ORIGINAL ARTICLE

Assessment of Variation in Sphenoid Sinus Pneumatisation in Indian Population

Lokesh C[1], Dharan Venkatesh K. A[1], Krishna Kumar M[1] and Senthilnathan V[1]
[1]Department of Radiodiagnosis
[1]Trichy SRM Medical College Hospital and Research Centre, Trichy-621105, Tamil Nadu, India

Abstract:

Back ground: The purpose of the study is to assess the prevalence of variation in extent of sphenoidal sinus pneumatization in south Indian population and compare with existing literature. *Material and Methods:* Retrospective study which included 250 patients who underwent CT scan of paranasal sinuses. Results:In our study presellar type of sphenoid pneumatization was observed in 2.4 % of cases. Sella type of pneumatization included 97% study population in our study which is much higher than figures from south- western Asia. Higher frequency of clival extension type of pneumatization was seen in our study which increases the suitability of trans-nasal surgical route for accessing surgical pathologies involving the posterior cranial fossa. Lateral sphenoidal extension was recorded in 50.4% of cases in our study which is near to the frequency mentioned by authors in south India. Existence of higher prevalence of sellar type of pneumatization in sphenoid along with dorsal and lateral extensions in south Indian population gives more advantage of targeting lesions in posterior and middle cranial fossa by endoscopic trans-nasal and trans-sphenoidal route. *Conclusion:* Extension of sphenoidal sinus pneumatization provides expanded operative corridor and also place the sinus in close relation to the targeted structures. Higher frequency of prevalence in our study makes south Indian population more suitable for transsphenoidal endoscopic surgeries.

Keywords:

Anatomical variation, sphenoidal sinus, CT, Pneumatisation, Sphenoidal sinus transnasal endoscopic surgery

Introduction:

The knowledge of anatomy and variation of sphenoidal sinus is necessary requisite for understanding the pathological process in radiology. Sphenoid sinus is a non- pneumatized bone which contains only red marrow at birth. Sphenoid pneumatization occurs in two stages; first from birth to four years and second between 8 to 12 years[1]. The sphenoid sinus shows signs of pneumatization as early as nine months of age. Sphenoid sinus pneumatization shows slow development (i.e) it reaches back of Sellaturcica by seven years and attains adult volume by 12 to 15 years[2-3]. The sphenoid sinus is most inconsistent and least accessible paranasal sinus with variation in sphenoidal sinus pneumatization[3]. The pneumatization may extend into greater wing of sphenoid, pterygoid process, clivus and sometimes into anterior clinoid process[4][5].

Pathologies affecting the sellar and parasellar regions and extended approach of transnasal endoscopic procedures to lesions affecting the floor of the middle cranial fossa, petrous apex and pituitary lesion[6][7]. The knowledge of these variants allows us to highlight their presence to the surgeon and aid in optimal patient selection, intraoperative guidance, predicting the complications of intracranial lesions, and minimize the iatrogenic complications in surgical practice.

Material and Methods:

Computed tomography study of nasal sinuses was reevaluated retrospectively. A total of 250 CT scans (200 slides) of paranasal sinuses were investigated. The age range was taken between 18 and 69 years. Among them 125 were male and 125 were female. Patient less than 18 years and extremes of age were excluded. Patients were scanned on Siemens Somatom GO ALL 64 slice CT scan machine. Data was acquired on saggital, axial and coronal planes. Coronal CT scans are best for analysing lateral extension and lesser wing of sphenoid extension. Saggital CT scans are used for analyzing clival extension. Based on the images acquired by CT, following variables were assessed: Type of pneumatization of sphenoidal sinus, type of clival, lateral, lesser wing and anterior recess extension of sphenoidal sinus[8][9].The sphenoidal sinus was classified into conchal, presellar and sellar (incomplete and complete) types based on the relation to anterior and posterior walls of sellaturcica on the saggital plane [Figures 1 and 2]. The extent of pneumatization into the clivus was classified into subdorsal, dorsal, occipital and combined(dorsal + occipital) types based on relation to posterior wall, floor of sella and vidian canal [Figure 1,2,3,4]. The lateral extension of pneumatization was classified into greater wing of sphenoid bone, pterygoid and full lateral (greater wing + pterygoid extension) based on line connecting the medial aspects of foramen rotundum and vidian canal (VR line). The lesser wing extension was said to be present when there is extension into optic strut, lesser wing or anterior clinoid process. Statistical analysis of all data sets was performed with SPSS version 2.

