



## ORIGINAL RESEARCH PAPER

## Anatomy

### FORAMEN OVALE-MORPHOMETRIC & MORPHOLOGICAL ASSESSMENT IN HUMAN ADULT NEUROCRANIUM

**KEY WORDS:** Skull, Foramen Ovale, Morphology & Morphometry

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#### ABSTRACT

**AIM:** To interpret bilateral morphological disparities & morphometric measurements of the Foramen ovale in human adult skulls.

**MATERIAL AND METHODS:** Study was carried out in 200 skulls (unknown sex) of Indian origin. Differences in Shape of the foramen were noted & Digital vernier callipers is utilised to appreciate Anteroposterior & mediolateral diameters of both sides from which Areas were obtained & evaluated statistically.

**RESULTS:** The classic shape of the foramen ovale in majority of the crania is OVAL 53% and 54% followed by ALMOND in 13% & 12%, ROUND in 11% & 12% on right and left sides respectively. Bony outgrowths were noticed. Mean Dimensions for the right side (APD, TD & AREA) were 6.68 ± 1.58mm, 4.07 ± 0.82mm, 21.22 ± 6.05mm and the left side were 6.15 ± 1.32mm, 3.86 ± 0.74mm, 18.71 ± 5.04mm respectively

**CONCLUSION:** Anatomical familiarity of foramen ovale is crucial; as various diagnostic and invasive surgical approaches are handled via foramen ovale including biopsy of the deep lesions (that would otherwise require craniotomy or open surgical biopsy having high risk of morbidity). Consequently the present study was worthwhile with regard to diagnostic & surgical significance of foramen ovale.

#### INTRODUCTION:

Foramen ovale (FO) is present in the greater wing of sphenoid bone which transmits Mandibular nerve, Lesser petrosal nerve, Accessory meningeal artery and the emissary veins.

The FO provides access to Trigeminal nerve hence it is important in functional cranial anatomy and neurosurgeries. It has been hypothesized that entrapment of mandibular nerve when it cross FO is a primary cause of Trigeminal neuralgia (TN) with high incidence on right side (RS) because of narrower FO on right Side<sup>1</sup>.

Anatomical knowledge of the foramen ovale is important for neurosurgical procedures involving the TN and administration of anaesthesia via mandibular nerve<sup>2</sup>. Moreover, percutaneous biopsy of cavernous sinus is also performed through FO<sup>3</sup>.

The technique of CT-guided trans facial fine needle aspiration technique through the foramen ovale is used to diagnose squamous cell carcinoma, meningioma etc., and allows biopsy of deep lesions that would otherwise require craniotomy or open surgical biopsy<sup>4,5</sup>.

#### MATERIAL & METHODS:

Present study is made on 200 crania of unknown sex that has been obtained from several Anatomy & forensic departments in India. Skull with any fractures or pathology is excluded from the study. Morphology of the foramen ovale, presence or absence of any bony growths has been observed. Bilateral morphometry of Anteroposterior, mediolateral diameter was done with the help of Digital vernier callipers having a precision value of 0.1mm (Fig: 1 & 2). Area is determined with the formula  $A = \pi \times APD \times TD / 4$ . To minimise errors each measurement is noted thrice and average value is noted. Statistical analysis is assessed by using SPSS software version 11.5. Comparison of right and left sides is done by calculating the means of dimensions using Student's t-test and p value with <0.05 are taken as significant.

#### OBSERVATION & RESULTS:

Morphology of the Foramen ovale is observed for the shape and the bony out growths. Oval (53.5%) is the most common

type of shape noticed followed by almond (12.5%), round (11.5%) and slit (6.5%). However other shapes like kidney, pear, D-shape, triangular and irregular were also noticed in our study. The bilateral frequency distribution of various shapes and bony out growths, percentages were depicted in Table no: 1 & 2

Anteroposterior diameter is measured from the longest diameter while shortest diameter is taken as the mediolateral diameter (Fig: 1 & 2). Mean Dimensions for the right side (APD, TD & AREA) were 6.68 ± 1.58mm, 4.07 ± 0.82mm, 21.22 ± 6.05mm and the left side were 6.15 ± 1.32mm, 3.86 ± 0.74mm, 18.71 ± 5.04mm respectively

Student's T-test is applied to compare right and left differences of Anteroposterior and mediolateral diameters. Based on t value obtained p values were calculated. Statistical data is shown in Table-3 & 4. Comparison of the Dimensions of right and left sides were not significant as p values calculated was >0.05. Areas compared were extremely significant because the p value is <0.0001.

#### DISCUSSION: MORPHOLOGY:

Foramen ovale is used as a guide for several diagnostic and surgical procedures. Unforeseen shapes of the foramen ovale and neighbouring osseous structures in patients may result in unusual hassle in surgical approaches. Embryological basis helps in explaining such abnormalities.

