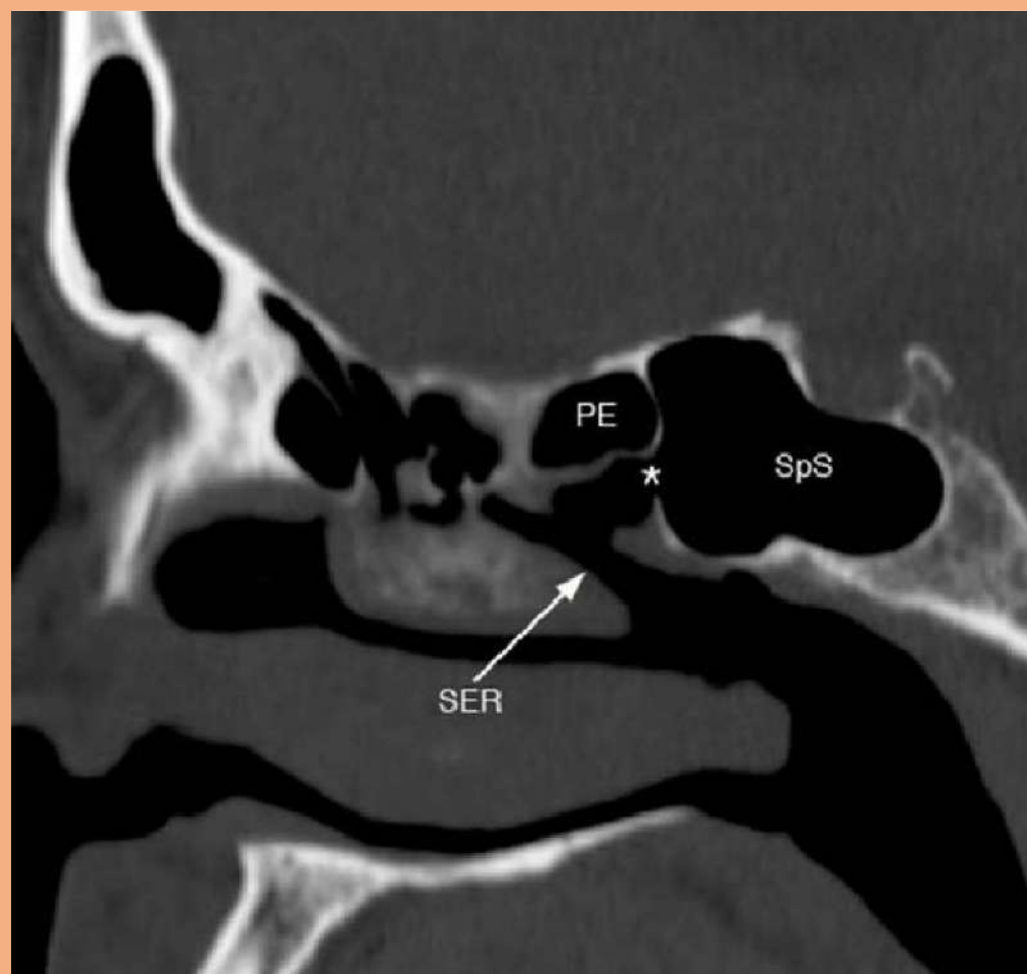
## SPHENOID SINUS



Occupies the body of sphenoid •  
Right & left, separated by a thin strip of bony septum (like frontal sinus)

Ostium opens into sphenoidal recess •

Relations of the sinus are very important, esp during the surgical approach of pituitary gland •





