

Assessment of Variations in Sphenoid Sinus Pneumatization in South Indian Population

<https://doi.org/10.47210/bjohns.2021.v29i3.489>

Amardeep Singh,¹ Manjunath Kameshwarachar,² Harbans Singh³

ABSTRACT

Introduction

Morphometric study of sphenoid sinus shows various degrees of pneumatization. Knowledge of such variability is extremely important to guide the surgeon in predicting what type of surgical approach will be safer for the pathologies involving skull base region. Considering recent advances in trans-nasal trans-sphenoidal endoscopic interventions and improved visualization, it has become imperative to become familiar with the anatomical variations which are likely to be encountered during surgical procedures.

Materials And Methods

A retrospective study was conducted on the basis of CT scan records of 120 patients to evaluate variability in pneumatization of sphenoid bone and its extensions in South Indian population.

Result

The study revealed the prevalence of conchal, pre-sellar, incomplete sellar and complete sellar types of sphenoid pneumatization in 02%, 08%, 28% and 62% cases respectively. Posterior or clival extension was the commonest type seen in 80% cases which included sub-dorsal (50%), dorsal(15%) and occipital(15%) types of clival variants. In lateral extensions, pterygoid sub-type was observed in 37% of patients whereas lesser wing, greater wing and full lateral sub-types were present in 20%, 14% and 09% cases respectively. Various combinations of lateral sub-types were seen in 15% of study population.

Conclusion

In our study higher percentage of pneumatization of sphenoid sinus and its extensions was observed when compared to Egyptian and Chinese populations. High prevalence in South Indian population also provides an additional armament in the hands of surgeon to reach the otherwise unreachable lesions involving middle and posterior cranial fossae through trans-sphenoidal approach.

Keywords

Sphenoid Sinus; Pneumatization; Anatomical Variations; South Indian Ancestry Group

Sphenoid sinus is deeply located, most inconsistent and poorly accessible of all paranasal sinuses.¹ Development of sphenoid sinus is usually asymmetrical with unequal pneumatization and variable deviation of inter-sinus septum.² Anatomically sphenoid sinus and its variations have major impact on the surgical approaches involving skull base surgery.^{3,4} Wide range of normal variations in size, shape and septum of this sinus have been described in literature.⁵ These morphological variabilities may disturb the inter-relationship of vital structures located in close vicinity of sphenoid sinus like pituitary gland, internal carotid artery, optic nerve, third,

fourth, sixth and divisions of fifth cranial nerves.^{2,4} It has been observed that pneumatization pattern of sphenoid sinus shows variations in different groups of people which

1 - Department of Head and Neck Oncology, Gujrat Cancer and Research Institute, Ahmedabad, Gujarat

2 - Department of Otorhinolaryngology, Basaveshwara Medical College and Hospital, Chitradurga, Karnataka

3 - Department of Anatomy, Institute of Dental Sciences, Sehora, Jammu, Jammu and Kashmir

Corresponding author:

