

ANATOMICAL VARIATIONS OF FORAMEN SPINOSUM

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ABSTRACT

Objective: To conduct a morphometric study of foramen spinosum of the human sphenoid bone. **Methods:** The study was conducted on 35 dry human skulls available in the Department of Anatomy, School Medical Sciences and Research, Greater Noida, Uttar Pradesh. Variations in size, shape and number of foramen spinosum was noted. **Results:** Mean length of foramen spinosum in male was 3.31 ± 0.84 mm on left side and 3.73 ± 0.63 mm on right side. Mean length of foramen in female was 3.20 ± 0.83 mm on left side and 3.81 ± 0.71 mm on right side. Difference between the length of right and left side and the two sexes was not statistically significant ($p > 0.05$). Mean width of foramen spinosum in male was 1.5 ± 0.27 mm on left side and 1.8 ± 0.41 mm on right side. Mean width of foramen in female was 1.5 ± 0.37 mm on left side and 1.5 ± 0.24 mm on right side. Difference between the width of right and left side and the two sexes was not statistically significant ($p > 0.05$). **Conclusion-** Considering the immense anatomical, surgical and radiological importance of foramen spinosum, this study was worth conducting.

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INTRODUCTION

Foramen spinosum is an important opening on the infratemporal surface of the greater wing of the sphenoid bone and lies posterolateral to foramen ovale^[1]. It transmits the middle meningeal vessels and the nervous spinosus. Developmental studies have shown that the perfect ring-shaped formation of the foramen spinosum is observed by the 8th month after birth and the latest by 7 years after birth^[2]. The foramen is very small compared to foramen ovale and is usually round in shape^[1,3].

In A German study^[4] on postnatal enlargement of foramen spinosum and their topographical changes revealed length, of foramen spinosum was about 2.25 mm in newborn to 2.56 mm in adult. The width extends from 1.05 - 2 mm in adults. The foramen spinosum may be found unilaterally (1%) or incompletely separate from the foramen ovale (2%)^[5-7]. It is an important landmark in microsurgery of the middle cranial fossa^[8]. Several studies have reported the clinical importance of this foramen in surgery using the middle meningeal artery (MMA) as a graft in bypass surgery involving petrous part of internal carotid artery or posterior cerebral artery^[9,10]. It was reported that like all foramina, the FS also contains a venous component, the middle meningeal vein which connects the cavernous sinus with the pterygoid plexus, hence any variation in this foramen or in the structure passing through it should be known to the radiologist or surgeon.

This study aimed at determining the exact range of measurements, the variations, asymmetry and inequality

of size, seen in the foramen spinosum in the north Indian population.

MATERIALS AND METHODS

The study was conducted on 35 dry human skulls available in the department of Anatomy, School Medical Sciences and Research, Greater Noida, Uttar Pradesh. After the sex of each skull was determined, the foramen piercing the greater wing of the sphenoid bone was identified and its non-metric features analyzed both in the middle cranial fossa and on the infratemporal surface of greater wing of sphenoid. Sounding of the foramen was performed with a stiff steel wire of 0.1 mm in diameter. The variants in morphology of the foramina were described and photographed. Skulls showing postmortem damages in and around the foramen were excluded.

Measurements of the foramen spinosum of both the sides were done through extracranial side by placing a pair of dividers on the anteroposterior (length) and transverse (width) diameters of the foramina and then carefully transferred to a meter rule for the readings to be taken. Results were compared and data analyzed statistically using the student's t test. The level of significant difference was $P < 0.05$.

RESULTS

The present study was conducted on a total of 70 sides in 35 dry adult skulls. Mean length of foramen spinosum in male was 3.31 ± 0.84 mm on left side and 3.73 ± 0.63 mm on right side (Table II). Mean length of

foramen in female was 3.20±0.83mm on left side and 3.81±0.71mm on right side(Table II).Differences between the length of right and left sides and the two sexes was not statistically significant(p>0.05). Mean width of foramen spinosum in male was 1.5±0.27mm on the left side and 1.8±0.41mm on the right side(Table III). Mean width of the foramen in female was 1.5±0.37mm on left side and 1.5±0.24mm on right side(Table III).Differences between the width of the right and the left sides and the two sexes was not statistically significant(p>0.05).

The incidence of round, oval, pinhole and irregular shapes on 35 skulls has been shown in Table- I.

34.2 % of the skull showed bilaterally round foramen 14.2% showed bilaterally oval foramen. In the present study the foramen spinosum was a permanent feature on right side of skull but on left side it was absent in 2 skulls (Figure1).

