ORIGINAL ARTICLE

ANATOMICAL VARIATION BETWEEN COLUMELLA AND SPHENOIDAL SINUSES: A STUDY CONDUCTED ON ADULT CADAVERS

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ABSTRACT

BACKGROUND: The sphenoid sinuses are located at the skull base at the junction of the anterior and middle cerebral fossae. The sphenoid sinus drains through a single ostium into the sphenoethmoid recess: this ostium is classically situated 7 cm from the base of the columella at an angle of 30° with the floor of the nose in a parasagittal plane, and this usually corresponds to a location halfway up the anterior wall of the sinus. Endoscopically, the posteroinferior end of the superior turbinate points superiorly and medially toward the ostium and thus represents a very important landmark to identify it. The objective of this study was to establish whether there is uniformity of distance measurements both from nasal aperture and between right and left sphenoidal sinuses.

METHODS: This study was conducted in conjunction with the department of Anatomy at the National University of Ireland, Galway, Ireland. Total of 10 cadavers were examined with rigid nasal endoscopes, guide wires and digital vernier caliper. Distances were obtained for anterior and posterior sphenoid walls in each cadaver on each side.

RESULTS: The total mean distance from nasal aperture to anterior sphenoidal wall was 70.17mm (range 61.04-79.32) and the mean distance from nasal aperture to posterior sphenoidal wall was 83.82mm (range 75.10-90.87mm).

CONCLUSIONS: The analysis of the study revealed wide variations of distance, both from the nasal aperture and between Right & Left sinuses.

KEY WORDS: Sphenoid sinus, Endoscopy of sphenoid sinus, anterior wall of sphenoid,

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INTRODUCTION

The sphenoid sinuses are located at the skull base at the junction of the anterior and middle cerebral fossae. Their growth starts between the third and fourth months of fetal development, as an invagination of the nasal mucosa into the posterior portion of the cartilaginous nasal capsule. Between birth and 3 years of age, the sphenoid is primarily a pit in the sphenoethmoid recess. Pneumatization of the sphenoid bone starts at age three, extends toward the sella turcica by age seven, and reaches its final form in the mid- teens[1,2] The sphenoid sinus drains through a single ostium into the sphenoethmoid recess: this ostium is classically situated 7 cm from the base of the columella at an angle of 30° with

the floor of the nose in a parasagittal plane, and this usually corresponds to a location halfway up the anterior wall of the sinus. Endoscopically, the posteroinferior end of the superior turbinate points superiorly and medially toward the ostium and thus represents a very important landmark to identify it. When polypoid changes are present distorting the normal anatomy, the ostium can be located adjacent to the nasal septum, at the level of the posterior orbital floor seen through the middle meatal sinusotomy, usually within 10–12 mm from the superior arch of the choana, and approximately 7 cm from the columella. The superior wall of the sphenoid sinus usually represents the floor of the sella turcica.[3-5]

In order to perform proper nasal endoscopy (diagnostic and therapeutic), complete and exact understanding of anatomy and anatomical variations of sphenoidal sinus is vital.The anatomy of paranasal sinuses is extremely complex due to their close proximity to important organs such as optic nerve, carotid artery, and skull base and this clarifies the importance of recognition of anatomical variations in this area. Functional endoscopic sinus surgery has become popularized during the last decade for treatment of many diseases related to nose and sinuses all over the world. So, knowledge about the intricate anatomy and normal variations of sinus and related structures is of vital importance for the sinus surgeon to avoid probable complications. The importance of variation of sinus anatomy is undeniable. [6,7] The first description of sphenoid sinus mucocele in 1989 (Stankiewicz) has led to the development of a variety of surgical approaches to the sphenoid sinus eg. Intracranial, transeptal, transantral, external, etc. but all these approaches had their inherent problems. The endoscopic intranasal transsphenoidal approach, however, affords outstanding visualization and a safe, straightforward approach to the sphenoid sinus.[8] The sphenoid sinus is considered the most variable of the paranasal sinuses[9] in terms of degree and type of Pneumatization, number and position of intra and inter-sinus septa, relation with the surrounding surgical risk elements: the II, III, IV, V, VI and Vidian nerves, the ICA inside the cavernous sinus and the pituitary gland.[10]

The sphenoid sinuses vary in size and shape and owing to the lateral displacement of the intervening septum they are rarely symmetrical. They cannot be palpated during an extraoral examination. Their are average measurements are vertical height, 2.2 cm; transverse breadth, 2 cm.; antero-posterior depth, 2.2 cm.[11]

METHODS

This prospective study was conducted in conjunction with the department of Anatomy at the National University of Ireland, Galway, Ireland. This study involved examination of 12 adult cadavers comprising of 6 male and 6 female cadavers. The tools used in the study included 0° rigid nasal endoscopes or nasoendoscope, light source, a guide wire, a temporary marker, a digital vernier Caliper, Freir's elevator, nasal speculum and Blakesley nasal forceps.

During examination, a rigid naso-endoscope was introduced into nostril and identified sphenoid sinus. Blakesley nasal forceps opened the sinus and a guide wire followed this into the nostril. A mark on the wire by marker was made at collumella. Distances were measured with the help of vernier caliper from collumella to ostium of the sphenoid sinus and posterior wall of the sinus respectively.The distances are helpful in manufacturing the endoscopes with gradations, which are used in head & neck surgeries, thereby, increasing the accuracy of indepth Identification of landmarks intraoperatively. The data was analyzed on SPSS version 22, to find the mean and *p* value.

