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MORPHOLOGICAL AND MORPHOMETRICAL ANALYSIS OF DRY HUMAN SPHENOID BONE AND ITS CLINICAL IMPLICATIONS

Fathima Hinaz. Z and Karthik Ganesh Mohanraj

Fathima Hinaz.Z
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University,
Chennai – 600077
Tamil Nadu, India
Email ID: fathimahinaz26@gmail.com

Karthik Ganesh Mohanraj,
Assistant Professor,
Department of Anatomy,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical sciences (SIMATS),
Saveetha University,
Chennai – 600077
Tamil Nadu, India
Email ID: karthikm.sdc@saveetha.com

Corresponding Author:
Karthik Ganesh Mohanraj,
Assistant Professor,
Department of Anatomy,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical sciences (SIMATS),
Saveetha University,
Chennai – 600 077, Tamil Nadu, India
Email ID: karthikm.sdc@saveetha.com
Phone Number: +91 9940545168

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Abstract

Introduction: Many foramina and fissures are located in the sphenoid bone that carries nerve and blood vessels of the head and neck. Sphenoid bone is an unpaired centrally situated bone. In the cranium it lies anteriorly and to the middle cranial fossa its contribution is large. Also contributes to the posterolateral wall of the orbit and the lateral wall of the skull. Foramen spinosum is a very small foramina situated at the edge of the sphenoid bone in the middle cranial fossa. In the greater wing of the sphenoid bone foramen of spinosum is one of two foramina present. The foramen rotundum is a circular opening in the sphenoid bone that connects the pterygopalatine fossa. The foramen rotundum is a spherical opening positioned in the floor of the skull.

Materials and Methods: This osteology based study was conducted in the Anatomy Department at Saveetha Dental College with 38 dry human skulls. And the measurements were taken with the aid of a digital sliding vernier caliper. The collected raw data was subjected to analysis using SPSS software.
Results: Mean values of left and right sides of the foramina of the sphenoid bone were found and there was a significant difference only among right and left side breadth of the foramina ovale. Significance was obtained at $p<0.05$
Conclusion: Through these measurements, various other correlations with clinical implications can be found and studied, for further understanding and knowledge.

Keywords: Foramina, Sphenoid bone, Measurements, Diagnosis, Complications

Introduction

The greater wing part of the central sphenoid bone has various major foramina which includes foramen spinosum, foramen ovale and foramen rotundum, which are considered as the important foramina of the sphenoid bone (1). These are considered important (2), because some of the major nerves and vessels including the maxillary nerve, mandibular nerve and the middle meningeal vessels pass through them (3). The foramen ovale is posterolateral to the foramen rotundum and it is an anteromedial to the foramen spinosum (4). The foramen spinosum is often used as a landmark in neurosurgery (5). Foramen ovale is shaped in oval aspect, foramen spinosum is round in shape and foramen rotundum is also mostly spherical (6).

A study regarding the post-delivery expansion of foramina ovale and foramina spinosum revealed the change in their topography and size (7). In another study conducted the size of foramen ovale and foramen spinosum was found to be 3.85mm in newborn and more in case of adults (5). When A visual inspection was conducted maximum skulls showed the lack of foramen ovale on the left side and the position of foramen ovale was covered by certain laminas(3). There are various other clinical significance of the findings of the measurements of the foramina of the sphenoid bone, which includes sphenoid sinusitis, sphenoid fractures, sphenoid wing dysplasia (6). If these are not treated the right way,(2,8) can further lead to other complications such as brain abscess, ocular damage, vision loss etc., (9).

Considering Various parameters including surgical and radiological importance of these foramina, this Study was worth conducting. In a study conducted the dissimilarity among the mean lengths and widths of the foramen spinosum over the right side and left side of different genders was not statistically significant (10). The mean of the following measurement and variations in sphenoid bone might propose a point that it show a slight role in the dynamic activities of the blood circulation in the venous system of the head. It also fulfills the intricate understanding of the Anatomical variations and measurement of the sphenoid bone. Our scientist experts, with their encompassing information, research experience, data has transformed to several publications globally in well reputed indexed Journals (11–18),(19),(20),(21),(22,23),(24),(25),(26–30). The aim of this study was to analyse the various foramina present in the sphenoid bone through morphometric measurements and to correlate it with its clinical implications.

