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OBSERVATIONAL STUDY IN SOUTH INDIAN POPULATION ABOUT THE ANATOMICAL VARIATIONS OF SPHENOID SINUS PNEUMATISATION AND IT'S EXTENSIONS

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Abstract

Background: Sphenoid sinus is always non pneumatised and contains only red marrow at birth. It starts showing signs of pneumatisation as early as nine months of age and attains adult volume by adolescent years of age. It is the most uncertain and least accessible paranasal sinus. Awareness of these uncertain variations helps in minimizing the iatrogenic complications in surgical practise **Objective:** In this study, we assessed the prevalence of variations in sphenoid pneumatization in the South Indian population and studied the extensions of sphenoid sinus pneumatization subtypes using computed tomography. **Methods:** This is the observational study for 6 months including 76 patients who underwent CT of the paranasal sinuses. The axial CT was performed. Continuous axial sections were obtained parallel to the orbitomeatal line. Multiplanar reformations of paranasal sinus were assessed for the type of pneumatization and type of clival, lateral recess, lesser wing and anterior recess extensions. **Results:** The complete sellar, incomplete sellar, presellar and conchal types comprised 63.1%, 26.3%, 7.89% and 2.6% of patients. The extensions of pneumatization subtypes in the study population were clival in 74% subjects, lateral recess in 48%, lesser wing in 18% and anterior recess in 14% sinuses. The pure forms was seen in 30% and combined forms in 60% of sinuses. The sphenoid sinuses were extensively pneumatised, pure forms were relatively infrequent and combined forms being more frequent. **Conclusion:** Understanding the wide range of variability in sphenoid sinus pneumatization helps surgeons choose the best patients, provide intraoperative guidance, and anticipate intracranial lesion complications during transsphenoidal surgical procedures. Our study of sphenoid sinus has benefits for sellar and central skull base lesions as far as for both clinical and surgical implication.

Keywords: Sphenoid sinus, Computed tomography, variations, subtype

Introduction

Among the paranasal sinuses, sphenoid sinuses are the most inconsistent and least accessible sinuses. These sinuses are the air cavity within the body of the sphenoid bone which is located in the center of skull base. Sphenoid sinus lies anterior to the clivus, and posterior to the superior meatus of the nasal cavity. Superiorly it is related to pituitary fossa and the optic

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chiasm and inferiorly to the nasopharynx. Pneumatization of the sphenoid sinus can vary in a certain extent, occasionally extending into the pterygoid canal, anterior clinoid processes, greater wings of sphenoid sinus, clivus and other bones like the occipital, palatine and vomer bones. It can also extend laterally between the maxillary nerve and pterygoid canal nerve.[2] Understanding the wide range of variability in sphenoid sinus pneumatization helps surgeons choose the best patients, provide intraoperative guidance, and anticipate intracranial lesion complications during transsphenoidal surgical procedures.[3] Our study aims in reducing the risks due to high variability of pneumatization to surgeons in treating and operating diverse sellar and parasellar pathologies. The various pattern of pneumatization as it would not only determine the extent of surgery but also the type of approach to the sphenoid sinus, be it the transseptal, transantral, transethmoidal, transpalatal, or the endonasal endoscopic approach.[1]

Methodology

Aim: To assess the prevalence of variations in sphenoid pneumatization in the South Indian population and to study the extensions of sphenoid sinus pneumatization subtypes

Study Design: Observational study.

Study Site: The study was conducted in Department of ENT (Ear- Nose-Throat) of a tertiary care hospital.

Inclusion Criteria: Patients between the age group of 18 - 60 years who had complaints of nasal obstruction, breathing difficulty and headache

Exclusion Criteria: Patients with history of acute trauma, mass in nasal cavity, previous nose surgery or any surgery affecting the normal anatomy were all excluded from the study.

Ethical considerations: The study was initiated after obtaining approval taken from the institutional ethics committee and department of ENT. A written informed consent was taken from all the patients.