In the present study the most common type of shape that has been observed bilaterally is Oval. Yanagi<sup>6</sup> found oval shape of foramen ovale as majority, he also stated that shapes of foramen ovale are more irregular when compared to the other foramina of the sphenoid bone.

In another study Rayet al<sup>7</sup> observed that 63% & 60% of the skulls have oval-shaped foramen ovale on right and left sides respectively. Diami et al<sup>8</sup> noticed shape of foramen ovale as oval in 29.87%, D shaped 46.16%, Round 12.52%, Slit like 1.04% of skulls. John and Thenmozhi<sup>9</sup> in his study on 60 skulls spotted 48 (80%) oval, 4 (6%) round, 7 (11.6%) almond shaped and 1 slit like foramen ovale. Thus the current study on

shapes of foramen ovale is in correlation with the earlier studies.

Accessory bony structures like bony plate(9%), tubercle(7%) and spine (3%) were seen in the present study which is in correlation with the previous studies reported by Wadhwa et al<sup>10</sup>. in their study on 60 foramina's found bony plate in 6, spine in 1 and tubercle in 2 cases. John and Thenmozhi<sup>1</sup> in his study on 60 foramen ovale's also spotted bony plate in 7, spine in 8 tubercle in 4 cases.

### MORPHOMETRY

Morphometric data of our study is in correlation with the previous studies. It may be because of reasonably constant number of nerve fibres passing through the mandibular trunk In Humans. Lang et al<sup>11</sup> noted in their study the length of adult foramen ovale as 7.2 mm and width as 3.7 mm. Hwang et al<sup>12</sup> observed the length is 8.1 mm ,8.24 mm and the width is 4.12 and 4.01 mm on the right and left sides, respectively. Somesh et al<sup>13</sup> in their study stated that the mean AP diameter were 7.64 and 7.56 mm on right and left sides, respectively.

In another study carried out by Wadhwa et al, the mean length of the right and left foramen ovale was observed as 6.8 and 6.5 mm and the mean width of right and left foramen ovale as 3.7 and 4 mm, respectively. In a study Arun Kumar<sup>14</sup> noticed the maximum length of foramen ovale was 9.8 mm and minimum length was 2.9 mm. Mean length on left side was 6.56 mm and on the right side was 5.08 mm. Mean width was 3.60 mm & 3.64 mm on left and right sides respectively. A study conducted by Osunwoke E.A<sup>15</sup> spotted the mean of the lengths of the right & left foramen ovale was 7.01mm & 6.89mm respectively. The mean widths of the right foramen ovale was 3.37mm and that of the left foramen ovale was 3.33mm, noted that there was no significant difference between the mean of the length and width of the right and left foramen ovale which is in correlation with the present study.

### CONCLUSION:

Variations in the foramen ovale may hamper the clinicians to execute clinical procedures so earlier knowledge in its anatomy is necessary in order to overcome such hindrances. Hence the present study was undertaken to provide a comprehensive understanding of foramen ovale that could favour the clinicians and surgeons in planning and performing surgical operations of the skull base and also assist Anatomists in gaining a meticulous knowledge on the foramen ovale of human dry skulls

**FIG:1 FORAMEN OVALE APD (mm)**



**FIG:2 FORAMEN OVALE MLD (mm)**



**Table:1 Frequency distribution of Shapes of FO**

SHAPE	Right frequency	%	Left Frequency	%
OVAL	106	53	108	54
ALMOND	26	13	24	12
ROUND	22	11	24	12
SLIT LIKE	14	7	12	6
D SHAPED	8	4	8	4
KIDNEY	8	4	8	4
PEAR SHAPED	8	4	8	4
TRIANGULAR	4	2	4	2
IRREGULAR	4	2	4	2

**Table 2 Frequency distribution of Bony Out Growths of FO**

BONY OUT GROWTH	RIGHT	%	LEFT	%
ABSENT	160	80	164	82
BONY PLATE	20	10	16	8
TUBERCLE	16	8	12	6
SPINE	4	2	8	4

**Table 3 STATISTICAL ANALYSIS OF APD & MLD OF FORAMEN OVALE**

SHAPE	APD RT	APD LT	MLD RT	MLD LT
Minimum	3.45	3.1	2.4	2.45
Maximum	10.1	9.15	7.2	6.4
MEAN	6.6798	6.1525	4.07335	3.8692
STD	1.588632027	1.325405693	0.826376894	0.749934
STD.ERR MEAN	0.112333248	0.093720335	0.058433671	0.053028
T VALUE	0.000353951		0.010033433	
P VALUE	0.9		0.99	

**Table:4 STATISTICAL ANALYSIS OF AREAS OF FORAMEN OVALE**

	RT AREA	LT AREA
MINIMUM	9.23	7.1
MAXIMUM	34.75	32.7
MEAN	21.2251	18.71335
STD DEVIATION	6.05382632	5.04926566
STD ERR MEAN	0.42807016	0.357037
T VALUE	8.7706	
P VALUE	0.0001	

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