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ORIGINAL ARTICLE

Assessment of Significance of Anatomical Variations of Sphenoid Sinus on Multidetector Computed Tomography

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Abstract

Background: Majority of the skull base surgeries especially those in midline except those very extensive are usually managed through the endoscopic route in the era of minimally invasive modern medicine. Pre-endoscopic multidetector, computed tomography examination is the standard protocol of imaging. Hence, this study was done to evaluate the variations in sphenoid sinus and to determine its significant for transsphenoidal skull base neurosurgery.

Methods: This prospective, institutional study was conducted on thirty subjects visiting our institution over a period of six months. All subjects were subjected to noncontrast, multidetector computed tomography of the paranasal sinus region on a 128-slice CT scanner for a clinical indication using strict inclusion & exclusion criteria following written consent from the participants. The data was recorded in a predesigned proforma and analyzed statistically using appropriate tools.

Results: Both sexes were well represented in our study with age more than 15years. The average value of pre-sellar width of sphenoid sinus on axial CT scan images was 14.33mm while the maximum width of sphenoid sinus was 22.71mm. The average value of suprasellar depth on sagittal CT scan images was 12.29mm while the average value of pre-sellar depth was 14.53mm. Average value of infra-sellar depth of sphenoid sinus was 24.78mm while average value of pre-sellar height of sphenoid sinus was 21.89mm. The results were statistically significant representing significant person to person variation.

Conclusion: Significant variations occur in sphenoid sinus anatomy which is also related to geographical area. Knowledge of these dimensions play a key role in determining the best endoscopic approach to avoid surgical complications.

Keywords: Sphenoid Sinus, Computed Tomography, Anatomic Variations, Endoscopic, Transsphenoidal

Introduction

Sphenoid bone is a bat-shaped bone with body and two outstretched wings – lesser and greater. A pterygoid (wing-like) process with medial & lateral plates descend from the intersection of body with wings. The sinus cavity within the sphenoid bone is divided into right and left sphenoid sinus by a septum which is rarely in midline producing asymmetry on two sides of midline [1]. Every sinus drains into the sphenoethmoidal opening. The sphenoid sinus is related superiorly to the optic chiasm and on the sides to the cavernous part of internal carotid artery [1,2].

In the modern era of minimal invasive surgery, endoscopic transsphenoidal surgery has become the mainstay for surgical management of skull base lesions especially those in midline. Multidetector computed tomography (MDCT) serves as a roadmap for preoperative planning for skull base surgeries as it provides accurate details of the various dimensions of sphenoid sinus needed for insertion and manipulation of various surgical instruments during the surgical procedure [3,4]. As sphenoid sinus is related to multiple important & critical neurovascular structures at the base of brain, the knowledge of anatomical variations in these dimensions will help minimizing injuries during surgery.

Aims and Objectives

1.) To determine the variations in dimensions of

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sphenoid sinus using multidetector computed tomography.

2.) To examine the significance of the variations in sphenoid sinus.

3.) To develop a database of normal range of dimensions of sphenoid sinus needed for endoscopic surgeries.

Methods

This prospective, institutional study was conducted on *thirty* patients who underwent MDCT scan of paranasal sinus (PNS) region in our department for a clinical indication, over a period of six months.

Inclusion Criteria

- Patients of both sexes above the age of 15years

Exclusion Criteria

- Female patients not fulfilling 10-day rule
- Patients with skull base & facial fractures, neoplastic disease, rhinosinusitis and severe bone rarefaction.

NCCT PNS Protocol

Following the lateral topogram, transaxial spiral scanning was done using Philips Ingenuity Core 128-Slice CT scanner in caudocranial direction from the level of hard palate to the superior most margin of the frontal sinus along the plane of hard palate with slice width of 1.0-1.5mm. Subsequent reconstruction images were obtained in high-resolution, bone algorithm. Multiplanar reconstruction was done to achieve the images in desired plane for various measurement used in the study. Various parameters studied included:

In transaxial images:

- Immediate pre-sellar width (PSW) of sphenoid sinus (Figure 1A)
- Maximum width (MW) of sphenoid sinus (Figure 1A)

In midsagittal image (Figure 2):

- Suprasellar depth (SSD)
- Pre-sellar depth (PSD)
- Infra-sellar depth (ISD)
- Pre-sellar height (PSH)

The data collected was compiled, tabulated and analyzed using appropriate statistical methods and tests.

Results

The patients included in our study had an age range of 16 to 65 years. Fourteen out of 30 (46.6%) patients were males with rest being females.