Figure 1: Complete sellar and Occipital type of pneumatization

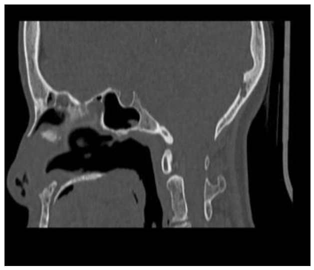

Figure 2: Incomplete sellar and subdorsal type of pneumatization

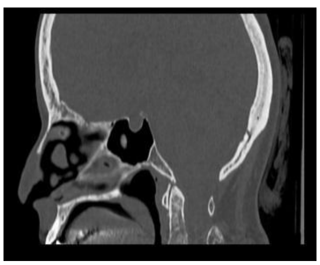

Figure 3: Complete sellar, dorsal type of pneumatization

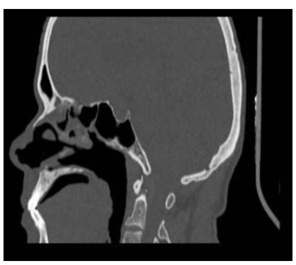

Figure 4: Complete seller, combined

Figure 5: Extension of pneumatization into left greater wing of sphenoid bone

Figure 6: Extension of pneumatization into left pterygoid inferior to vidian canal into pterygoid process

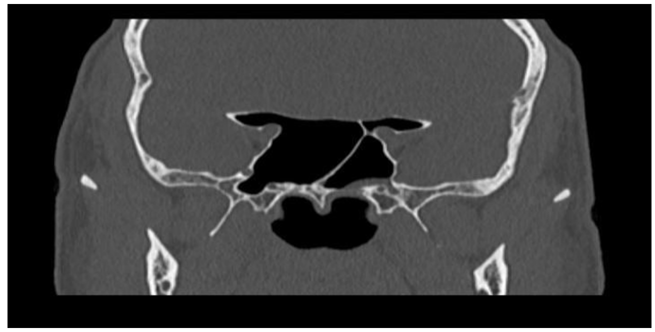

Figure 7: Extension of pneumatization into full lateral (pterygoid + greater wing) on right with bilateral anterior clinoid process pneumatization

Results:

A total of 250 patients were assessed with CT whose ages were from 12 years to 60 years. The study population comprised of 50 % males (125) and 50 % (125) females. There was no significant statistical difference in prevalence of pneumatization patterns in males and females. There were no patients with conchal type, 2.4 %[4]of patients with presellar type, 52% (130) of patients with sellar (incomplete type) and 45.6%(114) of patients with sellar (complete type)[Table 1].

Table 1: Prevalence of types of sphenoidal sinus pneumatization

Types	Individuals	Percentage
Conchal	0	0
Presellar	6	2.4%
Sellar(Complete)	130	52%
Sellar(Incomplete)	114	45.6%

Table 2: Clival extension

Pneumatization extension	Number of sinuses	Percentage
Subdorsal	197	76.4%
Dorsal	36	14.4%
Occipital	15	6%
Combined (Dorsal + Occipital).	8	3.2%

Out of the 250 sinuses, 76.4% (197) of patients with subdorsal type, 14.4%(36) of patients with dorsal type, 6%(15) of patients with occipital type, 3.2%(8) of patients with combined(dorsal + occipital) type[Table 2,3].

Table 3: Extent of sphenoid sinus pneumatization in CT

Sr no	Pneumatization extension	Number of sides	Percentage
1	Clival extension (patients)	114	45.6%
2	Lateral extension (sides)	126	50.4%
3	Anterior clinoid /optic strut (sides)	109	43.6%

The sinus with lesser wing pneumatization had extension into anterior clinoid process. The lesser wing type of pneumatizaton was found in 109(43.6%) of sinuses examined on imaging [Table 3].

Table 4: Lateral extension

Pneumatization extension	Number of sinuses	Percentage
Pterygoid	43	8.6%
Lateral wing	16	3.2%
Full lateral	67	13.4%

Table 5: Side of extension

Types of extension	Side of extension	Frequency	Percentage
Pterygoid	Right	17	6.8%
	Left	26	10.4%
	Bilateral	2	0.8%
	Total	43	8.6%
Lesser wing	Right	53	21.2%
	Left	56	22.4%
	Bilateral	31	12.4%
	Total	109	21.8%
Greater wing	Right	8	3.2%
	Left	8	3.2%
	Bilateral	0	0
	Total	16	3.2%

The lateral extension was found in 126 (25.2%) of the 500 sinus walls evaluated on CT. Among the 500 sinuses with a lateral extension, the full lateral extension was the most common type, seen in 67 (13.4%), followed by pterygoid seen in 43 (8.6%), lateral wing of sphenoid being the least common 16 (3.2%) [Table 4,5].