RESULTS

The mean distance to anterior sphenoidal wall was 70.17mm (range 61.04-79.32mm) of both the sexes and the mean distance from nasal aperture to posterior sphenoidal wall was 83.82mm (range 75.10-90.87mm) between both the sexes.

The distance of anterior and the posterior wall of sphenoid sinuses of both sides from nasal aperture are mentioned in **Table.1**.

Table.1: Measurement of distances of sphenoid sinus Anterior and Posterior walls from the nasal aperture:

Cadaver Number	RIGHT SPHENOLD SINUS Distance in mm		LEFT SPHENOLD SINUS Distance in mm	
	Anterior	Posterior	Anterior	Posterior
1	69.0	85.6	63.2	75.1
2	70.4	84.7	73.8	86.8
3	68.5	81.3	69.7	86.9
4	70.3	81.5	69.7	80.9
5	67.5	84.4	65.8	80.1
6	71.1	83.6	61.0	80.7
7	74.3	85.6	67.7	83.8
8	74.2	83.1	69.3	80.9
9	70.2	84.9	72.8	85.1
10	74.8	89.3	70.2	82.2
11	70.4	85.6	67.8	83.3
12	71.2	86.1	69.9	82.6

The mean distance of right side anterior wall was 71.24mm with SD±2, posterior wall was 84.8mm with SD±1. The mean distance of left side anterior wall was 68.5mm with SD±3, posterior wall mean was 83.2mm with SD±3. The study results were highly significant with *p* value .000 and CI 95%.**(Table 1)**

The distance of anterior wall of sphenoid sinus from the nasal aperture was found shorter in female cadavers and longer in male cadavers. **(Table 2)**

Table2: Comparison of distances from ostium to anterior wall of sphenoid sinus in both sexes.

Group Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
right anterior distance	females	6	68.6500	.96488	.39391
	males	6	72.5167	2.12736	.86849

The mean distance of right posterior sphenoidal sinus from the nasal aperture in male and female was found equal. In females it was 84.6mm SD±1 and in males it was 84.7mm SD±1.

The mean distance of left anterior sphenoidal sinus from nasal aperture was 68.1mm SD±3 in females, and 68.6mm SD±4 in males. The mean distance of left posterior sphenoidal sinus from nasal aperture in females was 82.1mm SD±4 and 82.5mm SD±2 in male.

Hence, not much difference was found at distance in both the sexes on the left anterior and posterior walls and also in the right posterior wall. The obvious difference in distance was found in the right anterior wall between the two sexes.

DISCUSSION

This study was conducted to demonstrate the anatomical variability in bone structures, natural openings of the sinuses, degree of aeration and septations within the sinuses and alterations in localization of neurovascular structures from an endoscopic view, so that the results obtained along the surgical path to the sellar region could be appreciated from a practical view of the endoscopic skull base surgery, which are helpful preoperatively, to avoid complications during Endoscopic Endonasal transsphenoidal surgical approach (EETSA).[12]

The distance between the two carotid arteries in the carotid sulci, to each other in their cavernous course is important during trans-sphenoidal approach to the pituitary as to avoid potential catastrophic injury to the carotid arteries and the surgeon has preoperative evaluation of the cavernous carotids throughout the entire length in each patient.[13] Vascular complications during this approach due to carotid artery injury can cause serious morbidity and mortality. The incidence of this complication ranges from 0.4-1.4%.[14] This is what our study also concluded that through the rigid endoscope the anatomical variation of all the structures including the internal carotids can be assessed preoperatively and surgical complication rate be decreased simultaneously.

A study by Hewaidi and Omami[14] outlines the surgically risky anatomic variants of the sphenoid sinus in the Libyan population, as well as the variable relationships between the sinus and related neurovascular structures for the safe removal of intrasphenoid and pituitary lesions.The prevalence of protrusion and dehiscence of the internal carotid artery and optic nerve were high among population.[15] Anatomic variations in relationship of sphenoid sinus to optic nerve and internal carotid artery seen on CT examinations in black Africans population, ensure a detailed pre-operative review of the CT scans to avoid the potential risks of blindness, uncontrollable haemorrhage and death that may attend anatomically uninformed sphenoidal surgeries.[16,17] Males had greater distances between the nasal columella and sphenoid sinus anterior wall than women, regardless of their ages. Anatomic evaluation about the variations of sellar and parasellar regions and their possible differences between genders and age groups have great importance for surgical fields. A better understanding of these complex structures is essential in clinical diagnosis and treatment of disease.[18,19] The nasal columella is the best mark to identify the distance to the operating sites during the Functional Endoscopic Sinus Surgery.[20] These studies are in line with our results, which concluded that the distance in female cadavers were more compared to male cadavers, from columella and the ostium or anterior wall of sphenoid sinus and columella was the best mark for measuring the distances of anterior and posterior walls preoperatively, so as to avoid complications during surgery.

Detailed preoperative analysis of the anatomy of the sphenoid sinus and its boundaries is crucial in facilitating entry to the pituitary fossa and reducing intraoperative complications. Coronal tomography more successfully detects the sphenoid sinus anatomic variations.[21-24] Radiological analysis of the structures or the pneumatization of sphenoid sinus, which is the one of the most variable of all sinuses,[25] through CT scan is less economical compared to rigid endoscopy which is easily available in the wards and operation theaters which can be performed preoperatively to make a plan of surgical approach preoperatively.

CONCLUSION

The analysis of the study revealed wide variations of the distance both from the nasal aperture and between Right & Left sinuses.

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