

Anatomical Variations of Sphenoid Sinus in Patients with Sino-Nasal Complaints- A Study based on CT Scan

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Abstract

Background: Sphenoid sinus is variably pneumatized and may show septations. There are some very important structures present in its relation like optic nerve and internal carotid artery. So, it becomes important to know the patterns of variations in pneumatization and septation of the sinus so as to avoid any inadvertent injury to these structures during Functional Endoscopic Sinus Surgeries. The Aim is to determine the anatomical variations of sphenoid sinus on CT scan. **Subjects and Methods:** It was a retrospectively done descriptive observational study carried out on 150 patients that presented with various sino-nasal complaints and underwent CT Scan in the Department of Radiodiagnosis, Bangur Institute of Neurosciences, Kolkata. Their CT scans were studied for the presence of Sphenoid sinus Pneumatization and Sphenoid sinus Septation. The data on radiological variations were summarized by routine descriptive statistics namely counts and percentages for categorical variables. **Result:** In 86% of the radiographs, sellar type of pneumatization was found followed by pre-sellar type (8%) and post sellar type (6.6%). Sphenoid sinus Septation was found as single septum in 82% and multiple septum in 18% cases. There was no statistically significant difference between males and females according as evident by the 'p' value of 0.879 for sphenoid sinus pneumatization and 0.833 for sphenoid sinus septation. **Conclusion :** The sellar type of pneumatization was found to be most common in the present study. Awareness of these variations will help the surgeon in his orientation during endoscopic sinus surgeries to avoid inadvertent injury.

Keywords: Sellar, Pre-sellar, Post sellar, Endoscopic Sinus Surgery.

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Introduction

Sphenoid sinuses are minute cavities at birth and their main development occurs after puberty. Pneumatization of sphenoid starts during the 4th year of childhood and gets completed by 17th year. Sphenoid bone closes off the back of the nasal cavity & separates it from the anterior & middle cranial fossa. Sphenoid sinus is the most variable cavity of the human body which makes its approach very difficult.^[1] It is in relation with important structures like the optic nerve & the carotid artery making a good understanding of its anatomy very important to the operating surgeon. The sphenoid sinuses are variably pneumatized. They are very often asymmetrical showing right or left sided "Sphenoidal Dominance".^[2] Depending upon the pneumatization of the sphenoid bone, the sphenoid sinus can be classified into the following types – Conchal, Pre – sellar, Sellar, Post – sellar.^[2]

Out of the four paranasal sinuses, sphenoid sinus is related to some of the very important structures like optic nerve and

internal carotid artery through its various extensions.^[3] The internal carotid artery is in direct relation to its lateral wall which leads to increased risks during the functional endoscopic sinus surgery.^[4] Fatal haemorrhage may occur if the surgeon is not aware of this variation because it is almost impossible to control the haemorrhage of an injured internal carotid artery within the sphenoid sinus.^[4] So it becomes very important to know the anatomical variations of this sinus before planning any endoscopic sinus surgery, as even a small unawareness can lead to disastrous complications.^[5-8]

This study was aimed to find out the prevalence of sphenoid sinus pneumatization and septation on CT scans in Eastern Indian population. It was observed that data regarding such variations were lacking in the said population, so this study attempted to fulfill the gap in the knowledge about such variations which will help the surgeons to know about the prevalence of these important anatomical variations of sphenoid sinus which are otherwise not causing symptoms. Such an analysis will be helpful in avoiding injury to the

structures in the vicinity of the sphenoid sinus and help in better surgical outcomes.

Subjects and Methods

A retrospective observational study was conducted in the Department of Anatomy, Institute of Post Graduate Medical Education & Research (IPGME&R), Kolkata for a period of 1 year from March, 2015 to February, 2016 after obtaining ethical clearance from Ethical Committee of IPGME&R, Kolkata having memo no. Inst/IEC/2015/005. It focused on the CT scan anatomy of the paranasal sinus region to find out the prevalence of sphenoid sinus pneumatization and septation. CT scans of 150 patients that attended the Department of Radiodiagnosis, Bangur Institute of Neurosciences, Kolkata were taken after studying their history and complaints. Being a descriptive study, it was proposed to recruit 150 subjects over a period of 1 year.

The CT scans of the patients fulfilling the inclusion and exclusion criteria were then collected for the present study to determine the variations. Patients with sino-nasal symptoms were selected after going through their brief history record available in the Department of Radiodiagnosis.