*According to Congdon ,  
sphenoid pneumatization:*

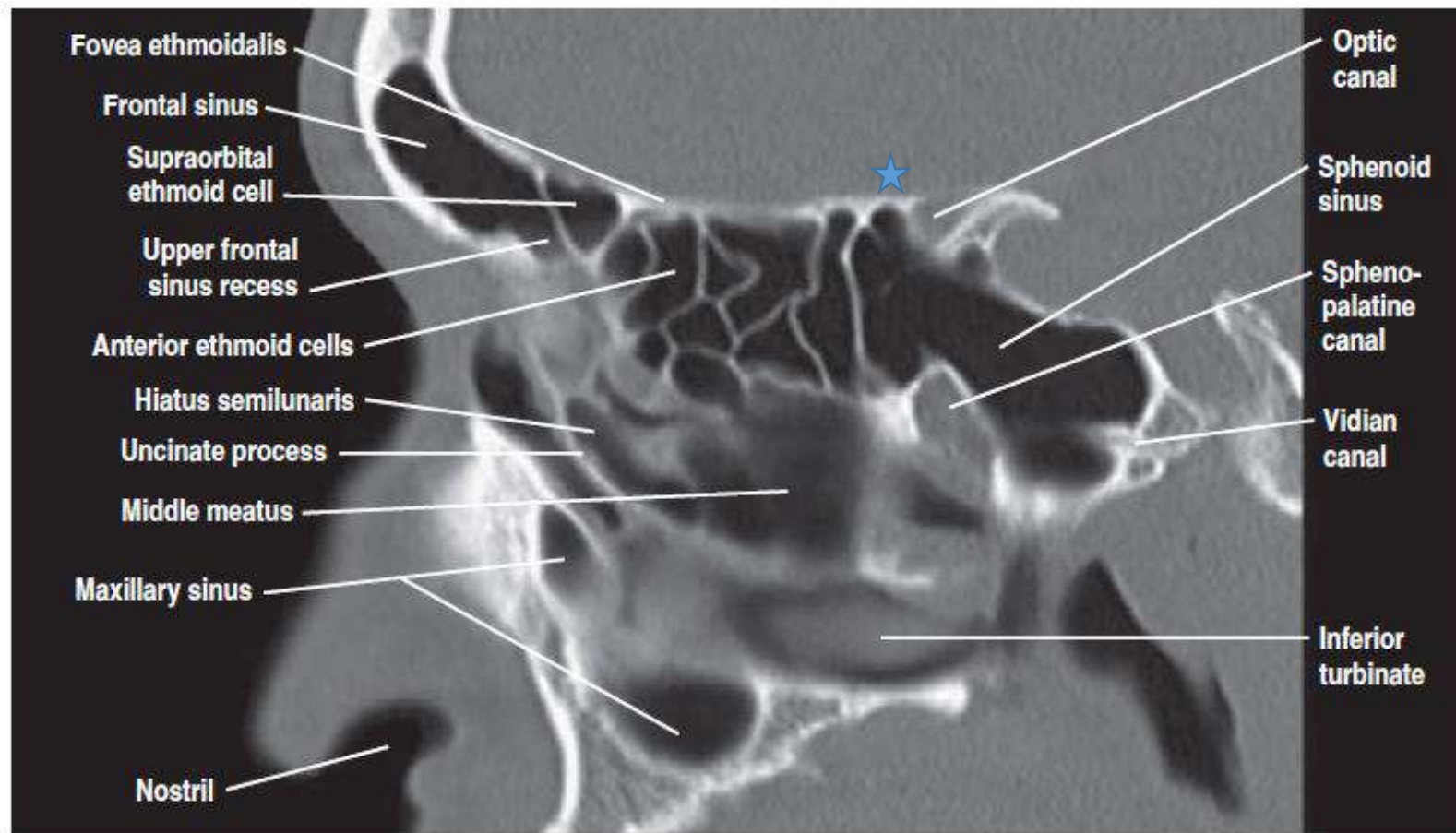
*A. Conchal – <1%*

*B. Presellar – 40 %*

*C. Sellar – 60%*



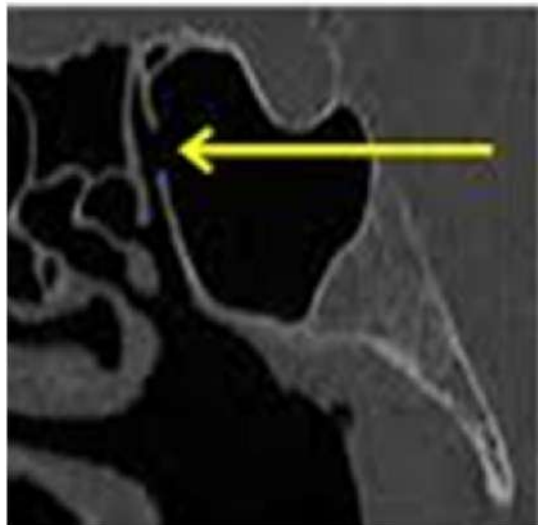
**Figs 9A to C:** The sphenoid pneumatization: (A) conchal, (B) presellar, (C) post-sellar<sup>11</sup>