Materials and methods

This study was conducted on 38 dry human skulls which were available in the Department of Anatomy, Saveetha Dental College. Firstly the foramina piercing the greater wing of sphenoid bone was found and analysed, and then the measurement of the foramen spinosum of both the sides were measured using a Digital Vernier caliper followed by the foramen ovale and rotundum. The pros include no sampling bias and that of the cons include the exclusion of different geographical regions. Scientific Review Board of the Institute approved and guided to carry out this osteometric study. Internal validity of the research is that all abnormal and broken bones were excluded from the study. Results were compared and data was analysed statistically using the student's T test.

Results

The present study was conducted on a total of 38 dry adult skulls. The various foramina present in cranial cavity and especially in sphenoid bone are shown in Figure 1 and Figure 2. Mean length of the foramen spinosum is 2.69mm on the right side and 2.83mm on the left side, whose standard deviation was 0.2 ± mm and 0.22 ± mm respectively. Mean breadth of foramen spinosum is 2.04mm on the right lateral side and 2.05mm on the left lateral side, whose standard was 0.18mm and 0.15mm respectively. Mean length of the foramen ovale is 5.34mm on the right side and 5.57mm on the left side, whose standard deviation was 0.43mm and 0.42mm respectively. Mean breath of foramen ovale to 2.96mm on the right and 3.05mm on the left, whose standard deviation was 0.24mm and 0.26mm respectively. Average size of the foramen rotundum was 2.96mm on the right and 3mm on the left, whose standard deviation was 0.1mm and 0.03mm respectively. Mean breadth was 3.27mm on the right and 3.32mm on the left for foramen rotundum, whose standard deviation was 0.03mm and 0.4mm respectively (Table 1).

The dissimilarity between the diameter of the right and left sides of the foramen spinosum was not statistically significant as p=0.078 (p > 0.05). The variance amongst the diameter of the right side of foramen ovale and left side of the foramen ovale was not statistically significant as p = 0.095 (p>0.05). The variance among the diameter of the right side of foramen rotundum and left side of the foramen rotundum was not statistically significant as p = 0.064 (p>0.05). All these statistical findings are shown in Table 2.

Table 1: The mean values of the foramina of the sphenoid bones are presented below.

PARAMETERS	MEAN (mm)	
	RIGHT	LEFT
Right and left length of foramen spinosum	2.6962	2.8397
Right and left breadth of foramen spinosum	2.0415	2.0521
Right and left length of foramen ovale	5.3449	5.5703
Right and left breadth of foramen ovale	2.9628	3.0564
Right and left length of foramen rotundum	2.9603	3.0038
Right and left breadth of foramen rotundum	3.2744	3.3249

Table 2: Shows the correlation of morphometric measurements of the right and left diameters of various foramina of sphenoid bone.

PARAMETERS (mm)	CORRELATION	SIGNIFICANCE
PAIR 1 Right and left diameter of foramen spinosum	0.516	0.078
PAIR 2 Right and left diameter of foramen	0.708	0.095

