

A MORPHOMETRIC STUDY ON FORAMEN OVALE

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ABSTRACT

Introduction: Variation of Skull base foramina always found to be associated with nervous and vascular malformations manifested by various clinical symptoms. The foramen ovale is an opening present in the posterior part of greater wing of sphenoid which transmits mandibular nerve, accessory meningeal artery, lesser petrosal nerve and emissary vein. The aim of the present study is to do morphometric measurements of the foramen ovale and also to study any variation in shape, number and find out the presence of pterygoalar bar.

Materials and Method: The study was conducted on 111 adult dry skulls(222 sides) in Department of Anatomy, ACS Medical college, Chennai. Variations in size, shape and number were noted.

Results: The most frequent shape observed was oval (68.46%) followed by D-shaped (15.31%), round (8.55%), almond(5.85%) and slit (0.9%). The mean length of foramen ovale found to be 7.57 mm on the right side and 7.39 mm on the left side. The mean width of foramen ovale observed to be 4.28 mm on the right side and 4.57 mm on the left side. Variations such as absent and duplicated foramen ovale, spine projecting from the margin of foramen and pterygoalar bar medial to foramen ovale were also observed.

Conclusion: The present study on morphometric measurements of foramen ovale has immense anatomical, clinical, diagnostic and surgical importance in case of fine needle aspiration technique in perineural spread of tumour and in trigeminal neuralgia.

KEY WORDS: Greater wing of sphenoid, mandibular nerve, pterygoalar bar, morphometry, trigeminal neuralgia.

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INTRODUCTION

The foramen ovale is an important opening in the posterior part of greater wing of sphenoid bone. It transmits the following structures namely sensory part of the mandibular nerve along with the motor root of trigeminal nerve, accessory meningeal artery, lesser petrosal

nerve, emissary vein which connects cavernous sinus to the pterygoid venous plexus and sometimes the anterior trunk of middle meningeal sinus[1]. The most exact location of foramen ovale is in the infratemporal surface of greater wing of sphenoid bone lateral to the lingula and posterior end of carotid groove, posterior and

lateral to the foramen rotundum and lateral to the foramen lacerum. It also lies close to the upper end of the posterior margin of the lateral pterygoid plate[2].

The foramen ovale also differs in size and shape like other foramina. The earliest perfect ring shaped formation of foramen ovale was observed in the 7th foetal month and latest in the 3 years after birth. and seen s a discrete foramen at 22 weeks.The length of the foramen ovale was about 3.85 mm in the new born and 7.2 mm in adults and the width of foramen ovale was about 1.81 mm in the new born and 3.7 mm in adults[3].

The previous studies which indicates the different variations of foramen ovale such as the venous component of the foramen ovale may be separated from the other contents of the foramen by a bony spur located antero-medially resulting in double foramen ovale[4] or it can be covered by ossified ligaments extending between the lateral pterygoid process and the sphenoid spine or found to be divided into 2 to 3 components associated with irregularities[5].

Since the foramen ovale is situated between intracranial and extracranial structures[6], it can be used for several surgical and diagnostic procedures. Knowledge of the variation in shape, size and number of foramen ovale is of great importance in various procedures such as biopsy of cavernous sinus tumour, percutaneous trigeminal rhizotomy for trigeminal neuralgia and administration of anaesthesia via mandibular nerve[7].Hence the aim of the present study is to determine the morphometry of foramen ovale and to highlight the importance of its clinical implications.

RESULTS

This present study was undertaken on 111 dry adult human skulls (222 sides) obtained from Department of Anatomy, ACS Medical College, Chennai. The foramen ovale was observed from the extracranial view of skull base. Skulls with damaged walls of foramen ovale were not considered. The shape of the foramen ovale were noted by direct inspection as per the classification given by Roma et al[8] and Daimi et al[9] such as oval, round, almond, D-shaped and slit shapes. Accessory foramen and bony

growth around the margins of foramen were also noted.

Measurements of foramen ovale were taken by placing a pair of divider on antero-posterior length and transverse diameters of the foramen and then carefully transferred to a meter rule for the readings to be taken. Variation in right and left side in length and breadth was evaluated.

RESULTS

The present study was conducted on 111 adult dry human skulls (222 sides). Following are the various findings of our study

Shape of foramen ovale:

Table 1: Shapes of foramen ovale.