Sagittal 12

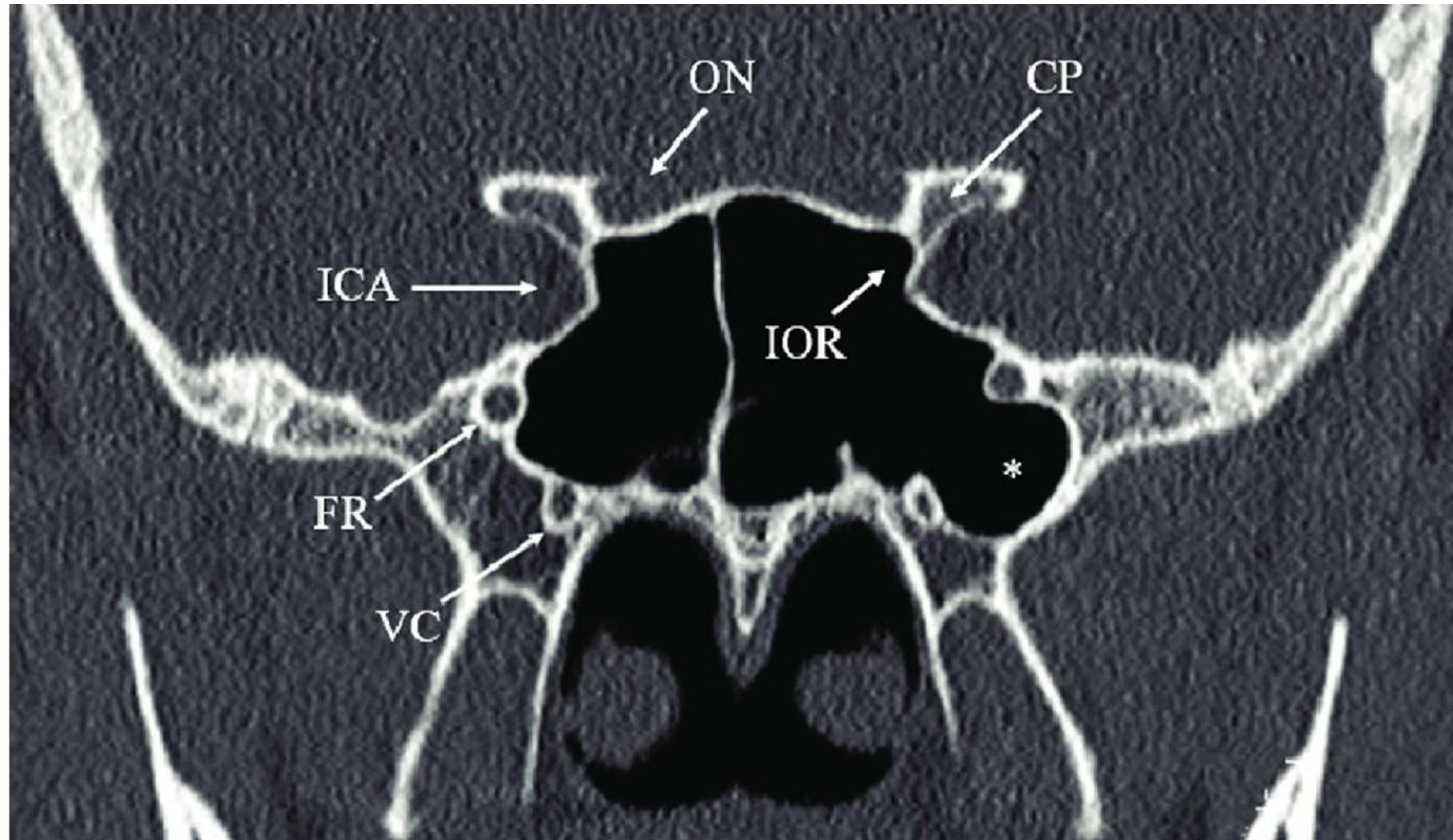
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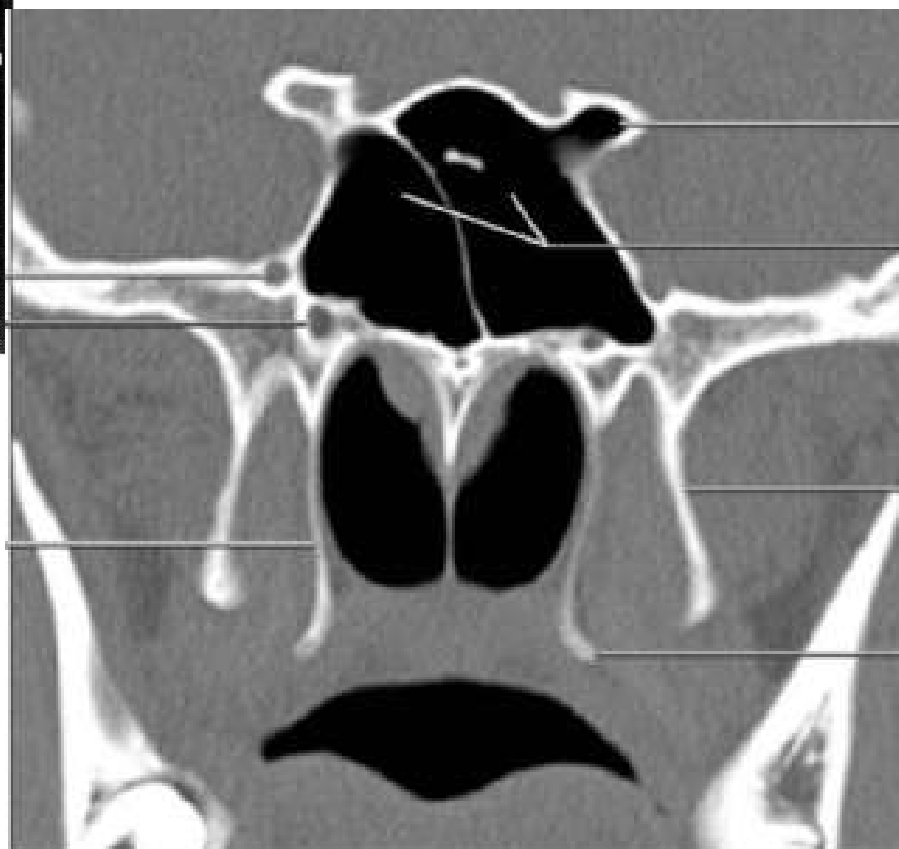
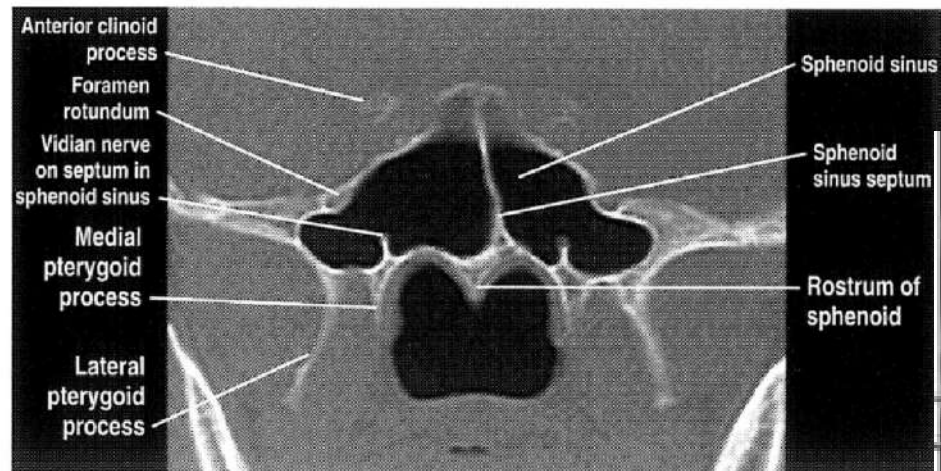
## *Sphenoethmoidal recess:*



