

ANATOMICAL VARIATIONS OF SPHENOIDAL INTER-SINUS SEPTA IN TERMS OF NUMBER AND ATTACHMENTS - A CT FINDING

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ABSTRACT

BACKGROUND

Sphenoid sinus is an important structure located in the body of the sphenoid bone. It is separated from critical surrounding structures like optic nerve and chiasm, cavernous sinus, pituitary gland and internal carotid artery by a thin bony lamella. Because of its location and close relation to these important anatomical structures, diagnosis and treatment of sphenoid sinus pathologies are very challenging. In the era of endoscopic approach to the sphenoid sinus and skull base, the detailed knowledge of anatomy of sphenoid sinus and its closely related structures is mandatory.

The objective of this study is, in this study we concentrated on the variations in the anatomy of sphenoid septa in terms of number and attachment to the nearby structures with the help of computed tomography.

MATERIALS AND METHODS

Retrospective analysis of the computed tomography of the PNS of 80 patients who came to the OPD of Department of ENT, Head and Neck Surgery, MLB Medical College, Jhansi with the complaints of headache, nasal discharge and nasal blockade was carried out. Anatomy of the sphenoid sinus and the variations in its anatomy were noted.

RESULT

With this study, we found that there are numerous anatomical variations in the sphenoid septum in its number and attachment. Commonest type being single complete septum and commonest attachment was to carotid artery.

CONCLUSION

Knowledge of sphenoid sinus anatomy for every single patient before sphenoid surgery is paramount and should be obtained with the help of pre-operative computed tomographic study of the paranasal sinuses.

KEYWORDS

Sphenoid Sinus, Computed Tomography, Anatomical Variations, Endoscopic Sinus Surgery, Skull Base, Internal Carotid Artery, Optic Nerve, Pituitary.

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BACKGROUND

The sphenoid sinus is recognisable at around the third intrauterine month as an evagination from the sphenoidal recess and can be seen as a small cavity at the time of birth. At the age of four, pneumatization of the sphenoid bone progresses and by seven years it reaches the floor of the sella turcica in most of the cases.^[1,2] Pneumatization is said to progress at a rate of 0.25 mm each year from the age of four years, but this is not constant.^[1] In adults, degree of pneumatization and the septum vary greatly, asymmetry being the rule rather than the exception.^[1,3] In rare cases, internal carotid artery, optic nerve, V2 and the vidian nerve can be dehiscence in the walls of the sphenoid sinus with almost no bony wall.^[4,5,6]

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Sphenoid sinus is considered to have the most variations in comparison to other sinuses in terms of degree and type of pneumatization and inter-sinus septa and surrounding structures.

The sphenoid sinus is located in the body of the sphenoid bone and is divided by inter-sinus septa into two or more compartments. Superiorly, it is related to sella turcica, the internal carotid artery in its lateral walls, the optic nerve superolaterally and the Vidian canal in lateral wall here to view linked References aspect of its floor. Its ostium is located medially in the superior portion of the anterior sinus wall and communicates with the sphenoidal recess and the posterior portion of the superior meatus. The sphenoidal recess is located lateral to the nasal septum and although best demonstrated in the sagittal and axial planes, may also be seen on coronal images. The thin inter-sinus septum separates the sinus into two in most of the cases, but in some cases this septa may be more than one; complete or incomplete separating the sinus into more than two compartments or it may be absent also.^[7,8] The inter-sphenoid septum is often deviated to one side and may be attached to the bony wall covering the nearby structures as mentioned above.^[9] Hence, these structures may be injured when the septum is avulsed during surgery.

The knowledge of sphenoid septal variations in terms of numbers and attachments to important prominence on lateral or posterior wall of sphenoid sinus is the key point for a safe sphenoid or trans-sphenoidal skull base surgery.^[10]

CT scan is the gold standard for the visualisation of sphenoidal sinus variations including the inter-sinus septa and its attachments. In our study, we investigated the variations in the sphenoid inter-sinus septa in terms of number and its attachments to various important prominences in the sphenoid sinus wall. Our aim was to determine these anatomical variations of inter-sphenoid septum for safe and successful surgery of the sphenoid sinus and skull base.

