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Variations in foramen ovale in Adult human skulls of North Indian Population

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ABSTRACT:

Introduction: Inferior surface of each greater wing of sphenoid bone forms part of the middle cranial cavity of the skull containing numerous foramina and fissures which accommodate many nerves and vessels. Foramen ovale is an important foramen present in the middle cranial cavity, at the posterior aspect of each greater wing of sphenoid bone. An anatomical study was conducted to observe the variations in foramen ovale.

Method: Our study was conducted on the total 50 dried adult human skulls of North Indian population. These skulls obtained from the Department of Anatomy in different medical colleges. Posterior part of greater wing of sphenoid bone was carefully observed for the study of variations in foramen ovale.

Discussion: Out of 50 dry skulls 100 foramen ovale was observed in both sides. The majority of foramen ovale were observed as oval 87% of the total, the next most common shape was round 4% of the total. Triangular, almond longitudinal slit, pear shaped were less common at both sides.

Result: In the right side of the skulls 42 foramen ovale were oval, 3 were round and 1 of each were triangular, longitudinal slit and almond. In right side of the foramen ovale no pear-shaped foramen ovale were found in the skull studied. Oval shaped foramen ovale was highest 87% and round was 4%. Further triangular, longitudinal slit and almond were 3%,2%,1% respectively.

Conclusion: The shape of foramen ovale was variable, typically oval shape foramen observed in most of the skulls. In our study there was no statistical significance difference in morphometric dimension.

Key words: Skull, Foramen ovale, Sphenoid bone, Trigeminal Neuralgia, Anatomical variations

Introduction:

At the inferior surface of skull numerous foramen and fissures were present out of which foramen ovale is an important foramen at the greater wing of sphenoid bone [1,2].Foramen ovale accommodate many nerves and vessels like- Mandibular Nerve, The accessary meningeal Artery, The lesser petrosal Nerve, and Emissary Vein [3].Foramen ovale sometimes covered by bony bridges which results from ossification of the ligaments that are stretched between lateral pterygoid process and sphenoid bone. Sometimes foramen ovale may be compartmentalized by a bony spur located anteriomedially looking like double foramen ovale [4,5]. The area around the foramen ovale was found to be covered from an osseous lamina and continuous with the lateral pterygoid plate and which forms a wall of an apparent canal, which opens on the lateral side of each pterygoid process [6].

Foramen ovale is seen in the 7th month of intrauterine life as a discrete ring shaped area and mostly visible at 3 years after birth [7]. The foramen ovale is not present in reptilian and acquired in mammal during the process of evolution. The semilunar ganglion develops outside the skull in some living mammals including the mammalian embryo in the absence of foramen ovale. The advanced character acquired during the evolution process is the exit of mandibular nerve through the foramen ovale [8]. Borders of foramen ovale in some skulls were irregular and rough. This may suggest that presence of morbid changes which based on radiological images, which may be the sole anatomical variation in human foramen ovale [9]. Different literatures suggested that variability exists in morphology of foramen ovale. The shape of foramen like oval, truly oval, elongated oval, semicircular, almond, round, slit, pear shape were reported [10,11].

Knowledge about these variations in foramen ovale will help in differentiating abnormal foramen from normal at the time of computed tomography and magnetic resonance imaging [12]. The knowledge of accurate location and dimension of foramen ovale plays an important role

during certain diagnostic procedure like electroencephalographic analysis, micro vascular decompression by percutaneous trigeminal rhizotomy and percutaneous biopsy of cavernous sinus tumors [13,14].

Methods:

This study has been conducted on the total **50** dried adult human skulls North Indian Population obtained from the Department of Anatomy. After obtaining ethical clearance from research cell committee. To prevent discrimination, skulls have recruited for our study fulfilling inclusion criteria.The skull was carefully observed for size and shape of the foramen ovale and presence of any accessory osseous bony structure in relation to it.