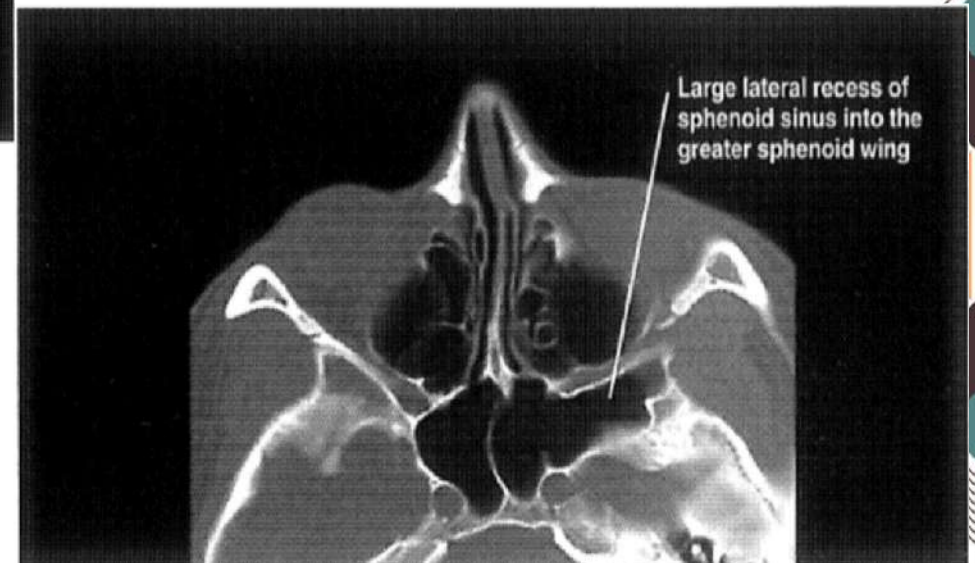
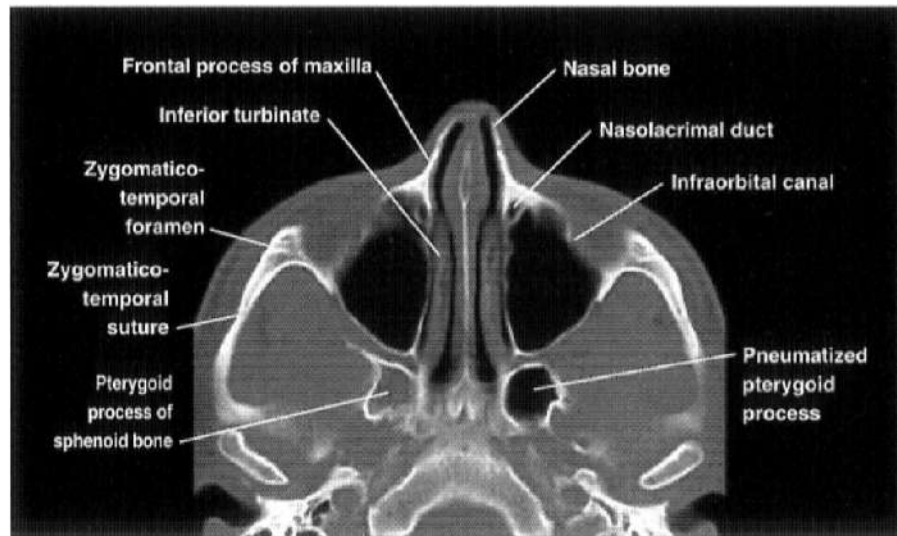


*the sinus cavity may be in a close relationship to the canals and grooves of the sphenoid foramen rotundum, pterygoid canal, optic canal, carotid groove and foramen Rotundum; Sphenopalatine ganglion*