Dr Amardeep Singh

email: amardeepsingh2018@gmail.com

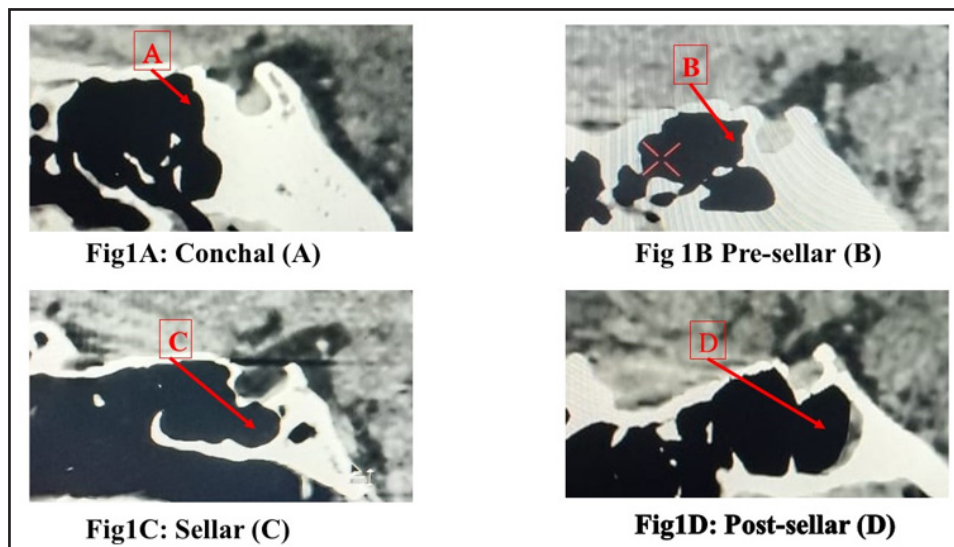


Fig.1 (A-D). Types of sphenoid sinuses

reflects the influences of ethnicity on its prevalence.¹ Knowledge about frequency of these regional variations along with their implications helps the surgeon in patient selection, intra-operative guidance and prediction of complications in transsphenoidal intracranial surgeries in order to minimize iatrogenic complications.^{1,6} Present study has been conducted in South Indian population to evaluate the prevalence of sphenoid sinus variations with emphasis on the awareness of such variants during related surgical procedures.

Materials and Methods

A retrospective study was conducted on the basis of CT scans of 120 patients covering a period from January 2019 to September 2019 in the Department of Otorhinolaryngology, Basaveshwara Medical College, and Hospital Chitradurga, Karnataka (South India). Prior to the study, approval from Institutional Ethical Committee was obtained. Patients undertaken for study were aged between 16 to 78 years which included 72 males and 48 females. Subjects having history of craniofacial trauma, previous surgeries leading to change in normal anatomy of sphenoid sinus and patients having lesions obscuring any component of sphenoid sinus were excluded from this study. Data on the types of pneumatization of sphenoid sinus as seen in sagittal and coronal plane was recorded. Criteria adapted by

Hiremath et al¹ was applied for classifying these types.

Types of Sphenoid sinus (Fig:1A-D):

1. Conchal type: Pneumatization more than 10 mm anterior to the anterior wall of sella.
2. Presellar type: Posterior wall of pneumatization is just anterior to anterior wall.
3. Incomplete sellar: Posterior margin of sinus is below sella but just anterior to the level of posterior wall of sella.
4. Complete sellar: Posterior margin of pneumatization extends posterior to posterior wall of Sella.

Types of Posterior or Clival extensions of sphenoid sinus (Fig:2A-B):

1. Subdorsal: Pneumatization remaining below the level of inferior margin of sella.
2. Dorsal: Pneumatization extending into dorsum sellae.
3. Occipital: Pneumatization extending into occipital bone.
4. Combined: Dorsal plus occipital.

Types of Lateral extensions of sphenoid sinus (Fig:2C)

1. Greater wing.
2. Lesser wing.
3. Pterygoid processes of sphenoid sinus.

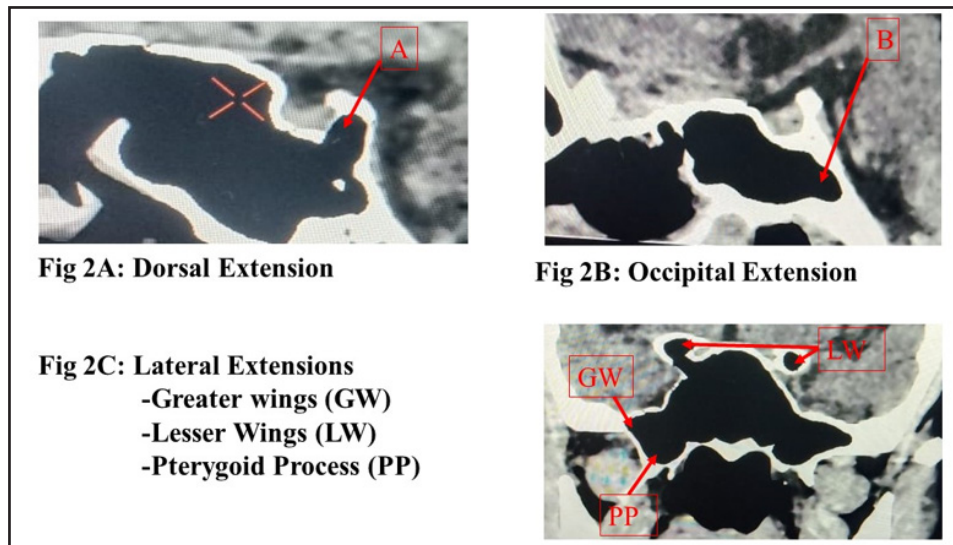


Fig. 2(A-C). Extensions of sphenoid sinuses

Data so obtained was tabulated in the form of frequency and percentage to determine the prevalence of variations in sphenoid sinus pneumatization in this part of India. For calculation of percentage, total number of patients in study population have been taken into account.