Observation & Results:

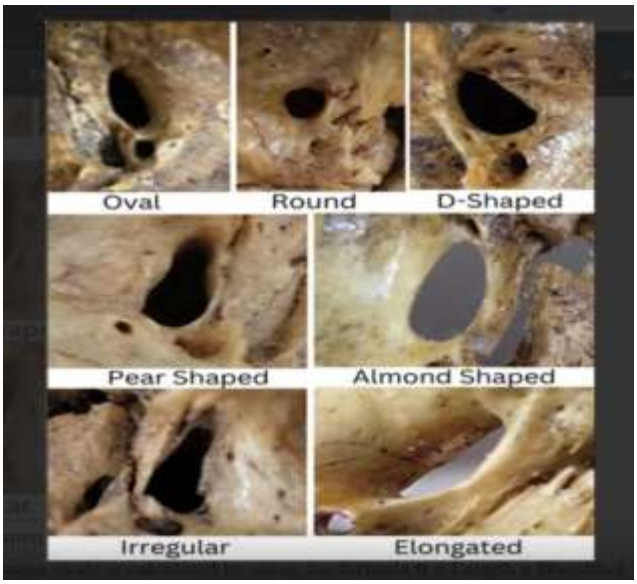

Figure -1 Shape of Foramen ovale

Table-1 Incidence of shape of foramen ovale on both sides

S. No.	Shape of foramen ovale	Right N (%)	Left N (%)	Total N (%)
1	Oval	42(84)	45(90)	87(87)
2	Almond	1(2)	0	1(1)
3	Round	3(6)	1(2)	4(4)
4	Longitudinal(Slit like)	1(2)	1(2)	2(2)
5	D Shaped	1(2)	0	1(1)
6	Triangular	1 (2)	2(4)	3(3)
7	Pear	0	1(2)	1(1)
8	Irregular	1(2)	0	1(1)

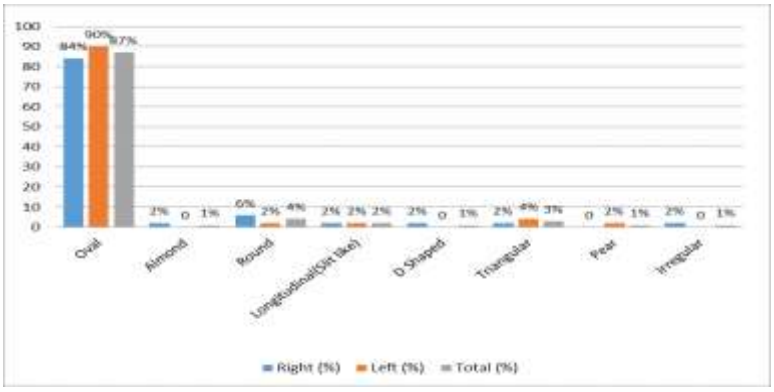

Fig-2 Shape of foramen ovale

Table-2 Incidence of accessory bony projection in foramen ovale on both sides

S. No.	Accessory Bony structure if present	Right N (%)	Left N (%)	Total N (%)
1	Bony projection	1(2)	1(2)	2(2)

Table-3 Bilateral measurement of foramen ovale

S.No.	Parameter	Side	Min-Max(mm)	Mean±SD	p value
1	Length	Right	4.34-8.94	6.74±1.13	> 0.05
		Left	4.01-9.02	6.53±1.04	
2	Width	Right	2.67-6.54	4.174±0.92	> 0.05
		Left	2.96-5.97	4.27±1.06	
3	Distance from root of zygoma	Right	15.50-24.79	20.09±1.98	> 0.05
		Left	15.82-23.60	19.97±2.02	
4	Distance from articular tubercle	Right	22.48-35.50	29.705±2.86	> 0.05
		Left	23.48-33.54	29.08±2.79	