Discussion:

The classification of sphenoidal sinus into conchal, presellar , sellar by Hammer and Radberg [10] was a widely accepted classification as it predicts the surgical corridor used in transsphenoidal surgeries. The subdivision of sellar type into incomplete type and complete types based on extension of pneumatization beyond the posterior wall of the sella was given by guldner et al [11]. The system focuses on the posterior extent of pneumatization and the ease of accessibility of the sellar floor during endoscopic surgeries. Newer development in transsphenoidal sinus surgeries and its utility in accessing the lesions involving the middle cranial fossa, retroclival region and foramen magnum portrays the importance of study of pneumatization patterns of sphenoidal sinus.

Wang et al[9] expanded the classification based on the anatomical and imaging studies to include the lateral and anterior extension to access the possible sites in extended transsphenoidal sinus surgery.

Among the published studies from the Caucasian and East Asian populations, the overall prevalence of conchal type was 1 to 2%[12][13][14][15][8].However, there were no patients with a conchal type of pneumatization in our study. In our study presellar type of sphenoid pneumatization was observed in 2.4 % of cases. It is less common when compared to prevalence of 12.6%, 16%, and 18% reported by Elkam, Sevine and Baldea respectively. Sella type of pneumatization included 97% study population in our study which is much higher than figures from south-western Asia. Higher frequency of clival extension type of pneumatization was seen in our study which increases the suitability of trans-nasal surgical route for accessing surgical pathologies involving the posterior cranial fossa. Lateral sphenoidal extension was recorded in 50.4% of cases in our study which is near to the frequency mentioned by authors in south India. Prevalence of lateral pneumatization was low in study Egyptian investigators (21%). Existence of higher prevalence of sellar type of pneumatization in sphenoid along with dorsal and lateral extensions in south Indian population gives more advantage of targeting lesions in posterior and middle cranial fossa by endoscopic trans-nasal and trans-sphenoidal route.

Arrested and under pneumatization of sphenoidal sinus is common in sickle cell disease and cystic fibrosis than in general population. The presence of such variants will highlight the likely etiology in appropriate clinical setting[16][17]. Non pneumatized and concha pneumatization are less favorable for transsphenoidal approach to sellar and parasellar lesions. These subtypes require drilling and removal of thick cancellous bone resulting in increased operative time.

However access to sella is safe with the availability of intraoperative navigation after confirmation of surgical landmark in these subtypes[18].

The hyper pneumatization of sphenoidal sinus allows extended approach of transsphenoidal surgeries, however increases the likelihood of collision between operative instrument and chances of iatrogenic injuries. The anterior extension of aeration into planumsphenoidale and posterior extension of aeration into clivus, dorsum sellae results in inadvertent damage to bony wall of sphenoid sinus resulting in cerebrospinal fluid leaks[12]. The bony dehiscence and protrusion of adjacent neurovascular structures into the sphenoid sinus increase in proportion to the pneumatization[11][19]. Extension of pneumatization into the lesser wing leads to protrusion and thinning of bony wall of the optic nerve and internal carotid artery, thereby increasing the susceptibility to injury during endoscopicsurgeries [11]. Special mention is needed in extension into clinoid process in presurgical evaluation of sellar - suprasellar masses and preclinoid aneurysm to avoid postsurgical CSF leaks[20]. Maxillary nerve, vidian nerve and carotid artery are susceptible to iatrogenic injury in lateral extension into pterygoid process and greater wing of sphenoid bone[21][22]. Individuals can present with vidian and maxillary neuralgia as a complication of inflammatory sinus disease. Extensive pneumatization of sphenoid sinus and lateral recess and extension of sellar and parasellar lesions into sphenoidal sinus increases the susceptibility to bony erosions and spontaneous CSF leaks in idiopathic intracranial hypertension [23] [24]

Conclusion:

It is mandatory for preoperative assessment of variations in sphenoid sinus in trans-nasal transsphenoidalendoscopic surgeries for pathologies relating to skull base. Extension of sphenoidal sinus pneumatization provides expanded operative corridor and also place the sinus in close relation to the targeted structures. Higher frequency of prevalence in our study makes south Indian population more suitable for transsphenoidal endoscopic surgeries.

Source of support: Nil
Conflicts of interest: Nil

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Address for correspondence:
Dr. K.A Dharan Venkatesh,
Associate Professor of Radiodiagnosis,
Trichy SRM Medical College Hospital and Research Centre, Trichy-621105,Tamil Nadu, India.
Mobile no: +91 9944369232
Email: dr.dharanvenkat@gmail.com

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