ovale		
PAIR 3 Right and left diameter of foramen rotundum	0.583	0.064

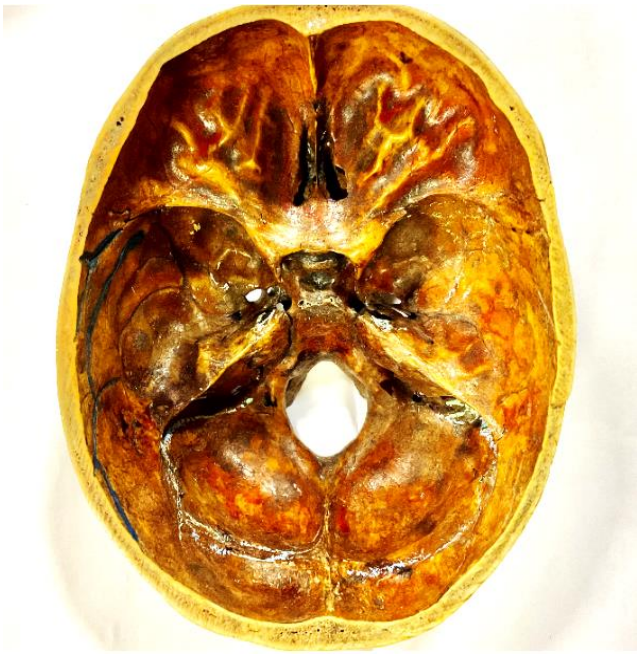

Figure 1: Base of the skull showing the greater wing of the sphenoid bone.

Figure 2: Morphology of the foramina of the greater wing of the sphenoid bone of the human skull.

Discussion

In this study the characteristics of foramina of sphenoid bone was analysed. The lengths of the foramen spinosum was found between 2.54 millimetres to 3.02 millimetres and the breadth was found between 1.91mm to 2.99mm. The length for the foramen ovale was found between 5mm and 6.24mm while the breadth was found between 2.73mm to 4.09mm. The length for the foramen Rotandum was found between 3.1mm and 3.57mm. The standard deviation for pair 1 (right and left side lengths of spinosum) is 0.26mm. For pair 2 (right side and left side breadth of spinosum) is 0.25mm. For pair 3 (right and left side lengths of ovale) is 0.51mm. For pair 4(right and left side breadth of ovale) is 0.19mm. For pair 5 (right and left length of rotundum) is 0.18mm. For pair 6 (right and left side breadth of rotundum) is 0.25mm. In certain studies conducted, the boundary of the foramen ovale was found uneven and coarse, which suggested on radiology pictures, occurrence of some alterations, which is an anatomical variation that might occur (2).

Foramen rotundum can also be classified into various types based on the position and the variations in their measurements, a study conducted with the patients who have undergone paranasal sinus computed tomography scan from june 2014 to November 2015 were entered in the cross-sectional study to obtain some morphometric measurements to analyze the variations in their anatomical features (4). The size also plays a major role as it decides the passage of several nerves, veins and vessels, for example the entrapment of the mandibular nerve when it is crossing the foramen ovale is found to be the principle cause of trigeminal neuralgia (4).

Variations of skull base foramina are associated with certain vascular and nervous malformations as it is implicated in clinical diagnosis (31). A study conducted the vascular networks of the cranium, established that foramina spinosum was relatively smaller or overall absent in 0.4% of the cases (32). In a study conducted, the variation such as asymmetry or inequality in size was observed in the Nigerian population (33). Foramen ovale is much bigger and circular when compared to foramen spinosum (34). Since all of these foramina play the role of gateway for certain neurovascular structures, which play an important role in clinical significance (35).

Limitations: The research was limited to a small sample size or population of south Indian dry skulls of various other ethnicities as different geographical parts are not included.

Future scope: The irregularities in the foramina can be further analyzed and studied, knowing the average values of the right aspect and left aspect of the sphenoid bone, several diagnostic usages in future can be done based on their abnormalities in the measurements of the foramen.

Conclusion

The various measurements of foramen spinosum, ovale and rotundum of the sphenoid bone were measured and analysed including the mean values of lengths and breadths, and have already been discussed above. Through this information provided in the study, it can help various anatomists to understand and have a better point of resource or knowledge, about the various measurements of foramina of the sphenoid bone, that can help in the detection of tumors and various other abnormalities.

Author contributions

Author 1: Fathima Hinaz.Z, carried out the study by collecting data and drafted the manuscript after performing the necessary statistical analysis and in the preparation of the manuscript.

Author 2: Karthik Ganesh Mohanraj, aided in conception of the topic, designing the study and supervision of the study, correction and final approval of the manuscript.

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Conflicts of interest

None declared.

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