



## MORPHOMETRIC AND MORPHOLOGICAL STUDY ON FORAMEN OVALE

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**ABSTRACT**

**Background:** Foramen ovale is an important foramen of the middle cranial fossa. Foramen ovale is situated in the greater wing of the sphenoid bone, posterior to the foramen rotundum and lateral to the lingula and posterior end of the carotid groove. Through the foramen ovale the mandibular nerve, accessory meningeal artery and lesser petrosal nerve are passing through it. The shape of foramen ovale is ovale in shape as compare to other foramina of the skull, its shape and size is quite variable.

**Materials And Methods:** A total 250 skulls were used for this study. The skulls were collected with I MBBS student from different medical colleges in south India. Skulls in poor conditions or skulls with partly damaged surroundings of the foramen ovale were not considered. Maximum length and width of foramen ovale was measured. Variation in right and left side and sex difference in length and width were calculated, the variations in shape also recorded.

**Results:** The mean value of length of left foramen ovale is  $8.5+1.32\text{mm}$  and right was  $8.9+1.67\text{mm}$ . In female it was  $8.7+1.67\text{mm}$  and male was  $8.4+1.71\text{mm}$ . The mean value of width of left foramen ovale is  $3.7+1.03\text{mm}$  and right was  $3.9+0.98\text{mm}$ . In female it was  $3.8+0.92\text{mm}$  and male was  $3.7+1.02\text{mm}$ . The shape of foramen ovale was ovale in 69% of skulls, almond in 29% of skulls and round was 2% of skulls.

**Conclusion:** The present study concludes that there is significant difference between sizes of right and left side foramen ovale and found that between male and female foramen ovale sizes also not shown any significant difference. Foramen ovale has practical significance to both neurosurgical and functional cranial neuroanatomy as it provides transcutaneous approaches to the skull base especially in cases of trigeminal neuralgia, as the Gasserian ganglion can be approached through it.

**KEYWORDS :** Foramen ovale, Neuroanatomy, Trigeminal neuralgia, Gasserian ganglion.

**BACKGROUND**

The foramen ovale is present in sphenoid bone which transmits the mandibular nerve, accessory meningeal artery, emissary vein and the lesser petrosal nerve. The most predominant location of foramen ovale is in the infratemporal surface of greater wing of the sphenoid bone posterior and lateral to the foramen rotundum and lateral to the lingual and posterior end of the carotid groove. It lies close to the upper end of the posterior margin of the lateral pterygoid plate. The Foramen ovale is situated at the transition zone between intracranial and extracranial structures. Therefore, it is used in various surgical as well as diagnostic procedures [1,2].

The previous studies which indicate the abnormal morphology of the foramen ovale, such that it can be occasionally covered by ossified ligaments stretching between the lateral pterygoid process and the sphenoid spine or its venous part may be compartmentalised by a bony spur located antero-medially resulting in doubled foramen ovale [3,4]. The venous segment of the foramen ovale may be separated from the remainder of the contents of the foramen by a bony spur; thus resulting in a so-called doubled foramen ovale. Such spurs are located anteriorly and medially according to Lang [5]. Regarding the developmental aspects of foramen ovale, it is situated at the posterior border of greater wing of sphenoid. This sphenoid bone has both intramembranous and endochondral ossification centers and it consists of the body called as basisphenoid, the paired lesser wings called as orbitosphenoids and the greater wings called as alisphenoids. The basisphenoid is derived mainly from presphenoid and postsphenoid centres and the postsphenoid centre is the one which is associated with the development of the greater wing of sphenoid. The first ossification centre appears for alisphenoids and its large portion forms the greater wing of sphenoid by membranous ossification. The mandibular nerve becomes surrounded by cartilage to form the foramen ovale. At 22 weeks of age the foramen ovale can be seen as discrete ring-shaped opening in the area of unossified cartilage that can be well recognised 3

years after birth at the latest [6].

Information on foramina variants of the human skull gives insight into associations between neurovascular anatomy and the cranial morphology. The sphenoid bone, because of its complex structure and intricate embryological origin, should be studied in different anatomical aspects, including its normal and abnormal variation. Foramen ovale is used for various invasive surgical as well as diagnostic procedures such as electroencephalographic analysis of the seizure for patients undergoing selective amygdalohippocampectomy [7], microvascular decompression by percutaneous trigeminal rhizotomy for trigeminal neuralgia [7,9] and percutaneous biopsy of cavernous sinus tumours [10]. The technique of CT-guided transfacial fine needle aspiration technique through the foramen ovale is used to diagnose squamous cell carcinoma, meningioma, Meckel etc., and allows biopsy of deep lesions that would otherwise require craniotomy or open surgical biopsy [11,12]. The present study focused on the different diameters such as length and width of foramen ovale and its shape, the knowledge of this study may help in surgeries of neurological diseases.