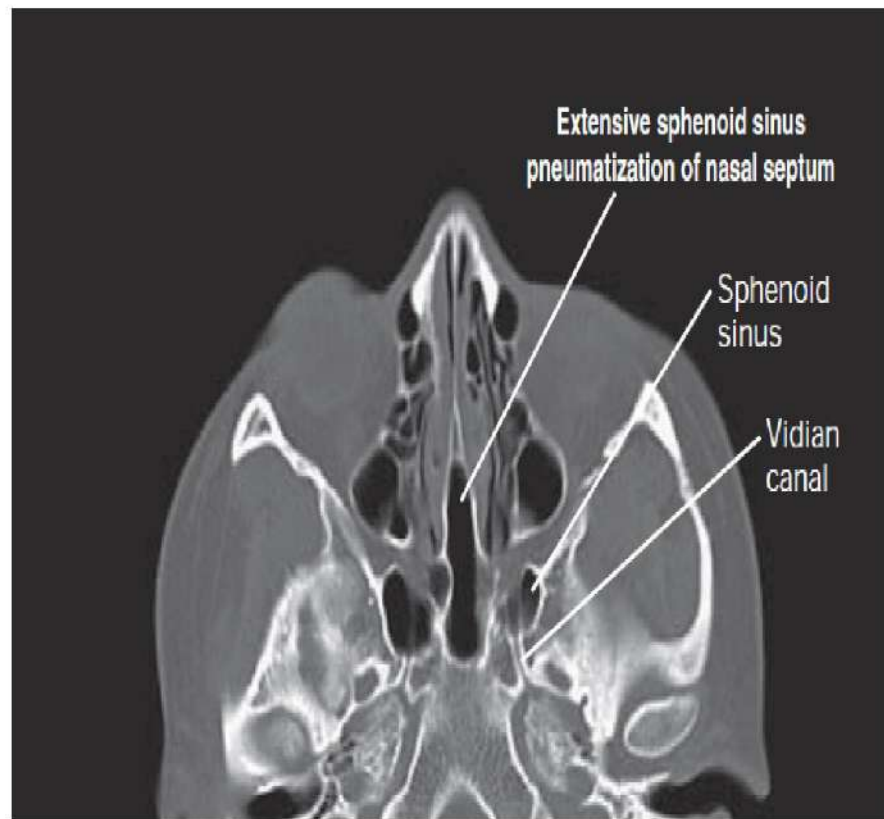




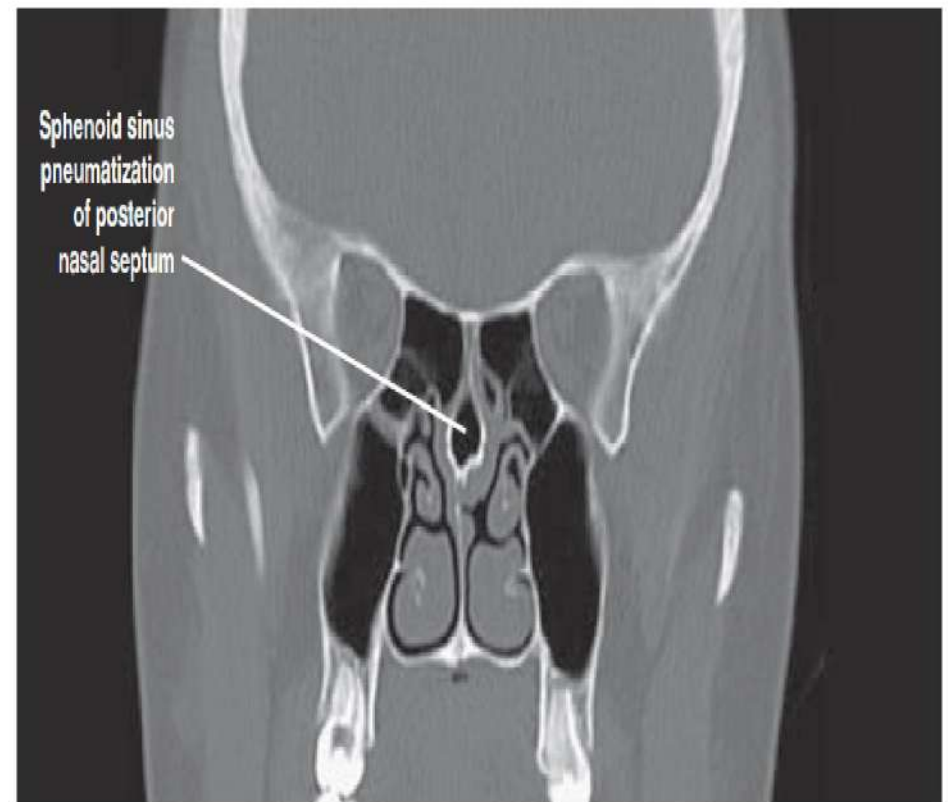






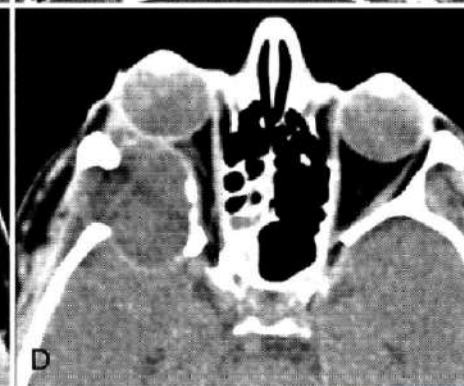
