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COMPUTED TOMOGRAPHIC EVALUATION OF SPHENOID OSTIUM MORPHOMETRY AND ITS CLINICAL IMPLICATIONS FOR ENDOSCOPIC ENDONASAL SURGERY IN A NIGERIAN POPULATION

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Abstract

Background: The sphenoid ostium is a critical landmark for accessing the sphenoid sinus and skull base. Its location and dimensions are crucial for safe endoscopic sinus surgery and transsphenoidal approaches. This study utilized Computed Tomography (CT) to provide morphometric data on the sphenoid ostium in a Nigerian population, addressing a gap in local anatomical knowledge to help minimize complications in skull base surgeries.

Objective: To assess the morphometric characteristics of the sphenoid ostium in a Nigerian population using computed tomography (CT) imaging.

Materials and Method: This retrospective study was done in the Radiology department of Rivers State University Teaching Hospital. CT paranasal sinuses of three hundred adults (≥18 years) were reviewed and measurements taken in axial planes using RadiAnt DICOM Viewer. Morphometric parameters measured included ostium diameter on both sides, distance between right and left ostia and ostium angles. Sex and side differences were analysed using mean ± SD and ANOVA.

Results: Among the 300 CT scans analysed; 164 males (54.7%) and 136 females (45.3%). The mean diameter of the right ostium was significantly larger in males (3.14 ± 0.48 mm) compared to females (2.907 ± 0.44 mm), with a statistically significant difference ($p < 0.05$). The mean left diameter of the sphenoid ostium was significantly bigger in males compared to females (3.30±0.49mm; 3.30±0.49mm; 3.12 ±0.44mm $p < 0.05$). No statistical difference was found in the distance between left and right ostia and also in the ostium angle.

Conclusion: This study provides morphometric data on sphenoid sinus ostia in a Nigerian population, showing sex-specific differences in ostium diameters (males > females) and variability in location relative to the midline. Findings emphasize the need for preoperative imaging and tailored surgical strategies in endoscopic endonasal approaches.

Keywords: *Sphenoid ostium, sphenoid sinus, morphometry, transphenoidal surgery*

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Introduction

The Sphenoid ostium is a major anatomical landmark used in accessing the sphenoid sinus, the natural ostium is the safest place to enter the sphenoid sinus without damaging adjacent structures.[1,2] The sphenoid sinuses are being assessed from various possible routes due to their vastly complicated and varied anatomical structure. Some of the most recognizable variants include their dimensions, pneumatization and hence presence of recesses, as well as relation to the neighbouring neurovascular entities, namely the internal carotid canal.[3] The sphenoid sinus is related to important vascular and neural structures including the internal carotid artery, cavernous sinus, optic nerve, trigeminal nerve, vidian nerve and pituitary gland.[4] Also, the position of the sinus at skull base makes it a suitable route to approach the anterior and middle cranial fossae.[5] So, understanding of the anatomy of the sinus region is essential for ENT and neurosurgeons to avoid major complications during endoscopic sinus surgery (ESS) and skull base surgery. The position of the sphenoid ostium (SO) which may be affected by variability of pneumatization of the sinus and nearby structures is still the safest place and one of the most consistent and principal routes to enter the sphenoid sinus[6]. The sphenoid ostium (SO) provides a natural portal for entering the sphenoid sinus and beyond up to the skull base.[2] A clear-cut image of the osseous structures of the sphenoidal sinus and the sphenoidal ostium can be obtained by the computed tomography (CT), which is regarded as one of the most accurate methods of imaging of the sinuses as it allows for a distinction between the anatomical variants of the sinuses.[7] When surgically approaching the sphenoid sinus, its ostium is typically found medially and inferiorly to the rim of the superior turbinate.[8] Having identified the ostium, the anterior wall of the sphenoid sinus is typically excised around both ostia, allowing for a facilitated access into the sinus.[9] Knowledge of the dimensions of the sphenoidal ostium is a very important in medicine especially in Otorhinolaryngology and Neurosurgery. It is an important landmark with reference to certain intracranial anatomical structures. The ostium is a crucial structure for transsphenoidal surgery, due to its proximity to anatomical structures, including sella turcica, internal carotid artery, cavernous sinus, and optic nerve. If the ostium is missed during surgical procedure, complications such as arterial bleeding, or septal perforation, or cerebrospinal leakage may occur. Therefore, it is important to adequately study the sphenoid ostium and provide data for our population, hence the study. However very few data is available for the sphenoidal ostium size amongst Nigerians and this could pose as a significant challenge during skull base surgeries. The aim of this study was to evaluate the morphometry of the sphenoid ostium amongst Nigerians using computed tomography.

The images for the study were acquired using a computed tomographic machine, GE evolution, 64 slice, version 2018 and stored in external re-writable CD drives in the picture archiving and communication system (PACS) unit of the radiology department of RSUTH

Materials And Methods

This was a retrospective study conducted in the Radiology Department of Rivers State University Teaching Hospital. A total of 300 computed tomography (CT) scans of the paranasal sinuses of adults aged 18 years and above were retrieved and analyzed. Images were gotten from CT scan machine, GE evolution, 64 slice, version 2018. The age and sex of the patients were documented. Measurements were done by a radiologist in in axial planes using RadiAnt DICOM Viewer. The horizontal diameter of the sphenoid sinus ostium was measured as the distance from the medial margin of the ostium to the midline (fig. 1). Patients with previous paranasal sinus surgeries, head injuries, brain surgeries were excluded from the study. The inter-ostial distance was measured as the distance between the medial margins of the right and left sphenoid sinus ostia (fig. 1). Data were analysed using the Statistical Package for Social Sciences (SPSS) version 22.0, Analysis of variance (ANOVA) were used for comparisons, and a p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Research and Ethics Committee of the Rivers State University Teaching Hospital (RSUTH REC 2023414).