Inclusion Criteria

Patients who presented with sino-nasal complaints underwent CT scan, so as to observe any anatomical variation, if present, in view of achieving better medical and surgical outcome. Patients were included based on their sino nasal complaints only, who required CT scan.

Exclusion criteria

CT plates that revealed nasopharyngeal tumors, polyp, any other sino-nasal disease causing bony deformity or bony destruction were excluded. Scans of patients with history of previous surgeries involving nasal cavity and paranasal sinuses or trauma or injury (as obtained from the records) were also excluded.

As a protocol all the scans were performed by keeping the patient in prone position. Axial sections were taken from tip of the nose to the roof of the frontal sinus. Coronal sections were taken from tip of the nose to the roof of sphenoid sinus perpendicular to the hard palate. Sagittal sections were also taken after reconstruction. CT scan Machine - Toshiba-Asteion- Super-4, Model NO. – TSX – 021B/4F, was used in the study.

Statistical Analysis

Sphenoid sinus pneumatization and septation was seen on the CT scans and the results were analysed as percentages. Chi Square Tests and Fischer's Exact Tests were applied to calculate the 'p' value to find out any statistically significant difference between males and females. Fischer's exact test was

used for 2x2 contingency tables. While Chi Square test was used to compare expected frequencies assuming null is true with the observed frequencies from the study.

Results

On analyzing the CT scans obtained, the following results were observed regarding the pneumatization and septation patterns of sphenoid sinuses.

Sphenoid Sinus Pneumatization : 3 types of pneumatization of sphenoid sinus were observed as Sellar, Pre-sellar and Post-sellar. Sellar type was the most common among both males and females [Table 1 & Figure 1].

Sphenoid Sinus Septation : Presence of single or multiple septa in the sphenoid sinus were observed in this study. Single septum was found in 123 cases and multiple septa in 27 cases [Table 1 & Figure 2].

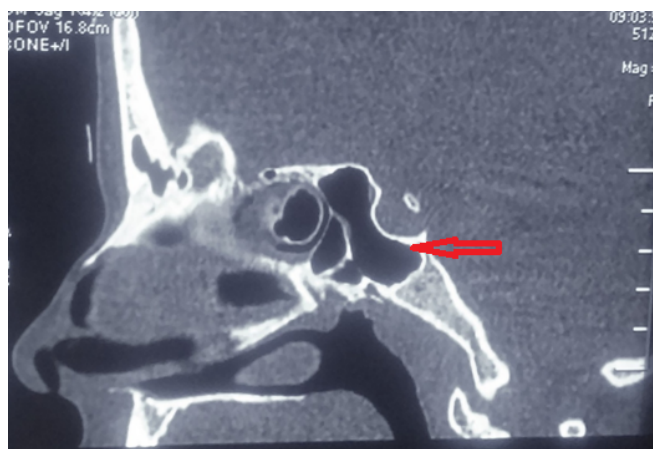


Figure 1: CT scan of PNS - Sagittal section showing Sellar type of Sphenoid sinus pneumatization.

Discussion

Sphenoid sinus is the most difficult sinus to approach by the surgeon and many vital structures lie within its vicinity. So, the common variations in its anatomy need to be looked for before planning the surgery. Many researchers have worked upon this area and have found different results based on the different geographic locations and different ethnicities.

A study was performed by Ossama Hamid et al.^[9] in 2008 to describe the anatomical variations of the Sphenoid sinus and to look for their impact on trans-sphenoidal approach in pituitary surgery. They retrospectively reviewed the CT scan and MRI of 296 patients operated for pituitary adenomas via a trans-sphenoid approach regarding the degree

Table 1: Distribution of pneumatization

Gender	Sellar (n,%)	Pre Sellar (n,%)	Post (n,%)	Sellar	Total (n,%)	Chi Square test (P)
Male	67 (44.67%)	6 (4%)	6 (4%)		79 (52.67%)	0.879
Female	62 (41.33%)	5 (3.33%)	4 (2.67%)		71 (47.33%)	
Total	129 (86%)	11 (7.33%)	10 (6.67%)		150 (100%)	

Table 2: Distribution of Sphenoid sinus septation

Gender	Single Septum (%)	Multiple Septum (%)	Total (%)	Fischer's Exact Test (P)
Male	64 (42.67%)	15 (10%)	79 (52.67%)	0.833
Female	59 (39.33%)	12 (8%)	71 (47.33%)	
Total	123 (82%)	27 (18%)	150 (100%)	