Objective

To determine the anatomical variations in the septum of sphenoid sinus in terms of number, position and attachments with the help of NCCT paranasal sinus of the patients presenting to OPD, Department of ENT and Head and Neck Surgery, M. L. B Medical College, Jhansi, Uttar Pradesh, India.

MATERIALS AND METHODS

The study was carried out in 80 patients who came to the OPD of Department of ENT, Head and Neck Surgery, MLB Medical College, Jhansi with the complaints of headache, nasal discharge and nasal blockade. All the patients underwent complete history taking and detailed examination including anterior and posterior rhinoscopy. They also underwent x-ray, PNS waters' view, nasal endoscopy and CT scan of paranasal sinuses to evaluate the status of disease and anatomy of PNS.

Patients who had previously undergone endoscopic sinus surgery were excluded from our study. Computerised tomography was done in axial and coronal sections with the neck slightly extended when the patient was positioned supine in the CT gantry and 2 mm slice thickness was used. Sphenoid sinus was studied for the number of compartments as separated by one or more than one septum or absent septum and the symmetry or asymmetry of the compartments and also for the attachment of the septum.

RESULTS

Out of the 80 patients taken for the study, 53 were males and 27 were females [Figure 6], ranging from age 14 years to 60 years. NCCT of paranasal sinuses in axial and coronal sections were analysed.

Total six types of sphenoid septal variations [Figure 7] regarding the number were found namely.

1. Single complete septum [Figure 1] dividing the sinus into 2 compartments (n = 42, 52.5%).
2. Single incomplete [Figure 2] septum (n = 12, 15%).
3. Double complete [Figure 3] septa (n = 4; 5%).
4. Double septa of which one is complete and the other one incomplete [Figure 4] (n = 13; 16.25%).
5. Triple septa (n = 5; 6.25%).
6. Absent septum [Figure 5] (n = 4; 5%).

Five various types of attachment of the sphenoid sinus septa to wall [Figure 8] are identified in the study and the observations are mentioned below -

1. Carotid (n = 28; 35%).

2. Sella (n = 21; 26.25%).
3. Lateral wall of the sinus (n = 10; 12.5%).
4. Optic nerve (n = 2; 2.5%).
5. To both sella and carotid (n = 9; 11.25%).
6. To both carotid and lateral wall (n = 5; 6.25%).
7. To sella, carotid and lateral wall (n = 1; 1.25%).

In summary there were single septum in 81.25%, double septa in 12.5% and no septum in 6.25% of the cases.

Male	Female
53	27

Table 1. Showing Sex Distribution of the Patients

Type	No. of Cases	Percentage
Single Complete Septum	42	52.5%
Single Incomplete Septum	12	15%
Double Complete Septa	4	5%
Double Complete + Incomplete Septa	13	16.25%
Triple Septa	5	6.25%
No Septum	4	5%

Table 2. Showing the Variations of Septa and Sphenoid Compartments

Attachment of the Septum	No. of Cases	Percentage
Carotid	28	35%
Sella	21	26.25%
Lateral Wall	10	12.5%
Optic Nerve	2	2.5%
Sella and Carotid	9	11.25%
Carotid and Lateral Wall	5	6.25%
Sella, Carotid and Lateral Wall	1	1.25%
No Septum	4	5%

