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Role of Computed Tomography in Evaluation of Anatomical Variations of Sphenoid Sinus and Related Structures

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Abstract: ***Background: Understanding anatomy and its normal variations is essential to comprehending abnormal processes in radiology. Pneumatization of the sphenoid sinus (SS) can be seen as early as nine months of age. The SS shows variations in size, pneumatization, and pattern of septations, which lead to differences in the segmentation of SS. The pneumatization can extend into the greater wing of sphenoid, pterygoid process, clivus, and sometimes into the anterior clinoid process. Understanding these variations and their consequences enables us to prevent iatrogenic difficulties in surgery, predict the sequelae of brain lesions, intra operative guiding, and draw attention to the presence of these variants for the surgeon. Aims: To demonstrate the anatomical variations of sphenoid sinus and related structures on computed tomography to help in the trans - sphenoidal and functional endoscopic sinus surgery and reduce complications due to it. Conclusion: Sphenoid sinus is a highly variable structure with varying degree of pneumatization. A comprehensive knowledge of the variable regional anatomy of the sphenoid sinus will undoubtedly reduce the surgical complications associated with transsphenoidal and functional endoscopic sinus surgery.***

Keywords: Computed tomography, Sphenoid sinus, Variants of sphenoid sinus, Dehiscence of neurovascular structures

1. Introduction

Para nasal air sinuses are meant to make the skull light weight, give the resonance to the voice and help to make inspired air moist and warm. To clinicians they are important because its infections and related complications.

Out of the frontal, ethmoid, maxillary and sphenoid sinuses, sphenoid sinus (SS) has got clinical significance in this new era of minimal invasive surgery.

For endoscopic trans - sphenoid approach, sphenoid sinus pneumatization pattern plays most important role in which the sellar type being most common and most favourable.[1]

Pneumatization varies in each and every individual. Because of variation in pneumatization, we get a lot of variations in SS and its relation with the neighboring structures. These relations are important for the surgeons to anticipate difficulties and complications during surgeries.

SS is non - pneumatized at birth; pneumatization starts at age 2–3 years, with some variability, with a development period of pneumatisation of 3–5 years or 6–10 years.[2]

Classification proposed by Hammer and Radberg, the SS shape can be divided into different groups, recognizable on the sagittal planes, and based on the relation to the anterior and posterior walls of sella:

- Conchal type: A small pneumatised space in front of the anterior wall of the sella.
- Presellar type: SS ends anteriorly to the anterior edge of sella
- Sellar type: posterior wall of the SS is between the anterior and posterior walls of the sella.
- Post - sellar type: posterior wall of the SS is located behind the posterior wall of the sella.[3]

Aims and Objectives:
To demonstrate the anatomical variations of sphenoid sinus and related structures on computed tomography to help in the trans sphenoidal and functional endoscopic sinus surgery and reduce complications due to it.

2. Research Methodology

This cross sectional study was conducted in the Department of Radio - diagnosis, Akash institute of medical sciences and research centre, Bangalore. Total 120 CT scans were selected randomly from patients who fulfill our inclusion and exclusion criteria. For imaging of sinuses, computed tomography is a gold standard procedure.[4]

Contiguous slice CT technique was used with 1 mm section thickness. We studied the type of pneumatization, protrusion or dehiscence of neurovascular structures, presence of accessory septa and its attachment, termination of inter - sinus septa, etc.

All subjects were between 18 to 70 years. We excluded subjects with acute or chronic sinusitis, FESS, trans - sphenoid surgery, head injury or intra - cranial infection.

CT sections were analyzed pertaining to variations in pneumatization of the sinus. Association of protrusion or dehiscence of the internal carotid artery (ICA), optic nerve

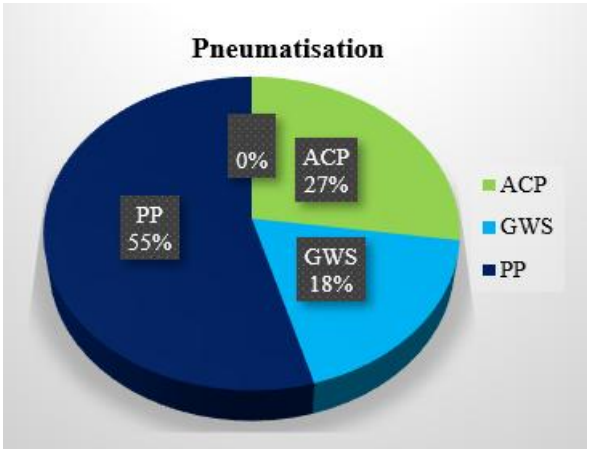
(ON), maxillary nerve (MN) & vidian nerve (VN) with extent of pneumatization of SS was also studied.