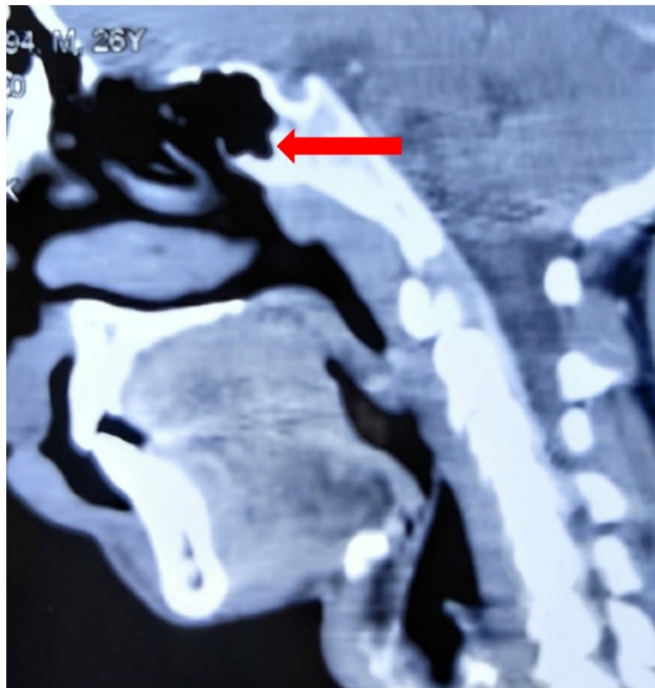


Figure 2: CT scan of PNS - Sagittal section showing Pre-Sellar type of Sphenoid sinus pneumatization.

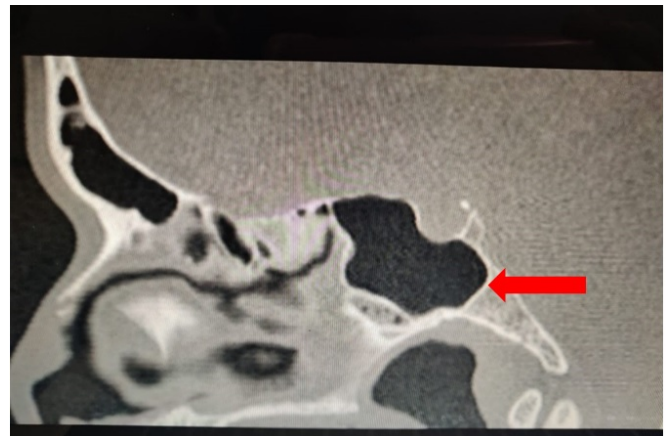


Figure 3: CT scan of PNS - Sagittal section showing Post-Sellar type of Sphenoid sinus pneumatization.

of pneumatization, sellar configuration and septation pattern in the sphenoid sinuses and concluded that knowing the details of the anatomy of the sphenoid sinus and the extent of pneumatization can guide the surgeon through difficult corners of the approach. Another prospective and non-randomized study was performed by Ashok K Gupta et al,^[10] in 2012. They performed both a cadaveric and an endoscopic study. Endoscopic surgery was performed on a total of 69 patients for disease of nose and PNS. Then a non-contrast CT of nose

and PNS was done and was studied for various anatomical variations of sphenoid sinus. Ozturan O et al,^[11] in 2013 performed a study on co-existence of the Onodi cell with the variation of perisphenoidal structures. They concluded that Pneumatization of the sphenoid sinus induces anterior clinoid pneumatization (ACP), affects the type of the Vidian nerve (VN) canal or alters the courses of the internal carotid artery (ICA), and the optic nerves (ONs) are strongly depending on it. A CT scan study was conducted by Vidya C S et al,^[12] in 2015 in Mysore based population to describe anatomical variations of sphenoid sinus. The septation type of intersphenoid septum and symmetry of sphenoid sinus was noted. The degree of pneumatisation presellar, sellar and postsellar was also observed.^[13] They concluded that CT scan should be used in pre-surgical evaluation of patients under consideration of trans-sphenoid sinus surgery to minimize the damage of neural and vascular injuries. Fernandez et al,^[14]