Table 3. Showing the Variations in the Attachment of Sphenoid Septum

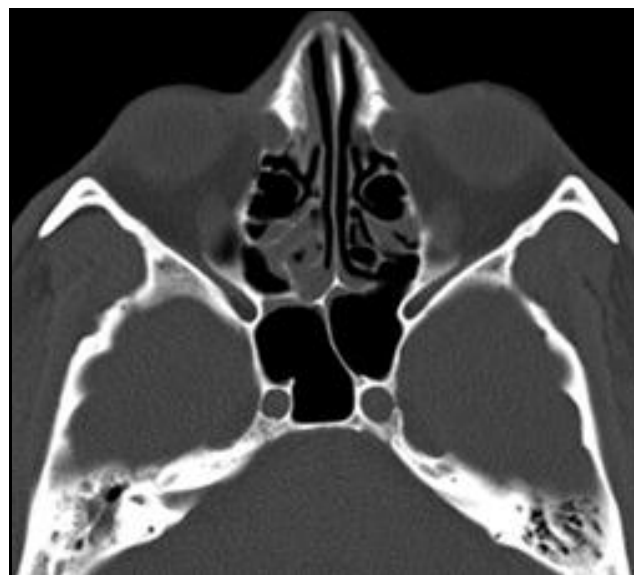


Figure 1. CT Scan showing a Single Complete Sphenoidal Septum



Figure 2. CT Scan showing a Single Incomplete Septum



Figure 5. Aseptate Sphenoid



Figure 3. CT Scan showing Double Septum

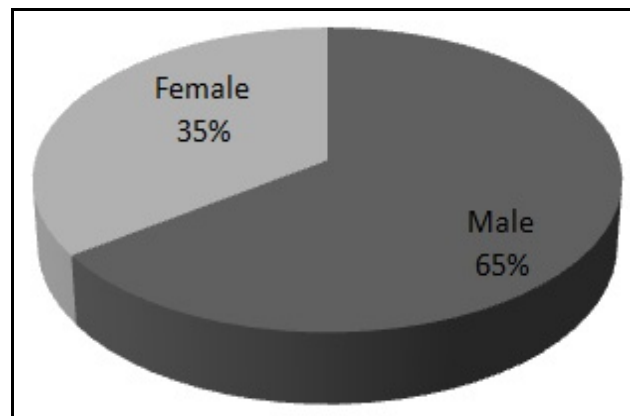


Figure 6. Sex Distribution of Patients



Figure 4. CT Scan showing Double Septum (One Complete and One Incomplete)

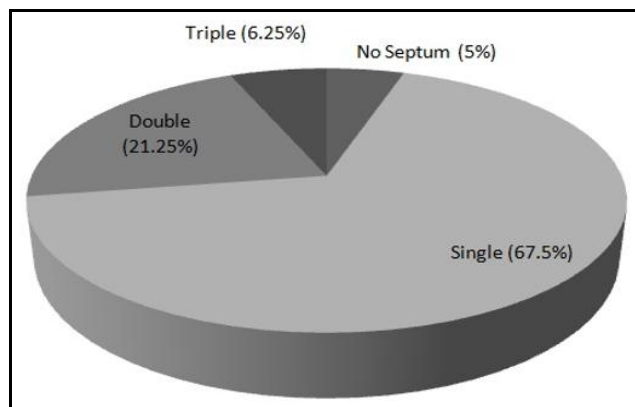


Figure 7. Pie Chart showing Various Findings in the Number of Septum

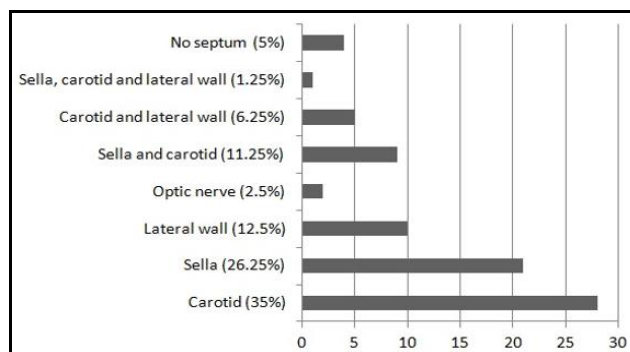


Figure 8. Bar Diagram showing Differences in the Variations in the Attachment of the Septum

DISCUSSION

The detailed knowledge of anatomical variations of sphenoid sinus septum as well as its relationship with the surrounding structures like optic nerve, internal carotid artery, cavernous sinus and pituitary gland using computed tomography is paramount for endoscopic sinus surgery and endoscopic skull base surgery including trans-sphenoidal approach or parasellar area. It shortens the operation time, reduces the number of complications^[10,11] as well as help in understanding the possible spread of any tumour or any inflammatory process in the sphenoid sinus and surrounding structures.^[10] Higher number of anatomical variations of sphenoid sinus septum can lead to increased risk in terms of injury to important neurovascular and glandular structures. Here, we discuss the anatomical variation of sphenoidal sinus septum and its attachments to the projection of the internal carotid artery, optic nerve projection, sella turcica or directly to the lateral wall of the sphenoid sinus.