3. Observation and Results

Extent of Pneumatization

The study of pneumatization patterns of SS has gained added importance due to newer developments in transsphenoidal sinus surgeries and its utility in accessing the lesions involving middle cranial fossa, retroclival region, and foramen magnum.[5]

It was observed that pneumatization of greater wing of sphenoid sinus (GWS) in 27 sinuses, pterygoid process (PP) in 80 sinuses and anterior clinoid process (ACP) in 40 sinuses.

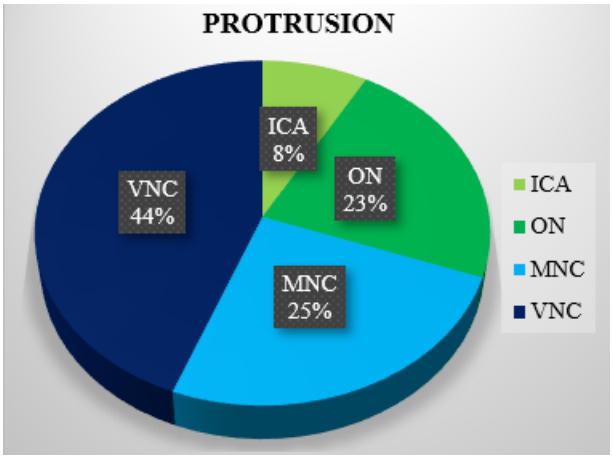


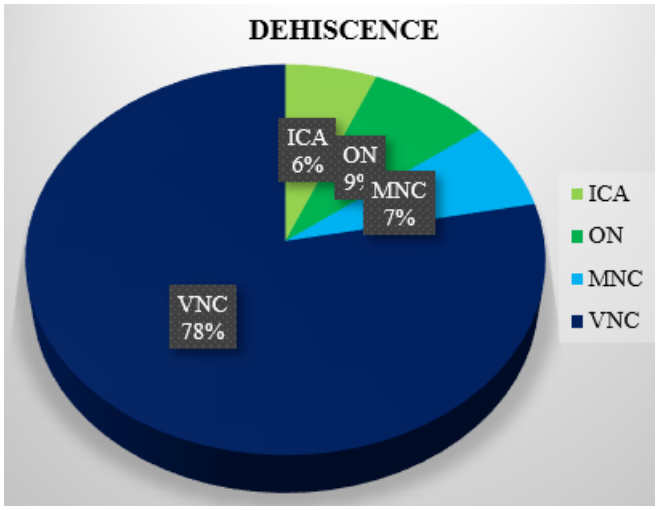
	Present	Absent
Pneumatised ACP	40	80
Pneumatised GWS	27	93
Pneumatised PP	80	40

Protrusion of Neurovascular Structures

Usually protrusion of ON is associated with pneumatization of ACP, protrusion of MN is associated with pneumatization of GWS, protrusion of vidian nerve (VN) is associated with pneumatization of PP.[6]

Protrusion of ICA was observed in 14 sinuses.





Dehiscence of Neurovascular structures

Dehiscence of ON was noticed in 8 cases. There was dehiscence of ICA in 6 cases.

	Protrusion	Dehiscence	Total
ICA	14	6	20
ON	38	8	46
Maxillary nerve canal	43	7	50
Vidian nerve canal	75	14	89

Pneumatisation of anterior clinoid process was found in 40 patients, greater wing of sphenoid in 27 patients and pterygoid process in 80 patients. Internal carotid artery canal protrusion was seen in 14 patients, while it was found dehiscent in 6. Optic nerve canal protrusion and dehiscence were found in 38 & 8 respectively. Protrusions of maxillary and vidian nerve canal were noted in 43 & 75 while dehiscence was noted in 7 & 14 respectively.