Method: The subjects who presented to the ENT outpatient clinic with nasal complaints went through a detailed ENT examination. Patients were selected for the study if they fulfill the inclusion and exclusion criteria. A written consent was obtained from every patient. The axial CT was performed with 0.5 to 1mm slice thickness. Parallel to orbitomeatal line, continuous axial sections were obtained. Multiplanar reformations of paranasal sinuses were assessed for the type of pneumatization of the sphenoid sinus from the radiologists.

Classification of types of Sphenoid sinus Pneumatization:

Based on the relation to anterior and posterior walls of sella turcica on the sagittal plane sphenoid sinus pneumatization was divided into conchal, presellar, complete sellar and incomplete sellar types. [Fig1,2,3,4]. Clivus extension was classified based on relation to the posterior wall, the floor of sella and vidian canal into subdorsal, dorsal,occipital and combined (dorsal+ occipital). The line joining the medial aspects of foramen rotundum and vidian canal was used to classify lateral extension of sphenoid sinus into the greater wing of the sphenoid, pterygoid and full lateral(greater wing +pterygoid). Lesser wing extension and anterior extension beyond the plane of the sphenoidal crest is also present.[3] In order to access potential locations for extended transphenoidal sinus surgery Wang updated the classification system based on anatomical and imaging studies to include the lateral and anterior extension.[9]

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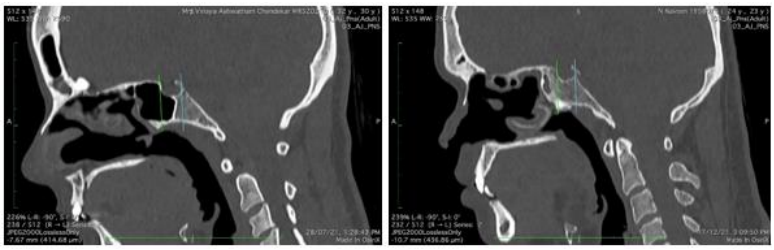

Figure 1: Incomplete sellar; Figure 2: Conchal type

Figure 3: Complete sellar; Figure 4: Presellar type

Sample size:

On the basis of the study conducted by Shivakumar Hiremat (3) assuming P =22.2% with 95% Conference interval, 10% allowable era (L). Sample size estimated is 69 for assuming 10% non response rate. Final sample size estimated is 76

Sampling technique: Convenient sampling

$$\text{Sample size} = \frac{(Z\,\underline{\alpha})^{2}_{1-2}\ \text{X P (1-p)}}{\text{L}}$$

Results

Our study included 76 patients who underwent Computed tomography of paranasal sinuses. With the above-mentioned method, types of pneumatization was assessed. The complete sellar type was the most common type seen in 48 patients (63.1%) in our study. Incomplete sellar in 20 patients (26.3%), presellar in 6 patients (7.89%) and conchal types seen in 2 patients (2.6%). The most common extensions of pneumatization subtypes in the study population was clival in 74% patients (subdorsal type being the most common). The next common subtype seen was lateral recess in 48% with pterygoid extension being the most common. The other subtypes were lesser wing in 18% and anterior recess in 14% sinuses respectively. The pure forms (Fig 5) in 30% and combined forms (Fig 6) in 60% of sinuses. The sphenoid sinuses were extensively pneumatised. The clival type which is usually rare was seen in 2 patients in our study in the pure form. The other pure forms seen were lesser wing, lateral, anterior recess extensions. Combined forms were the most commonly seen.

Table 1

TYPES	NUMBER OF INDIVIDUALS	PERCENTAGE
Conchal	2	2.6%
Presellar	6	7.89%
Incomplete Sellar	20	26.3%
Complete Sellar	48	63.1%

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

Table 2

Pneumatization Extension	Number of Sides	Percentage
Clival extension	56	74%
Lateral extension	36	48%
Lesser wing extension	14	18%
Anterior recess	10	14%