Results

Distribution of cases shows high frequency of patients (50%) in the age group between 21-40 years with gender distribution of 31% males and 19% females followed by the age group of 41-60 years which included 28% of subjects (18% males and 10% females). There were 15% patients (07% males and 08% females) in under 20 years group and 07% cases (04% males and 03% females)

in group above 60 years (Table I). Majority of subjects (90%) had sellar type of sphenoid pneumatization, out of which 28% were of incomplete and 62% of complete sellar type pneumatization. Second frequent type was pre-sellar type observed in 8% cases. Conchal type of sphenoid pneumatization was present in 2% cases only (Table II). Posterior or clival extensions included highest number of cases in subdorsal group (50%) followed by dorsal and occipital types with figures of 15% in each group. Occipital plus dorsal type was not detected in this cohort (Table III).

In lateral extensions, pterygoid type was found in 37% cases out of which 18% were bilaterally located whereas 13% and 06% were on left and right sides respectively. Lesser wing pneumatization was present in 20% persons with predominance on left side (8%)

Table I: Age and gender distribution of patients

AGE (YEARS)	FREQUENCY(N)			PERCENTAGE(%)		
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
<20	08	10	18	07	08	15
21-40	37	22	59	31	19	50
41-60	22	12	34	18	10	28
>60	05	04	09	04	03	07
Total	72	48	120	60	40	100

Table II: Types of sphenoid bone pneumatization

TYPE OF PNEUMATIZATION	FREQUENCY(N=120)	PERCENTAGE(%)
Conchal	02	02
Pre-sellar	10	08
Incomplete Sellar	34	28
Complete Sellar	74	62
Total	120	100

Table III: Types of posterior (clival) sphenoid sinus extensions

TYPE OF EXTENSION	FREQUENCY(N=120)	PERCENTAGE(%)
Subdorsal	60	50
Dorsal	18	15
Occipital	18	15
Occipital+dorsal	00	00

Table IV: Types of lateral sphenoid sinus extensions

TYPE OF EXTENSION	SIDE OF EXTENSION	FREQUENCY(N=120)	PERCENTAGE(%)
Pterygoid	Right	07	06
	Left	15	13
	Bilateral	22	18
	Total	44	37
Lesser wing	Right	07	06
	Left	09	08
	Bilateral	07	06
	Total	23	20
Greater wing	Right	05	04
	Left	05	04
	Bilateral	07	06
	Total	17	14
Full lateral	Right	01	01
	Left	02	02
	Bilateral	07	06
	Total	10	09

Table V: Types of combined lateral extensions

TYPE OF COMBINED EXTENSION	FREQUENCY (N=120)	PERCENTAGE (%)
Pterygoid+Greater+Lesser wings	05	05
Pterygoid+Lesser wing	04	04
Pterygoid+Greater wing	03	03
Greater wing+Lesser wing	03	03
Total	15	15

followed by 6% each in right and bilateral variety. Greater wing extension was present in 14% cases, 6% of these were bilateral whereas right and left showed occurrence of 4% each. Full lateral extension group included 9% subjects with 6% bilateral, 2% left and 1% right presentation (Table IV). Combined lateral extensions were recorded in 15% cases only. Pterygoid, greater and lesser wing combinations were present in 5% cases, majority of these had bilateral representation. Pterygoid plus lesser wing group, mostly bilateral was present in 4% of the study population. Pterygoid-Greater wing and Greater-lesser wing combinations included 3% in each section (Table V).

Discussion

Trans-nasal trans-sphenoidal approach has become a standard approach in procedures for pathologies involving sellar, para-sellar and adjoining skull base regions. This route provides natural operative corridor for minimally invasive surgeries with excellent visualization of structures around sella turcica thereby decreasing the risk of morbidity and mortality.⁷ Due to new developments in trans-sphenoidal techniques, it has become imperative to evaluate various patterns of sphenoid sinus and its extensions to access the pathologies involving middle cranial fossa and the region behind clivus up to foramen magnum I. Correlation of preoperative findings of radio-imaging with intra-operative anatomical observations provides booster to the safety in trans-nasal trans-sphenoidal procedures.⁸

In our study, conchal type pneumatization was observed in 2% cases which collaborates with the overall prevalence of 0-2% mentioned by most of the authors.^{1,5,6,7} However higher figures of 08%-14% have

been observed in Romanian population.^{2,9} In current study, pre-sellar type of sphenoid pneumatization was observed in 8% of cases. It is less common when compared to prevalence of 12.6%, 16% and 18% reported by Elkam,⁵ Sevine⁶ and Baldea² respectively. Sellar group included 90% of the study population in our case which is much higher than the figures from South-Western Asia.^{5,6} Prevalence relating to sellar type pneumatization in our study in South Indian population nearly collaborates with the previous study conducted in Kerala¹, another state of South India (90% and 98.8% respectively). From these observations, it can be reasonably inferred that ethnic lineage does play a role in sphenoid pneumatization as mentioned in literature.