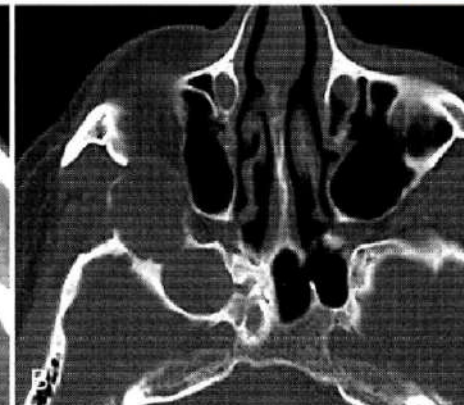
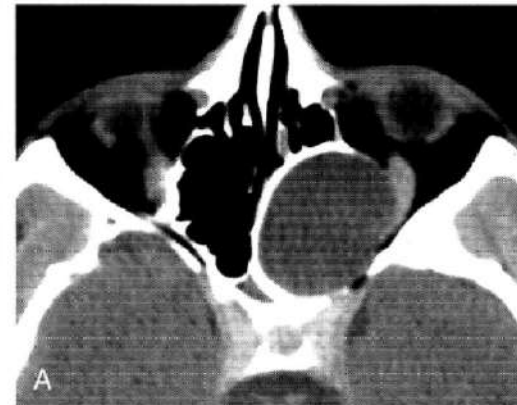
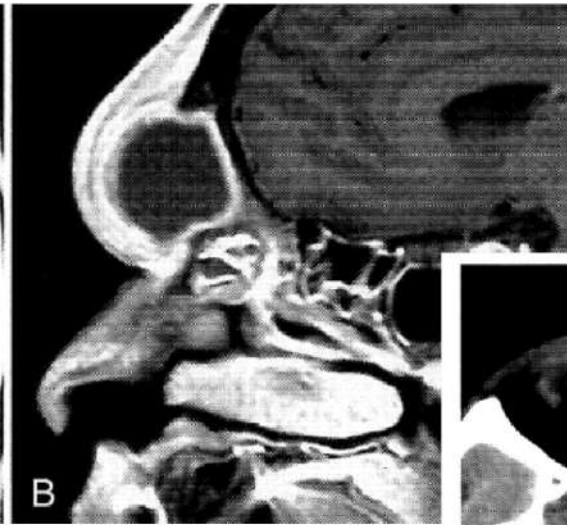
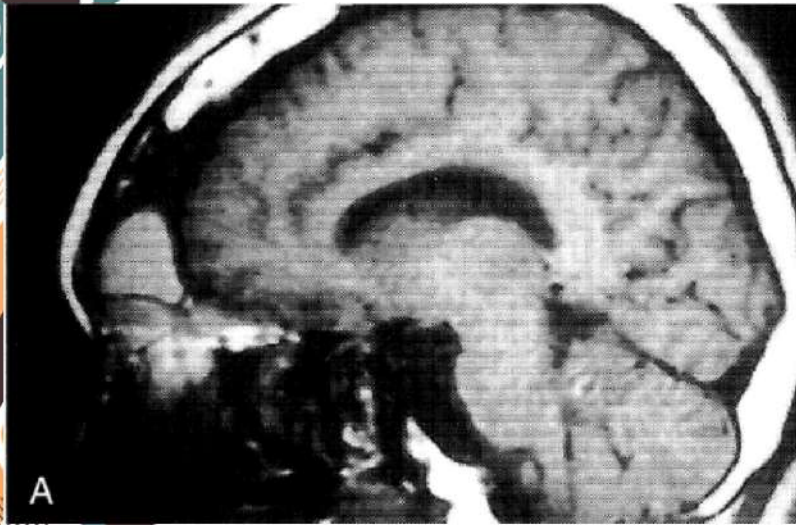