Foramen spinosum on 69 sides was seen anterior to spine of sphenoid and posterior to the spine on right side in one skull (Figure 2). In 2 skulls the foramen on left side was divided by a thin bar of bone .

Table I. Types of foramen spinosum.

Shape of the foramen	Percentage on right side	Percentage on left side
irregular	2.8%	2.8%
pinhole	5.7%	8.5%
oval	34.2%	31.4%
round	57%	51.4%

Table II. Length of foramen spinosum (mm)

Value	Male		Female	
	left	right	left	right
Maximum	4.5	4	4	4
Minimum	2	3	3	3.5
mean	3.31	3.73	3.20	3.81
Standard deviation	0.84	0.63	0.83	0.71

Table III. Width of foramen spinosum(mm)

Value	Male		Female	
	left	right	left	right
Maximum	2.0	2.5	2.0	2.0
Minimum	1	1.5	1.5	1
mean	1.5	1.8	1.54	1.5
Standard deviation	0.27	0.41	0.37	0.24

Figure 1-The left foramen spinosum (arrow)seen anterior to spine of the sphenoid(arrow head),right foramen spinosum(arrow) seen posterior to spine of sphenoid(arrow head).LFS-left foramen spinosum, RFS-right foramen spinosum,

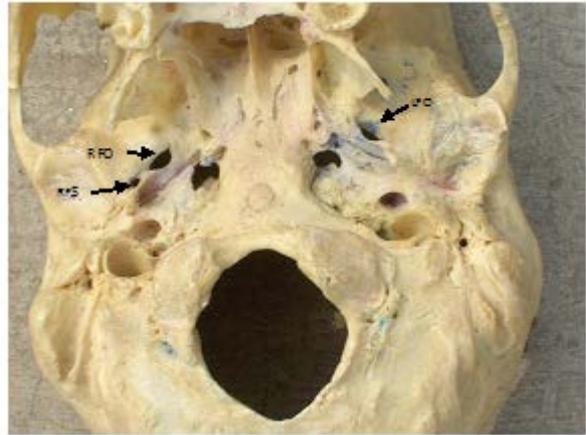


DISCUSSION

In the present study considerable variations were seen in the anatomy of foramen spinosum. In this study the characteristics of the foramen spinosum was analyzed both from the extracranial view of the skull base and the middle cranial fossa. . In 61% of foramen studied (70 sides), the lengths of the foramen spinosum were between 3.0 to

3.5mm and in 57% the widths were between 1.5-2mm. The findings of this study were within the range reported previously [4,5,11].

Figure 2-Note absence of foramen spinosum on left side . LFO -left foramen ovale ,RFO-right foramen ovale, RFS-right foramen spinosum



In the present study difference between the mean lengths and widths of the foramen spinosum on the right and left sides of male and female skulls was not statistically significant (p>0.05). Of the 70 foramen spinosum studied it was found to be unilaterally absent in 2.85 % or very small (≤0.1mm) in 4.25% on the left side. In a study conducted on 100 human skulls by Raymond[12] , the foramen spinosum occurred as a permanent element .Lindlom [13] in his study found out that the foramen spinosum was absent in 0.4% cases , Nikolova[14] observed the absence of foramen spinosum among the medieval male (0.70%) and female (0.72%) skulls but not in contemporary skulls .

The absence of the foramen spinosum can be a normal variation as seen in up to 3% of skull base CT studies[5,15,16] and is associated with abnormal development and altered course of the MMA. In such MMA arises from the ophthalmic artery and enters the middle cranial fossa through the superior orbital fissure Besides being a normal variant hypoplastic or aplastic foramen spinosum is a usual finding in a rare congenital vascular anomaly known as the Persistent stapedia artery (PSA) [17] .

2.85% of the foramen spinosum(n=70) were partially divided either by thin plate or thick bar of bone, this could be due to early division of the MMA into an anterior and posterior division leading to the duplication of the foramen spinosum[18] .

Foramen spinosum of the 35 dry adult human skulls studied ,were of varying shapes. The majority of the foramen spinosum were round in shape others were either oval or irregular .In 17skulls bilaterally symmetrical shapes of foramen spinosum was seen ,14 skulls were asymmetrical .

CONCLUSION

The study is of clinical and anatomical significance to medical practitioners as recognition of the morphometric variations in the foramen spinosum and structures passing through it will help in distinguishing normal from potentially abnormal foramina during radiological investigation.

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