

Incidence and reporting of surgically relevant variant anatomy in the paranasal sinuses

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Background

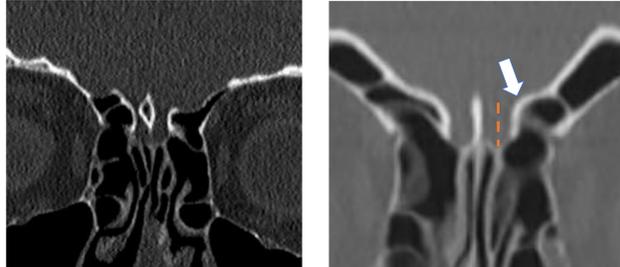
The paranasal sinuses are anatomically complex and packed into a small, compact area. There are anatomical variants which are of vital importance to surgeons when performing endoscopic nasal surgery. Identification can allow for the planning of safer surgery. A mnemonic has been described in the literature (CLOSE)¹ as essentially five findings which should be reviewed and reported upon. This study aims to review the incidence of these structures and then review whether they are reported.

Methods

Retrospective review of 50 consecutive studies of non-contrast CT Sinus scans. The presence of CLOSE structures was reviewed and when present, the report was further scrutinized. The structures being reviewed have been detailed below.

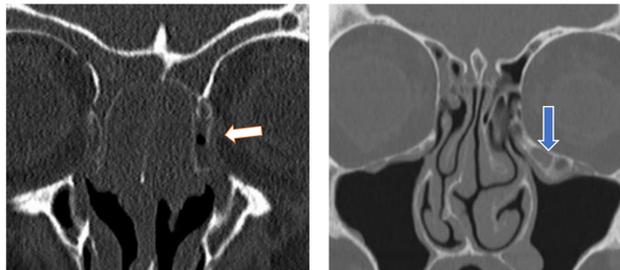
Cribriform plate

- Viewed in the coronal plane.
- Keros Classification:
 - Keros 1: 1-3mm
 - Keros 2: 4-7mm
 - Keros 3: 8-16mm (Considered the abnormal variant for the study)



Lamina Papyracea & Haller air cells

- Viewed in the coronal plane
- Looking for Bony dehiscence or fracture
- Presence of Haller air cells (infra-orbital air cells)



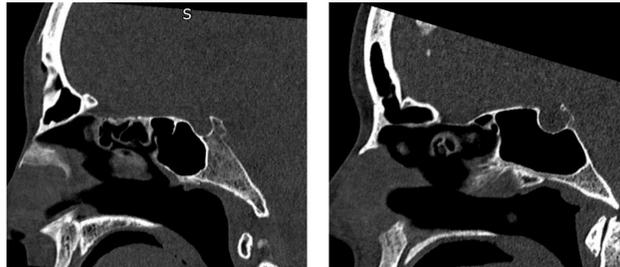
Onodi Cells

- Viewed in the sagittal and coronal plane
- Presence of ethmoidal air cells superior to the sphenoid sinus
- Alternatively named; Supra-orbital air cells



Sphenoid sinus pneumatization pattern

- Viewed in sagittal plane and coronal plane
- How far posterior the sphenoid sinus extends
 - Conchal
 - Pre-sellar
 - Sellar (Considered the abnormal variant for the study)
- Anterior clinoid or skull base pneumatization



(Anterior) Ethmoidal artery

- Viewed in the coronal plane
- Identifying the anterior ethmoidal notch
- Assess the presence of supra-orbital air cells



Educational Tips!

- Identify the fovea ethmoidalis (white arrow) then measure vertically downwards to the level of the cribriform plate (orange dashed line).
- Check both sides as there is commonly asymmetry! (Left image)
- The measurement is most significant for Keros 3 where the cribriform plate is considered 'low lying' and most at risk of damage.
- The lamina papyracea is a thin bone and the principal bone of the medial orbital wall.
- Look for interruptions in the wall continuity to suggest dehiscence or a fracture (Left image; white arrow).
- Haller air cells are air cells that reside below the inferior orbital wall and can narrow the ostium of the maxillary sinus. (Right image; blue arrow)
- Onodi cells are ethmoidal air cells which pass superior to the sphenoid sinus. They can occasionally cover the optic nerves and expose these structures to damage.
- Look for the anterior wall of the sphenoid sinus and then check for ethmoidal air cell extension. (Left image; dashed line = anterior line of sphenoid sinus, white arrow = Onodi cell)
- The sphenoid sinus can extend laterally and involve the skull base (Right image)
- The more pneumatized the sphenoid sinus, the less bony stock there is behind it therefore more fragile clivus.
- Look coronally, for extension into the skull base and anterior clinoid processes, leading to involvement of the optic nerves or carotid arteries.
- The artery lies within the ethmoidal notch. This notch lies along the medial orbital wall at the level of the anterior ethmoid sinus (white arrow).
- Issues arise when there are supraorbital air cells (blue arrow) as the artery is no longer independently covered and travels freely in the ethmoid sinus.

Results

Anatomical structure	Number (out of 50) with a definite anatomical abnormality	How many of these were reported?	Our pickup rate (%)
Cribriform plate	16	15	94%
Lamina papyracea & Haller air cells	8	7	88%
Onodi cells	8	3	38%
Sphenoid sinus pneumatization	39	18	46%
Ethmoidal artery	14	6	43%

50 patient in total; 25 male, 25 female.
Average age 51
Requesting teams: Head and neck: 42 GP: 5 Haem-Onc: 3

- The cribriform plate was the most commented upon even when normal, but also had the highest pick-up rate for when abnormal.
- Lamina papyracea defects and Haller air cells were well identified.
- The most common anatomical abnormality was the regarding the sphenoid sinus which was also poorly reported.
- Onodi cells and supra-orbital pneumatization is common enough in this small cohort of patients that dedicated reviews should also be performed for a higher pickup rate.

Conclusion

Surgically relevant anatomical structures are prevalent in the general population receiving CT scans of their sinuses. The most common of these is poorly identified and reported. This study highlights the incidence of variant anatomy which would be useful for the ENT surgeon reviewing the patient especially when intervention may be planned.