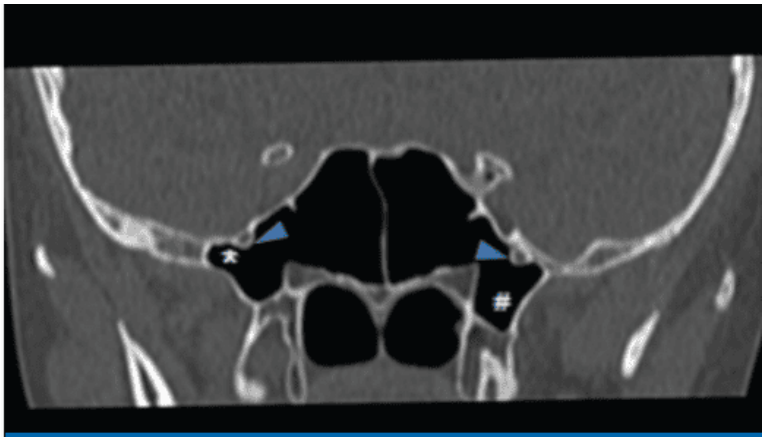


Figure 1: Pneumatisation of right GWS (*) with protrusion of both MN (arrow heads) and pneumatised PP (#)

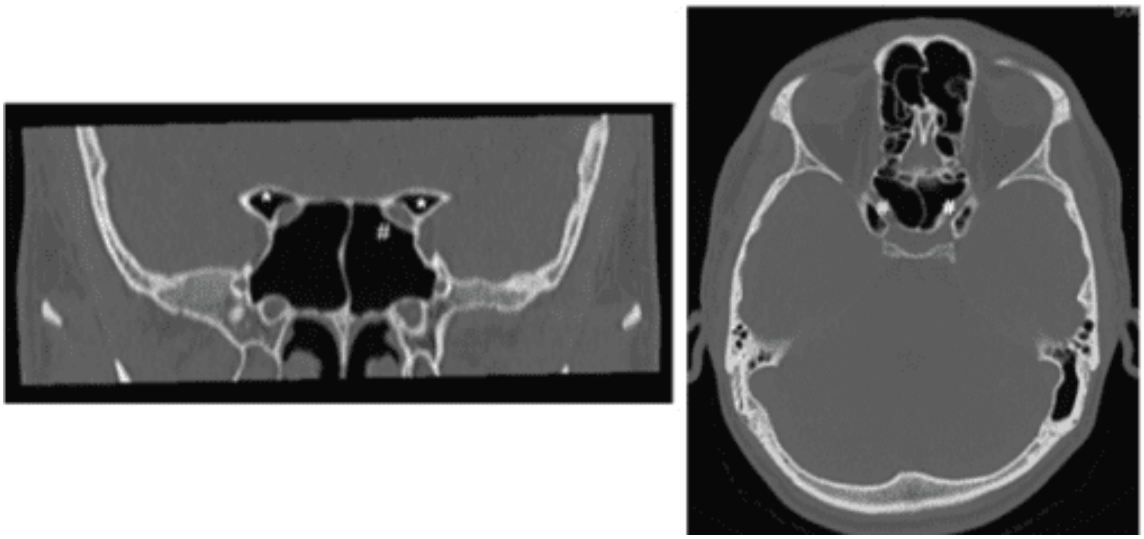


Figure 2: Bilateral pneumatised ACP (*) with both ON (#) passing through the sinus