Axial 31



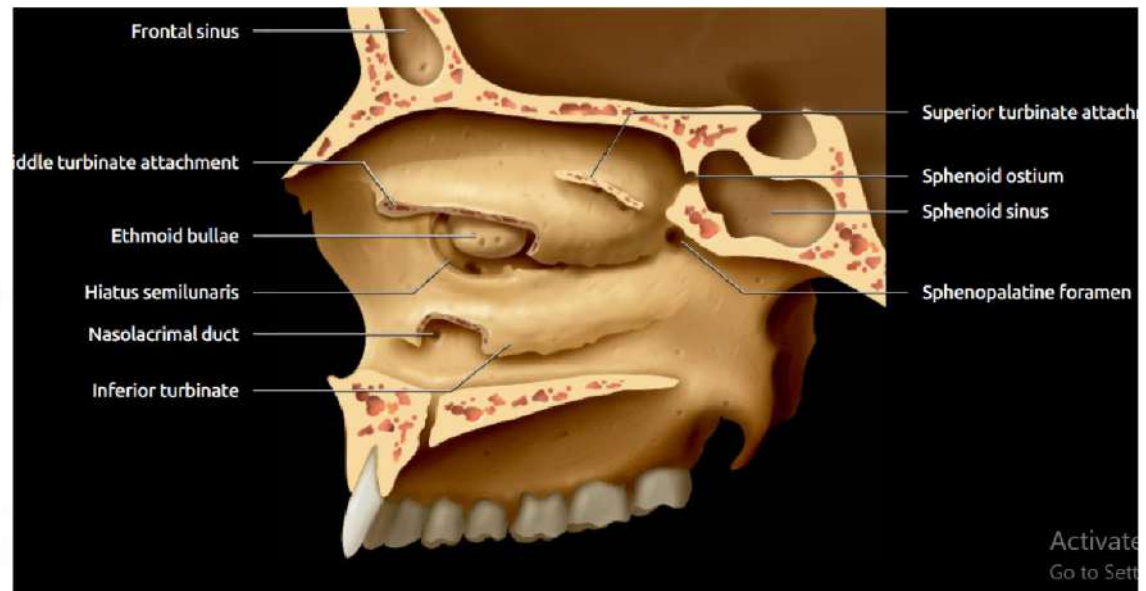
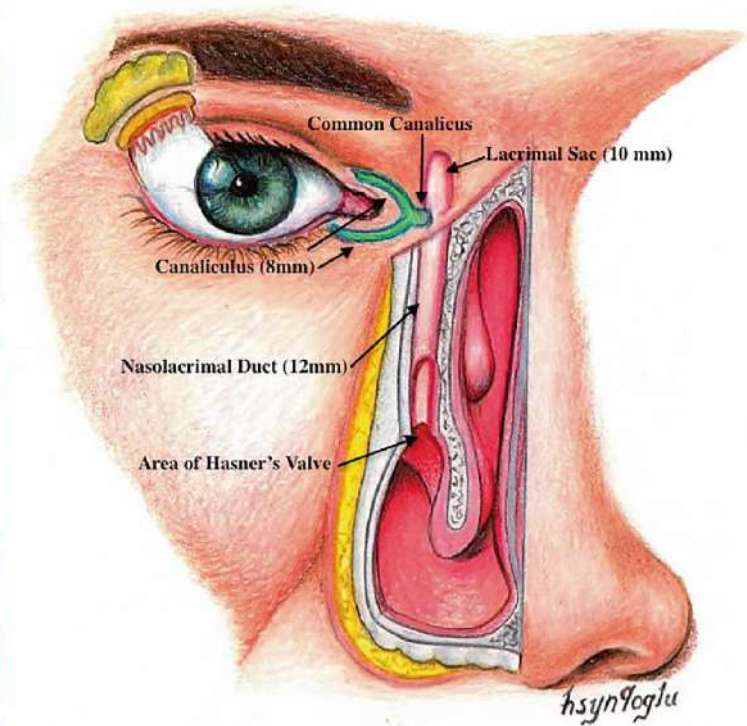
Coronal 46