**MATERIALS AND METHODS**

A total 250 skulls were used for this study. The skulls were collected with I MBBS student from different medical colleges in south India. Skulls in poor conditions or skulls with partly damaged surroundings of the foramen ovale were not considered. Maximum length (Anterio-posterior diameter) and width (transverse diameter) of foramen ovale were measured with help of Vernier calliper's scale. Variation in right and left side and sex difference in length and width were calculated, the variations in shape also recorded.

**RESULTS**

The mean value of length of left foramen ovale is  $8.5+1.31\text{mm}$  and right was  $8.9+1.67\text{mm}$ . In female it was  $8.7+1.67\text{mm}$  and male was  $8.4+1.71\text{mm}$ . The mean value of width of left foramen ovale is  $3.7+1.03\text{mm}$  and right was  $3.9+0.98\text{mm}$ . In

female it was 3.7+0.92mm and male was 3.9+1.02mm. The shape of foramen ovale was ovale in 69% of skulls, almond in 29% of skulls and round was 2% of skulls (Tables 1,2,3).

**Table 1: Length And Width Of Foramen Ovale.**

Dimension s of values	Foramen Ovale length (Left) mm	Foramen Ovale length (Right) mm	Foramen Ovale Width (Right) mm	Foramen Ovale Width (Right) mm
Maximum	11.4	11.7	5.6	5.5
Maximum	5.2	5.7	1.6	2.1
Mean	8.5	8.9	3.7	3.9
SD	1.31	1.67	1.03	0.98
P-Value	>0.05		>0.05	

**Table 2: Sex Deference In Length And Width Of Foramen Ovale.**

Dimension s of values	Foramen Ovale length (Right) Female mm	Foramen Ovale length (Left) Male mm	Foramen Ovale Width (Right) Female mm	Foramen Ovale Width (Right) Male mm
	Maximum	11.7	11.4	5.6
Maximum	5.2	5.7	1.6	2.1
Mean	8.7	8.4	3.7	3.9
SD	1.67	1.71	0.92	1.02
P-Value	>0.05		>0.05	

**Table 3: Shapes Of Foramen Ovale.**

Shape	Right	Left	Total
Oval	175 (70%)	170 (68%)	345 (69%)
Almond	70 (28%)	75 (30%)	145 (29%)
Round	5 (2%)	5 (2%)	10 (2%)

**DISCUSSION**

Foramen ovale is one of the important foramina situated at the transition zone between intracranial and extracranial structures, it is used for various invasive surgical as well as diagnostic procedures, because of this important reasons the knowledge of diameters and shapes of foramen ovale is essential for surgeons. In present study the mean value of length of left foramen ovale is 8.5+1.31mm and right was 8.9+1.67mm. In female it was 8.7+1.67 mm and male was 8.4+1.71mm, our results are in agreement with study of Biswabina Ray et al conducted on a total of 70 sides in 35 dry adult skulls in their study the mean length of foramen ovale was 7.46±1.41mm on right side 7.01±1.41 mm on left side. Mean length of foramen ovale in male was 7.27±1.39 mm and in female was 7.16±1.51mm. Maximum and minimum length observed was 10.2 mm, 5.1 mm and 10.4 mm, 4.9 mm on right and left sides respectively. Maximum length in male was in 10.4 mm. and in female was 10.2mm. and minimum length was 5mm. in male and 4.9mm. In female skulls [12]. In a developmental study conducted in Japan an average maximal length of foramen ovale was 7.48 mm and average minimal length was 4.17mm [6]. In Lang J study the length was 7.2mm [5]. In Landl MK study reported 6.9mm on right side and 6.8mm on left side with range length 5.0- 10.0mm [13].

In present study the mean value of width of left foramen ovale is 3.7+1.03mm and right was 3.9+0.98mm. In female it was 3.7+0.92mm and male was 3.9+1.02mm, difference between the width of right and left side was not statistically significant. Our results are correlating with Biswabina Ray et al study, they reported maximum width of foramen ovale was 5.0mm on both right and left sides while minimum width was 1.0mm on right side and 2.2mm on left side. Meanwidth on right side was 3.21+1.02mm and 3.29+0.85mm on left side. Difference between the width of right and left side was not statistically significant (p > 0.05). In Lang J study the average width was 3.7mm. In Landl MK study reported the average width on right side was 3.4mm and 3.8mm. In the present study difference

between the length and width of foramen ovale in male and female sex was not statistically significant this are in agreement with Biswabina Ray et al [12] and Yanagi study[6]. In our study the shape of foramen ovale was ovale in 69% of skulls, almond in 29% of skulls and round was 2% of skulls. Our results are in agreement with study of Biswabina Ray et al they reported that maximum number of foramen to be ovale shaped 61.4% almond shaped 34.3%, round was 2.9% and slit like was 2.9%. The Similar results were observed in developmental studies conducted by Yanagi [6].

**CONCLUSION**

The present study shows variations in shape may be due to developmental reason. There was no statistical differences in length and width of foramen ovale. The knowledge of present study helps in clinical and anatomical significance for the medical practitioners in cases of trigeminal neuralgia and in diagnostic detection of tumors and abnormal bony outgrowths.

**Conflicts Of Interests:** None

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