Figure 5: Pure form; **Figure 6:Combined form(lateral+clival+Complete)**

Discussion

Based on the previous article the conchal type was only 1-2%, we are glad that we got approximately 2% in our study. Due to extensive pneumatization of sphenoid sinus in South Indian Population there was a statistically significant difference in types of Sphenoid sinus pneumatization with P<0.05. Failure of a surgeon to understand the local variations of the anatomical landmarks of the sphenoid sinus is a potential risk factor to cause damage to the optic nerve or internal carotid artery that lies on the walls of the sphenoid sinus.[1]

The human body's most erratic structures are thought to be the sphenoid sinuses; the assessment of anatomical variants of sphenoid bone and sphenoid sinuses has acquired with time a growing importance in different fields of application of clinical anatomy.The morphology and dimensions of the sphenoid sinus can fluctuate and supplementary septa can further divide the air spaces. In addition, the pneumatisation of sphenoid sinuses may range from absent to extensive, sometimes extending into anterior clinoid processes, pterygoid processes, greater wings, clivus, as well as also into other bones such as vomer, palatine and occipital bone. Therefore, the pneumatic structural analysis in patients is relevant to accurate surgical procedures planning.[2] The paranasal sinuses and mastoid air cells vary considerably in size and shape from person to person. The volumes of paranasal sinuses and mastoid air cells increases with age and women had a lower mean volume.[4] Sphenoid sinuses expand into the sphenoid bone back from posterior ethmoid cells and expand into the pterygoid laminas with the greater wings of the sphenoid bone. As sphenoid sinus expands, carotid artery and optical nerve are reported to form a bulge on the sinus lateral wall in parallel with the amount of expansion. When this expansion continues to anterior clinoid processes, there occurs a risk of injury for the optical nerve during surgery. It is extremely important to have information before surgery on an area which shows so much variation.[6]

The importance of studying the pneumatization patterns of the Sphenoid sinus has increased because of recent advancements in transsphenoidal surgeries procedures and their ability to address lesions affecting the foramen magnum, retroclival region and middle cranial fossa. In addition to enabling more extensive transsphenoidal surgical approaches, the hyperpneumatization of the sphenoid sinus increases the potential of iatrogenic injuries and the likelihood for surgical instrument collisions.[3]

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

In the case of extensive sphenoid sinus pneumatization these neurovascular structures like most likely internal carotid artery and Optic nerve may be dehiscence or protrude into the air cavities, sometimes without any bone separation. In these cases, they may be susceptible to iatrogenic damage with catastrophic consequences. According to the current findings and a review of pertinent literatures, the presence of well pneumatized sphenoid sinus is more likely to have dangerous variations. Surgeons must possess a thorough understanding of the anatomical linkages inside the sphenoid sinus and a thorough evaluation of its qualities in order to perform successful Endoscopic sinus surgeries. CT scans are crucial to preventing a higher risk of interpreting complications.[5]

Anatomic variations in sphenoid pneumatization between Asians and Caucasians have previously been reported.[7]

Our study was unique in that it analysed the anatomic variations in South Indian population Interestingly, it showed an overall higher prevalence of many anatomic variations including pneumatization of sellar type and clinoid extensive pneumatization among South Indians than previously reported. Given the simplicity of surgery and the incidence of complications among these ethnic groups, these findings might have intriguing ramifications. The limitations of this study include the smaller representation. In addition, there are no confirmatory endoscopic correlations with the HRCT scans. However, Shin compared the presence of Onodi cells on CT and then endoscopically and found a good correlation between the two modalities.[8] Though more research is obviously needed in this area, it is evident that CT scans are helpful in identifying anatomical differences and in preoperative planning.

Conclusion

Understanding the wide range of variability in sphenoid sinus pneumatization helps surgeons choose the best patients, provide intraoperative guidance, and anticipate intracranial lesion complications during transsphenoidal surgical procedures. Our study of sphenoid sinus has benefits for sellar and central skull base lesions as far as for both clinical and surgical implications. We would like to conclude that the most common extensions of the sphenoid sinus are complete and incomplete sellar extensions in our study. We analysed a large group of patients have clival and lateral extensions being more common. We hope this study increases the importance of knowing the sphenoid sinus pneumatization and its extensive variations to include in routine radiological reports and hence benefits surgeons.

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ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

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