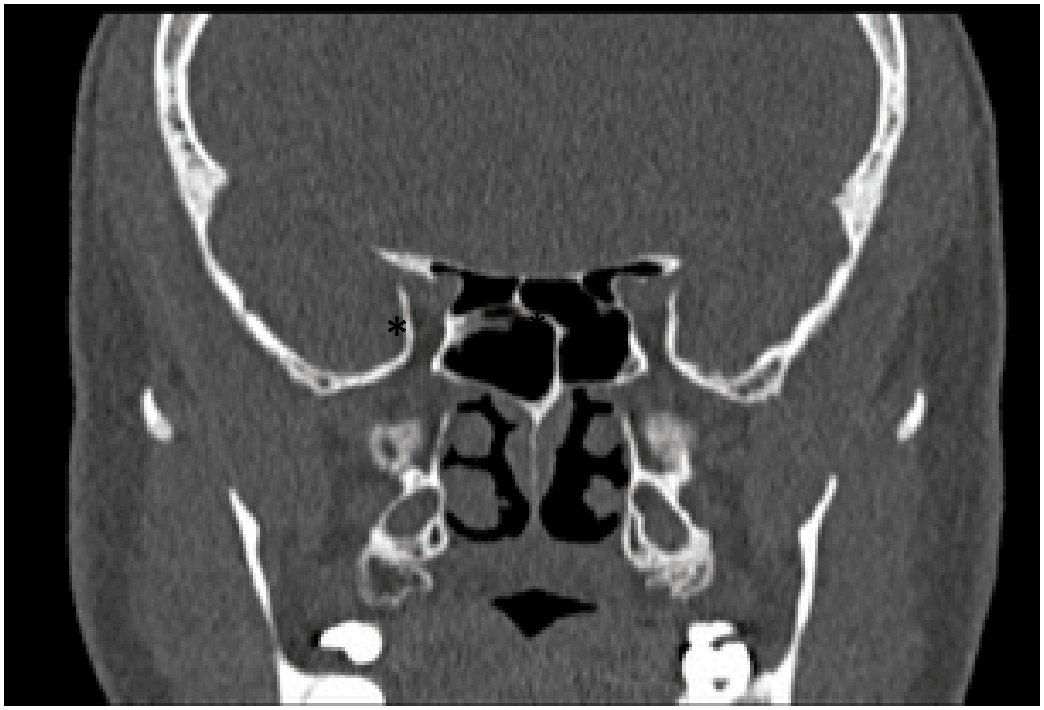


Figure 3: Pneumatisation of both anterior clinoid processes (*)

Figure 4: Pneumatisation of both GWS (O)

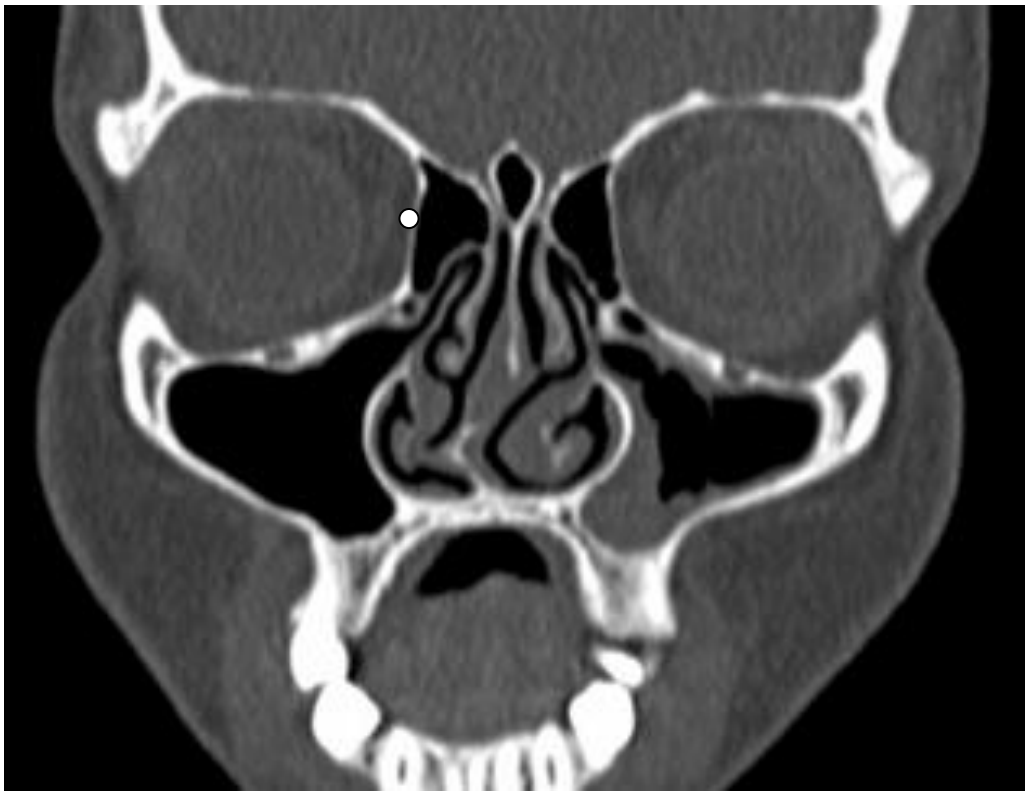


Figure 4: Pneumatisation of crista galli (O)

Figure 5: Intra - sphenoidal course of vidian canal (O)

4. Conclusion

- SS is surrounded by important neurovascular structure.
- Various types of pneumatization can be seen and if pneumatization spreads beyond body of the sphenoid bone it forms recesses.
- Due to this, SS is in close relation with MN, ON, VN & ICA. Newer techniques were helpful for the safety of the patient during intra - operative and post - operative period.
- Now, intra - operative fluoroscopic imaging or intra operative navigational devices are used to confirm surgical landmarks making these techniques very safe.
- Sphenoid sinus is a highly variable structure with varying degree of pneumatization.
- A comprehensive knowledge of the variable regional anatomy of the sphenoid sinus will undoubtedly reduce the surgical complications associated with transsphenoidal and functional endoscopic sinus surgery.

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