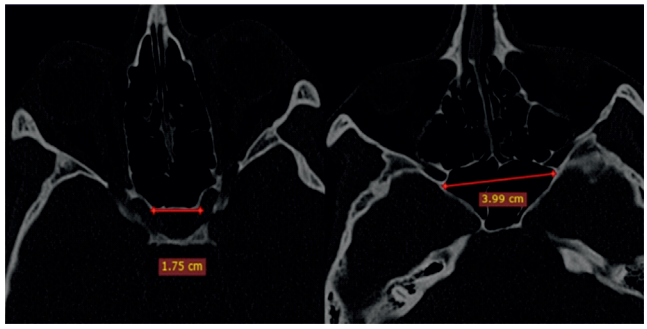

Figure 1: Transaxial CT images (Bone window) through sella (left) showing measurement of presellar width of sphenoid sinus just in front of sella turcica (anterior sellar wall) and sphenoid sinus (right) showing its maximum width

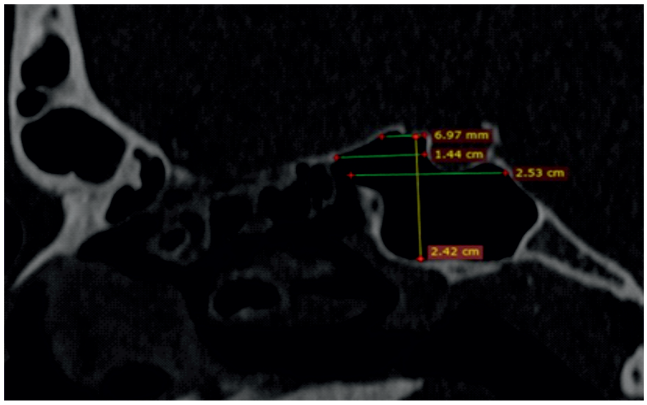

Figure 2: Sagittal CT image (Bone window) through sphenoid sinus showing measurement of suprasellar, presellar & infrasellar depth (horizontal lines from above downwards) and presellar height

Table 1 represents the various measurements obtained in our study. On transaxial CT images, the average value of the pre-sellar width of sphenoid sinus was 14.33 mm (range: 7.5 - 20 mm) while that of maximum width of the sphenoid sinus was 22.71mm (range: 11.5 - 39.9 mm). On the sagittal CT image, the average suprasellar depth was 12.29mm (range: 6.6-17.5 mm), average pre-sellar depth was 14.53 mm (range: 7.9-23.5 mm), average infra-sellar depth was 24.78 mm (range: 6.8-31.9mm) and average pre-sellar height was 21.89 mm (range: 13.1-29.4 mm). The differences in various parameters were significant as determined by one-way ANOVA with p-value of 0.001.

Discussion

In recent era of modern medicine, the endonasal transsphenoidal access is widely used for endoscopic neurosurgery, which is minimally invasive surgery for alleviation of not only clival and pre-sellar tumors but also for sellar and suprasellar tumors. By this approach, the sphenoid sinus and nasal cavity are used to access, the sella turcica, pre-sellar region and the center of the base of skull [5,6]. Along with rostrum, the anterior wall of the sphenoid sinus is resected. Pre-operative computed tomography is mandatory in such patients to know the

Table 1 shows the mean value along with standard deviations, standard error, minimum & maximum values of various parameters

Measurements	No. of Patient	Mean ($\bar{X}$)	Std. Deviation (σ)	Std. Error ($\sigma\bar{x}$)	95% Interval confidence for Mean ($\bar{X}$)		Min.	Max.
					Lower limit	Upper limit		
Pre-sellar width	30	14.33	3.780	0.690	12.92	15.75	7.5	20
Maximum width	30	22.71	5.921	1.081	20.50	24.92	11.5	39.9
Suprasellar depth	30	12.29	2.531	0.462	11.35	13.24	6.6	17.5
Pre-sellar depth	30	14.53	3.206	0.585	13.34	15.73	7.9	23.5
Infra-sellar depth	30	24.78	6.125	1.118	22.49	27.07	6.8	31.9
Pre-sellar height	30	21.89	3.977	0.726	20.43	23.40	13.1	29.4

Table 2: Comparison of dimensions of sphenoid sinus in various studies

Study	PSW (mm)	MW (mm)	SSD (mm)	PSD (mm)	ISD (mm)	PSH (mm)
Our study	14.30	22.70	12.29	14.53	24.78	21.89
Lokwani MS et al.[4]	11.75	30.52	10.78	13.47	25.46	21.27
Wiebracht ND et al.[6]	13.0	35.0	13.0	14.0	26.0	23.0

detailed anatomy of sphenoid sinus and sella for determining the various dimensions needed to select the size of endoscopic instruments, their manipulation within the sinus cavity and fixing various landmarks. The present study, delineate the various dimensions of sphenoid sinus needed by an endoscopic neurosurgeon for assessing the surgical implications are highly variable from person to person.

Table 2 shows the comparison of average values of various parameters obtained in our study with those done quoted from Indian and American studies. From the table, it is evident that in addition to person-to-person variation, the dimensions of sphenoid sinus also vary greatly from population to population. Average pre-sellar width in our study was closer to American population while average maximum width of sphenoid sinus was significantly lower than other Indian as well as American populations. Average suprasellar depth in our study was close to American population while pre-sellar depth was higher than other Indian as well as American populations. Though the average infra-sellar depth in our study was lower than other Indian and American populations but the pre-sellar height was similar to other Indian population.

Conclusion

The sphenoid sinus is a highly variable structure with respect to its various dimensions. The dimension not only vary with the population in different geographical areas but also from person to person. Hence, multidetector computed tomography of sphenoid sinus to detect various dimensions of sphenoid sinus should be an integral part of evaluation of patients prior to any form of endonasal transsphenoidal approach. Preoperative evaluation of sphenoid sinus result in a better outcome due to better surgical approach subsequently lowering complication rates.

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