Author	No of skulls	Length in mm (right side)	Length in mm (left side)	Width in mm (right side)	Width in mm (left side)
Poornima et al[16]	100	6.5±1.3	8.6±1.4	3.5±0.5	3.5±0.8
Ashwini et al[17]	55	6.59±2.21	6.38±2.52	4.83±0.97	4.97±0.97
Suniti et al[15]	50	7.6±1.2 (Male) 8.0±1.2 (Female)	7.5±1.2 (Male) 8.0±1.1 (Female)	4.4±1.0 (Male) 4.1±1.0 (Female)	4.0±1.0 (Male) 4.0±1.0 (Female)
Magi et al[11]	200	8.9±1.6	8.5±1.3	3.7±1.0	3.9±0.9
Osunwoke et al[18]	87	7.01±0.1	6.89±0.09	3.37±0.07	3.33±0.07
Karan et al[19]	100	6.19 (Male) 6.16 (Female)	5.93 (Male) 5.86 (Female)	3.41 (Male) 3.10 (Female)	3.07 (Male) 3.10 (Female)
Zahira et al[20]	55	7.04±1.08	7.18±1.14	4.15±0.92	3.99±0.86
Nirupma et al[12]	35	7.2±1.1	6.4±1.3	3.5±0.7	3.5±0.7
Binod et al[21]	40	6.8±1.2	6.8±1.3	3.5±0.5	3.5±0.5
Present Study	111	7.57±1.55	7.39±1.53	4.28±0.9	4.57±1.1

The incidence of shapes of foramen ovale had been tabulated in Table 1. The most frequent shape observed was oval (68.46%) [Fig.1] followed by D- shaped (15.31%) [Fig.2], round (8.55%) [Fig.3], almond(5.85%) [Fig.4] and slit (0.9%) [Fig.5]. Foramen ovale was oval in shape on both sides in 65 skulls(29.27%), D-shaped on both sides in 11 skulls(4.95%), round in shape on both sides in 5 skulls (2.25%) and almond shaped on both sides in 3 skulls (1.35%).



Fig. 1: Showing oval shape of foramen oval.

Fig. 2: Showing D-shape of foramen ovale.



Fig. 3: Showing round shape of foramen oval.



Fig 4: Showing almond shape of foramen ovale.



Fig. 5: Showing slit shape of foramen oval.



Variations of foramen ovale:

1. The foramen ovale found to be absent in 1 skull on both the sides (0.9%) [Fig. 6]
2. The pterygoalar bar found to be present in one skull on the right side (0.45%) [Fig.7].
3. Double foramen ovale found to be present on five sides (2.25%), two on the right side and three on the left side
4. Spine protruding from the margin of foramen ovale (0.9%), one on the left side and one on the right side.

Fig. 7: Showing Pterygoalar bar.

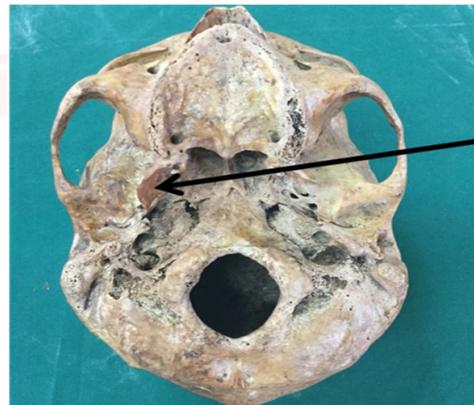


Fig. 6: Showing Absent foramen ovale.



Fig. 8: Showing double foramen ovale.



Fig. 9: Showing spine protruding from the margin of foramen ovale.



Morphometry of foramen ovale:

Table 2: Dimensions of foramen ovale in right and left side.

S.No	Values	Length (Right side in mm)	Length (Left side in mm)	Width (Right side in mm)	Width(left side in mm)
1	Maximum	12	12	7	10
2	Minimum	5	5	2	3
3	Mean	7.57	7.39	4.28	4.57
4	Standard deviation	1.55	1.53	0.9	1.1

The length and width of foramen ovale has been summarised in Table 2. The mean length of foramen ovale found to be 7.57 mm on the right side and 7.39 mm on the left side. The mean width of foramen ovale observed to be 4.28 mm on the right side and 4.57 mm on the left side. Difference between the length and width of foramen spinosum of the right and left side was not statistically significant.

DISCUSSION

The foramen ovale acts as an important landmark for middle cranial fossa surgery and is also one of the most important foramina for various diagnostic and invasive surgical procedures[6,7]. Developmentally, sphenoid bone has intramembranous and endochondral ossification centres which comprises of basisphenoids (body), orbitosphenoids (paired lesser wings) and allisphenoids (greater wings). The presphenoid and postsphenoid centres give rise to basisphenoid and the postsphenoid centre is the one which is associated with the formation of greater wing of sphenoid. The first ossification centre appears in the allisphenoid and its larger portion forms the greater wing of sphenoid by

membranous ossification. The foramen ovale is formed where mandibular nerve is surrounded by cartilage. The perfect ring shaped foramen is observed in the 7th foetal month and later in 3 years after birth[10,11].