# *Muccocell*

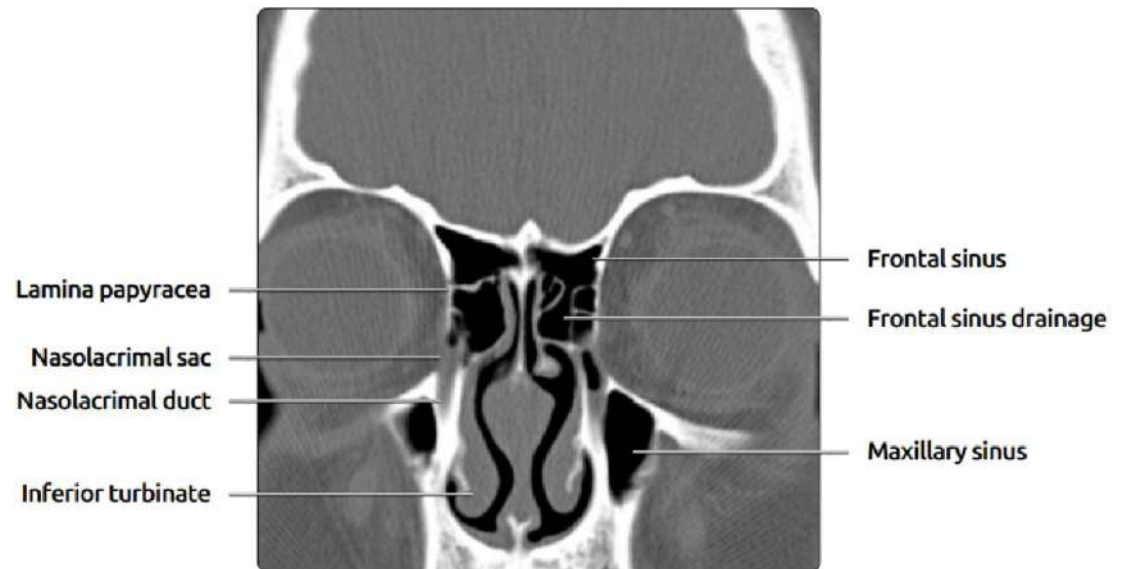


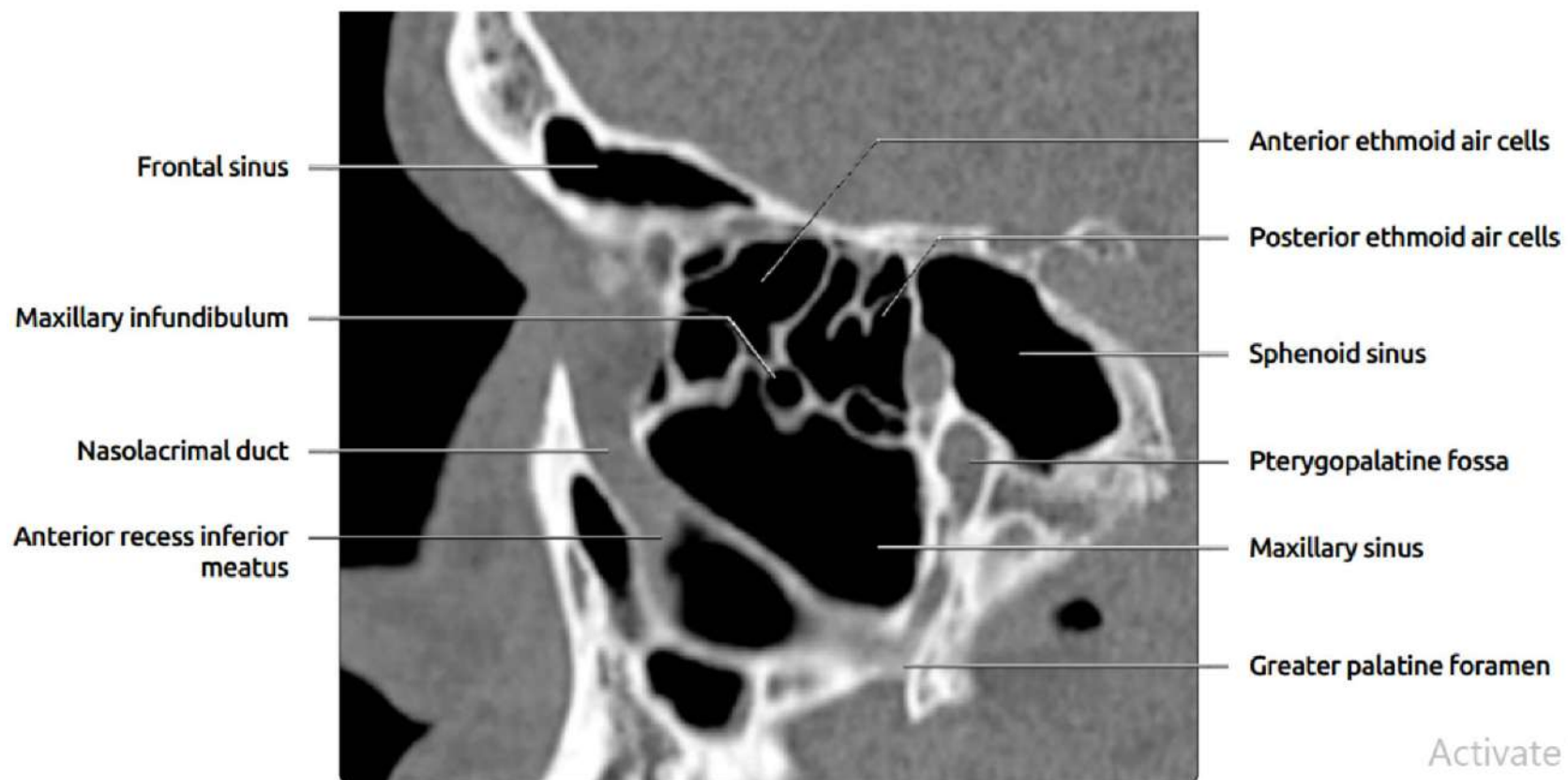


# *Nasolacrimal canal*









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# References

1. *Head and Neck imaging (SOM). 2011*

❑2. *Diagnostic Imaging - Oral and Maxillofacial, 2nd Edition.*

❑3. *Qureshi MF, Usmani A. A CT-Scan review of anatomical variants of sinonasal region and its correlation with symptoms of sinusitis (nasal obstruction, facial pain and rhinorrhea). Pak J Med Sci. 2021;37(1):195-200. doi:10.12669/pjms.37.1.3260*

❑4. *Özcan, İ., Gökel, S., Çakır-Karabaş, H. et al. CBCT analysis of haller cells: relationship with accessory maxillary ostium and maxillary sinus pathologies. Oral Radiol (2020).*



- ❑5. *A new classification proposal for sphenoid sinus pneumatization: a retrospective radio-anatomic study. Elif Bilgir. Oral Radiology volume 37, pages118–124(2021).*
- ❑6. *Evaluation of the posterior superior alveolar artery and the maxillary sinus with CBCT. Dilhan Ilgüy. Braz. oral res. vol.27 no.5 São Paulo Sept./Oct. 2013.*
- ❑7. *<https://radiopaedia.org/articles>*