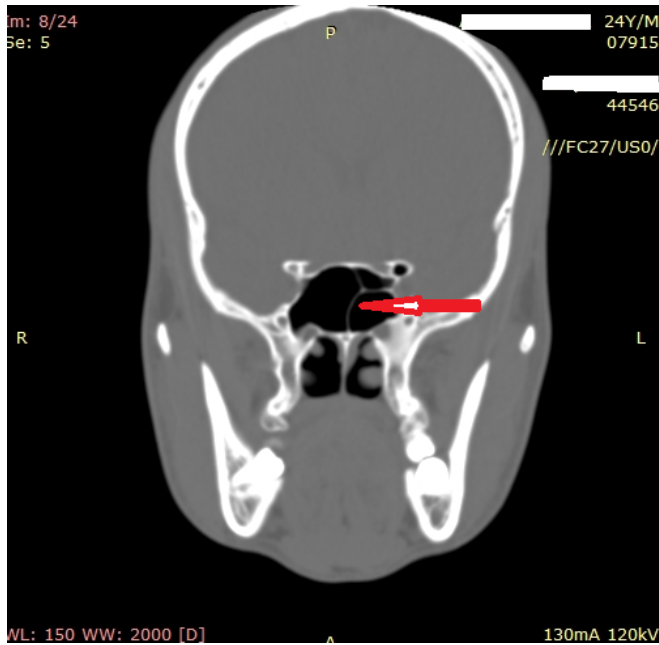


Figure 4: CT scan of PNS - Coronal section showing Sphenoid sinus septation.

in 2009 studied 54 sphenoid sinuses for finding out sphenoid septations and their relationship with internal carotid artery. 100 sphenoid sinuses were studied by Dziedzic T et al,^[15] in 2020 to find out the relationship between the sphenoid sinus septa and the parasellar or paraclival internal carotid artery prominence. Figen Tunali Turkdogan et al,^[16] in 2017 studied 200 cases (100 women, 100 men) who had PNS-CT in the emergency and radiology polyclinics within the period of one year. Multiple septations in sphenoid sinus was found. Rahmati A et al,^[17] in 2016 conducted a study on a total of 103 patients. They observed the degree of pneumatization of the sphenoid sinus as 4 types and concluded that type IV was the most prevalent and it affected males more than females. Tan and Ong,^[18] in 2007 conducted their study on adult Asian cadavers and observed that the conchal type of sphenoid sinuses pneumatization was more frequent (28% of their specimens).

The variations observed in the form of percentages have been tabulated in [Table 1 & Figure 3].^[19] The sellar type of pneumatization has been observed to be the most common type by several authors. The prevalence of single septum has also been observed to be the most common by many authors.^[20,21]

Limitation

The present study did not consider the child population of the concerned region. No analysis was done based on the age group of the population.

Conclusion

Variations in sphenoid sinus pneumatization and septation was established in the present study. The most common type of pneumatization was sellar type and most of the cases had single septum in the sphenoid sinus. The knowledge of these variations is very important for a surgeon who is planning any functional endoscopic sinus surgery or trans-sphenoidal approaches. Thus, this study will definitely help in providing a baseline data of sphenoid sinus variations and its impact on the outcome of surgeries.

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Table 3: Distribution of the variations in different studies.

Author Name [ref.]	Total population	Geographical location	septation	pneumatization
Ossama Hamid et al, ^[9]	296	Egyptian	Single – 212 Accessory - 32	Sellar – 162 Pre-sellar – 62 Post-sellar – 66 Conchal - 6
Ashok K Gupta et al, ^[10]	69	North Indian	Single – 24.6% Multiple – 12.3%	-
Vidya CS et al, ^[12]	80	Mysore	Transverse septa – 6	Sellar – 68 Pre-sellar – 8 Post-sellar – 4
Fernandez et al, ^[14]	27	Pittsburgh	Single – 23 Double - 11	-
Dziedzic T et al, ^[15]	100	Poland	Single – 42 Double - 7	-
Turkdogan FT et al, ^[16]	200	Turkey	Multiple – 11.25%	-
Rahmati et al, ^[17]	103		-	Sellar – 15 Pre-sellar – 2 Post-sellar – 86
Tan & Ong, ^[18]		Asian	-	Conchal – 28%
Hiremath SB et al, ^[22]		Indian	-	Sellar – 98.8% Pre-sellar – 1.2%
Present study	150	Eastern Indian	Single – 123 Multiple - 27	Sellar – 129 Pre-sellar – 11 Post-sellar – 10

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