Many studies have been done on the foramen ovale regarding shapes. In the study conducted by Nirupma et al[12] on 35 skulls, the most frequent shape observed was oval (54.29%) followed by almond (35.71%), round (8.57%) and slit (1.43%). In another study done by Chandra et al[13] on 50 skulls, the most common shape observed was oval (68%) followed by almond (30%), round (1%) and D-Shape (1%). In the present study which was done on 111 skulls, the majority of skulls found to be oval in shape (68.46%) followed by D-shape (15.31%), round (8.55%), almond (5.85%) and slit shape (0.9%). Following is the comparison between the present study and the previous studies regarding shapes of foramen oval

Table 3: Comparison of various studies regarding various shapes of foramen ovale.

Author	No.of.skulls	Oval (%)	D-Shaped(%)	Round(%)	Almond (%)	Slit (%)
Daimi et al[9]	90	29.87	46.16	12.52	10.41	1.04
Chandra et al[13]	50	68	1	1	32	-
Somesh et al[14]	82	56.75	-	10.97	28.75	3.65
Nirupma et al[12]	35	54.29	-	8.57	35.71	1.43
Magi et al[11]	250	69	-	2	29	-
Patel et al[8]	100	59.5	-	27.5	12	1
Present study	111	68.46	15.31	8.55	3.15	0.9

Various studies have been done on the morphometry of Foramen ovale. In the present study which was done on 111 skulls, the mean length of right and left side foramen ovale was 7.57+1.55 mm and 7.39+1.53. The mean width of foramen spinosum found to be 4.28+0.9mm on the right side and 4.57+1.1 on the left side. The present study results are in similar with a study done by Suniti et al [15] on 50 dry human skulls. Following table shows comparison between the morphometric measurements of the present study and the previous studies (Table.4)

Out of 111 skulls, 2 skulls showed the presence of bony spine one on the left side and the other on the right side(0.9%). Poornima et al[16] found bony spine on 22 foramina out of 100 skulls(11%) and John et al observed bony spine on 8 foramina out of 30 skulls (13%).

Table 4: Comparison between the morphometric measurements of the present study and the previous studies.

Author	No of skulls	Length in mm (right side)	Length in mm (left side)	Width in mm (right side)	Width in mm (left side)
Poornima et al[16]	100	6.5±1.3	8.6±1.4	3.5±0.5	3.5±0.8
Ashwini et al[17]	55	6.59±2.21	6.38±2.52	4.83±0.97	4.97±0.97
Suniti et al[15]	50	7.6±1.2 (Male)	7.5±1.2 (Male)	4.4±1.0 (Male)	4.0±1.0 (Male)
		8.0±1.2 (Female)	8.0±1.1 (Female)	4.1±1.0 (Female)	4.0±1.0 (Female)
Magi et al[11]	200	8.9±1.6	8.5±1.3	3.7±1.0	3.9±0.9
Osunwoke et al[18]	87	7.01±0.1	6.89±0.09	3.37±0.07	3.33±0.07
Karan et al[19]	100	6.19 (Male)	5.93 (Male)	3.41 (Male)	3.07 (Male)
		6.16 (Female)	5.86 (Female)	3.10 (Female)	3.10 (Female)
Zahira et al[20]	55	7.04±1.08	7.18±1.14	4.15±0.92	3.99±0.86
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Binod et al[21]	40	6.8±1.2	6.8±1.3	3.5±0.5	3.5±0.5
Present Study	111	7.57±1.55	7.39±1.53	4.28±0.9	4.57±1.1

Double foramen ovale found to be present on five sides (2.25%), two on the right side and three on the left side out of 111 skulls. Poornima et al[16] observed duplicated Foramen ovale on the right side in one skull among 100 skulls. Daimi et al[9] observed a double foramen in one case on a study of 90 skulls. Venous segment of foramen ovale may be separate from the other contents which is responsible for double or accessory foramen.

The pterygoalar bar which is rarely described in anatomical literature, refers to bony formation which is due to ossification of ligament between the lateral pterygoid plate and the greater wing of sphenoid. Daimi et al [9] revealed the presence of complete presence of pterygoalar bar and ptergoalar foramen in 7 skulls out of 90 skulls. Skrzat et al[22] observed pterygoalar bar and foramen in 5 cases. In the present study, the pterygoalar bar found to be present in one skull on the right side (0.45%) and pterygoalar foramen is absent.

Skrzat et al [22] found a absent foramen ovale on the left side of the cranial base. In the present study, the foramen ovale found to be absent in 1 skull on both the sides. Foramen ovale found to be covered by an osseous lamina continuous with the lateral pterygoid plate forming a wall of an apparent canal that opens on the lateral side of pterygoid process.

CONCLUSION

Knowledge in variations of morphometry of

foramen ovale has various clinical, anatomical and surgical importance. The present study is helpful for clinicians in cases of trigeminal neuralgia and in diagnostic detection of tumours and abnormal bony outgrowths causing ischaemia, necrosis and paralysis of parts of the body supplied, drained or innervated by its contents, to distinguish abnormal foramen from normal during computed topography and Magnetic resonance imaging.

Conflicts of Interests: None

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