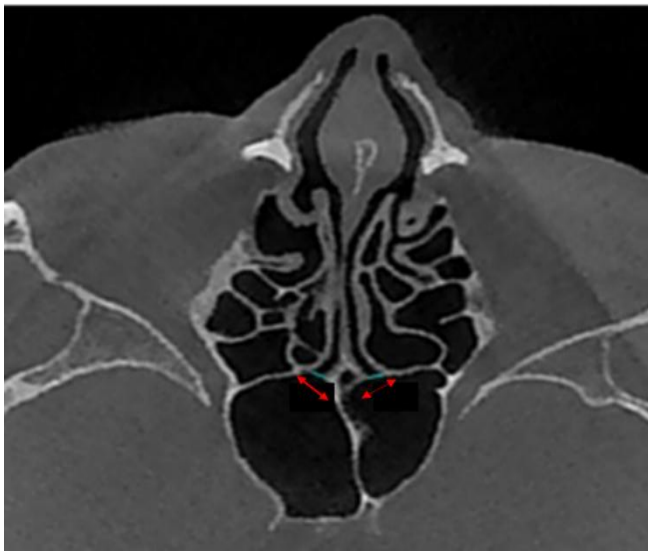

Fig. 1 Axial view showing the measurement of the sphenoid sinuses ostia

Fig. 2 Axial view showing the distance between the two sphenoid ostia

Results

In this study, among the 300 CT scans analysed; 164 males (54.7%) and 136 females (45.3%). The mean diameter of the right ostium was significantly larger in males (3.14 ± 0.48 mm) compared to females (2.907 ± 0.44 mm), with a statistically significant difference ($p < 0.05$). The mean left diameter of the sphenoid ostium was significantly bigger in males compared to females (3.30±0.49mm; 3.30±0.49mm; 3.12 ±0.44mm $p < 0.05$). No statistical difference was found in the distance between left and right ostia and also in the ostium angle.

Table 1. Descriptive statistics showing the various parameters that were measured

Parameters (mm)	Female (N= 136)		Male (N = 164)		P-value
	Mean (mm)	SD	Mean (mm)	SD	
Right ostium	2.91	0.44	3.14	0.48	**0.000***
Left ostium	3.12	0.44	3.30	0.49	**0.001***
Distance between left and right ostia	7.34	0.79	7.42	0.80	0.464
Right ostium angle	64.95	14.21	66.47	16.63	0.401
Left ostium angle	67.29	14.13	68.75	13.54	0.364

Discussion

The sphenoid sinus (SS) is the main route for accessing the skull base during endoscopic endonasal surgery. The sphenoid sinus ostium (SSO) is the safest entry point into the sinus, serving as a natural passage between the nasal cavity and SS. This makes the SSO a crucial landmark for guiding surgical approaches.[10,11] The location of the sphenoid sinus ostium (SSO) in the anterior wall of the sphenoid sinus (SS) varies due to developmental pneumatization and adjacent bony structures. Therefore, identifying the SSO's location using preoperative imaging is crucial for planning endoscopic endonasal approaches (EEA).[12] In this present study, the mean diameter of the right sphenoid sinus ostium was significantly larger in males compared to females (3.14 ± 0.48 mm; 2.907 ± 0.44 mm, respectively, $p < 0.05$). It was also observed in this study that the mean left diameter of the sphenoid ostium was significantly bigger in males compared to females (3.30±0.49mm; 3.30±0.49mm; 3.12 ±0.44mm $p < 0.05$). This implies that,

males in the study had larger sphenoid sinus openings compared to females. The clinical implications of these findings are noteworthy. The larger sphenoid sinus ostium in males may facilitate easier access during transsphenoidal surgeries, such as pituitary tumor removal. Additionally, understanding sex-specific differences in ostium size can aid surgeons in navigating the sphenoid sinus during endoscopic procedures, potentially reducing complications and improving outcomes. Awareness of these anatomical variations is essential for optimal surgical planning and execution. This finding contrasts with the results of previous study, who reported no significant differences in sphenoid sinus ostium dimensions among Polish populations.[13] Previous studies also done found no statistically significant difference between the right and left ostium sizes of males and females.[14,4]

In this present study, the distance between the two ostia in males and females was not statistically, this finding is similar to previous studies done.[13,14,15]

We also observed in this study that there was no sex related difference with respect to the ostium angle.

Conclusion

In conclusion, this study provides valuable morphometric data on the sphenoid sinus ostia in a Nigerian population, demonstrating significant sex-related differences in ostial diameters, with larger measurements observed in males compared to females, as well as notable variability in ostial position relative to the midline. These findings emphasize the critical role of detailed preoperative imaging and individualized surgical planning in endoscopic endonasal procedures to enhance surgical outcomes and reduce the risk of complications. Consideration of population-specific anatomical variations is essential for accurate localization of the sphenoid sinus ostia and effective surgical execution within the Nigerian clinical setting.

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