Usually, there is one intersphenoid septum which separates cavity of sphenoid sinus into two compartments. A study by Banna et al reported single septum (complete or incomplete) in 61% in [7]; 71% of cases in the study by Hamid et al,^[8] whereas in the study by Idowu et al showed 95% of the cases having main single septum in the sphenoid sinus. We found single (complete or incomplete) in 67.5% of cases and in our study incidence of single septum is comparable to other study. Our study indicates that septa were mostly in paramedian position and more towards left side, but the study by Idowu et al^[12] shows the septum is towards right side in most cases. Sareen et al^[13] cited the existence of multiple septa in 80% of cases, Idowu et al^[12] in 48.3% and a higher percentage (95%) of multiple septa are registries in the study of Jaworeka et al^[14] and 81.8% by Abdullah et al,^[9] while Hamid et al^[8] and Riza Dindar et al^[15] cited the existence of 8.7% and 7.1% multiple septations respectively, whereas in our study we have found 21.25% of cases having double septa in the sphenoid sinus and triple septa of sphenoid is seen in 5% cases.

Chmielik et al^[16] in their study in children with an average age of 10.9 years, cited the existence of the main septum in all cases. In similar studies conducted by Banna et al^[7] and Hamid et al^[8] found absent sphenoid septa in 11.4% and 10.8% cases respectively. Idowu et al^[12] found lack of septum in only one case of a total of 60 analysed patients. In our study, we observed 5% of cases had no septum in sphenoid sinus.

It was stated by Idowu et al^[12] that multiple accessory septa appear more frequently to the right of the main septum, both in men and women. They found that in men, 35 accessory septa were located to the right and 19 to the left side, while in women 18 to the right and 12 to the left of the main septum. But regardless of the existence of different percentages of multiple septa, all authors^[17,18,19,20] agree that it is the insertion of these septa to walls of sphenoid sinus is crucial for trans-sphenoidal surgery. Bademci and Ünal^[4] evidenced septal insertion to carotid canal in 25.5% cases; Abdullah cites their presence in 12.9% cases and Hamid in 6.75% cases. We found insertion of main or accessory septa to carotid canal in 28 cases, which makes 35% of patients; 2 cases (2.5%) to optic nerve projection; 21 cases (26.25%) to sella turcica and carotid(s) in case of 9 patients (11.25%); carotid(s) and lateral wall(s) in 5 patients (6.25%) and only

in 1 case to sella, carotid and lateral wall. Our study has the highest frequency where the septa gets attached to the carotid showing the risk of injury to the internal carotid artery during surgery.

Knowledge obtained from the previously available literature and from the results of our current study together insists that the sphenoidal main septum cannot be taken as a reliable landmark for endoscopic procedures. Its position, as we came to know from our study, is not always in the midline, but shifted to either right or to left side at least in parts of its entire length from anterior to posterior end. Also the frequency of insertion of the main and/or accessory sphenoid septa to the optic canal and the carotid canal varies significantly. Preoperative CT study of the PNS is necessary to avoid injury to the related structures.

CONCLUSION

In our data, sphenoid sinus has a lot of anatomical variations in terms of number and attachment to the related structures. So we must have the exact preoperative knowledge about the variations in the anatomy of the sphenoid septa for safe and successful surgery of sphenoid sinus and parasellar region. Hence, preoperative knowledge of anatomical variation of sphenoidal sinus septa by CT of paranasal sinuses is necessary to avoid intraoperative difficulties and complications.

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