In present study, posterior or clival extensions of sphenoid sinus were observed in 80% cases with prevalence of 50% in sub-dorsal group and 15% each in dorsal and occipital group whereas none of the study population had dorsal plus occipital type of extension. This prevalence is significantly higher when compared to 21.6% occurrence in Chinese population.¹⁰ Higher frequency of clival extension as seen in present study, increases the suitability of trans-nasal surgical route for accessing pathologies involving posterior cranial fossae. Lateral sphenoid extensions were recorded in 66% of cases in our study which approximates the frequency of 59.7% mentioned by authors in southern India¹. Lower prevalence of lateral pneumatization has been mentioned by investigators in Egyptians (21%).⁵ Lateral extensions in present cohort, showed higher frequency in pterygoid group (39%), majority of which had bilateral representation (18%). Lesser wing, greater wing and full lateral types were seen in 20%, 14% and 09% cases respectively with bilateral preponderance in latter two subvariants. These show higher occurrences than those

mentioned in other ethnic groups.^{5,10} Existence of high prevalence of sellar type pneumatization in sphenoid along with its dorsal and lateral extensions in South Indian population, makes them more advantageous for targeting lesions in posterior and middle cranial fossae by endoscopic trans-nasal trans-sphenoidal route.

Conclusion

Pre-operative assessment of variations in sphenoid sinus is mandatory in trans-nasal transsphenoidal endoscopic surgeries for pathologies relating to skull base. Pneumatization of sphenoid sinus and its extensions provide expanded operative corridors and also place the sinus in close relation to the target structures. Higher frequency of prevalence in our study makes South Indian population more suitable for trans-sphenoidal endoscopic surgeries with least susceptibility to iatrogenic trauma.

References

- Hiremath SB, Gautam AA, Sheeja K and Benjamin G. Assessment of variations in sphenoid sinus pneumatization in Indian population: A multidetector computed tomography study. *Indian J Radiol Imaging* 2018;28(3):273-9. doi:10.4103/ijri.IJRI_70_18
- BaldeaV, Sandu OE. CT study of the sphenoid sinus pneumatization types. *Romanian Journal Rhinology* 2012; 2(5):17-30
- Wang J, Bidari S, Inoue K, Yang H, Rhoton A Jr. Extensions of sphenoid sinus. *Neurosurgery* 2010; 66(4): 797-816. doi: 10.1227/01.NEU.0000367619.24800.B1
- Kusch AM and Garcia VR. Giant pneumatization of sphenoid sinus: Report of four cases and review of literature. *Rev Med Hered* 2019; 30:45-9. doi: 10.20453/rmh.v30i1.3472
- ELKammash TH, Moans M Enaba, Akram M Awadalla. Variability in sphenoid sinus pneumatization and its impact upon reduction of complications following sellar region surgeries. *Egyptian J Radiol and Nuclear Med.* 2014; 45: 705-14. doi:10.1016/j.ejrmm.2014.04.020
- Sevinc O, Is M, Barut C, Erdogan A. Anatomical variations of sphenoid sinus pneumatization in a sample of Turkish population: MRI study. *Int J Morphol.* 2014; 32(4):1140-3. doi: 10.4067/S0717-95022014000400003
- Hamid O, Fiky LE, Hassan O, Kotb A, Fiky SE. Anatomical variations of the sphenoid sinus and their impact on trans-sphenoid pituitary surgery. *Skull Base* 2008; 18: 9-16. doi: 10.1055/s-2007-992764
- Zada G, Agarwalla PK, Mukundan S J, Dun I, Golby AJ, Laws ER. The neurosurgical anatomy of the sphenoidal sinus and sellar floor in the endoscopic transsphenoidal surgery. *J Neurosurg.* 2011; 114(5):1319-30. doi:10.3171/2010.11.JNS10768
- Craiu C, Sandulescu M, Rusu MC. Variations of sphenoid pneumatization: a CBCT study. *Romanian J Rhinol.* 2015; 5(18): 107-13. doi:10.1515/rjr-2015-0013
- LuY, Pan J, Qi S, Shi J, Zhang X, Wu K. Pneumatization of the sphenoid sinus in Chinese: The differences from Caucasian and its application in the extended transsphenoidal approach. *J Anat.* 2011; 219:132-42. doi:10.1111/j.1469-7580.2011.01380.x.