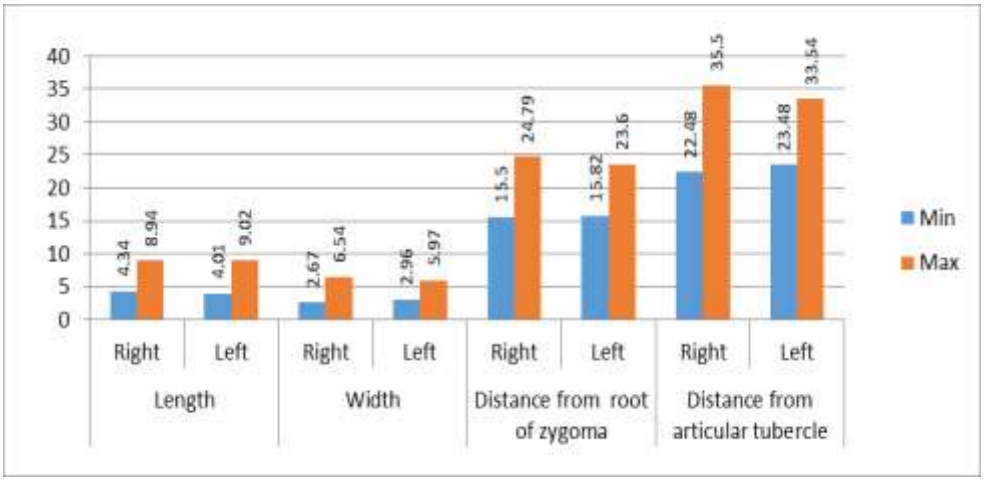

Fig-3 Bilateral measurements of foramen ovale

Result:

1. The shape of foramen ovale is oval (87%) most commonly, second common shape is round (6%), rest it is triangular (3%), D shaped (1%), pear (1%), and irregular shaped (1%). (Table No.1). In 2% cases bony projection is present in the foramen ovale.
2. The maximum and minimum length of foramen ovale is 8.49mm and 4.34mm on right side and 9.02mm and 4.01mm on left side. The maximum and minimum width is 6.54mm and 2.67mm on right side and 5.97mm and 2.96mm on left side.
3. The maximum and minimum distance from the root of zygoma to the foramen ovale is 24.79mm and 15.50mm on right side and 23.60mm and 15.82mm on left side. The maximum and minimum distance from the articular tubercle to the foramen ovale is 35.5mm and 22.48mm on right side and 33.54mm and 23.48mm on left side.

Discussion:

Table- 4 Comparison of shapes of foramen ovale

Author	N.of skulls	Oval (%)	Round (%)	Triangular (%)	Slit (%)	Almond (%)	D shaped (%)	Pear (%)	Irregular (%)
Somesh et al, 2011[9]	82	56.7	10.9	0	0	28.65	0	0	3.65
Gupta et al, 2013[16]	35	54.29	8.57	0	1.43	35.71	0	0	0
Mishra et al, 2014[27]	50	66	3	0	4	22	2	0	3
Murugan et al, 2014[7]	250	69	10	0	0	29	0	0	0
Patil et al, 2014[48]	60	70	13.33	0	7.5	5	0	4.17	0
Ashwini et al, 2017[53]	55	63.63	1.81	0	0	16.36	0	0	18.18
Poornima et al, 2017[54]	100	60	13	0	2	25	0	0	0
Present study	50	87	4	3	2	1	1	1	1

Author	N.of skulls	Length (mm) Min-Max(mean) Right side	Length (mm) Min-Max(mean) Left side	Width (mm) Min-Max(mean) Right side	Width(mm) Min-Max(mean) Left side
Somesh et al, 2011[9]	82	5.0-11.0(7.64)	4.5-11.0(7.56)	3.0-7.5(5.12)	3.0-8.0(5.24)
Gupta et al, 2013[16]	35	4.1-9.2(7.22)	3.2-9.0(6.48)	3.0-5.1(3.57)	2.5-6.0(3.5)
Mishra et al, 2014[27]	50	5.4-10.2(7.6)	5.6-8.9(7.5)	3.3-8.2(4.4)	2.4-5.4(4.1)
Murugan et al, 2014[7]	250	5.7-11.2(8.9)	5.2-11.4(8.5)	2.1-5.5(3.9)	1.6-5.6(3.7)
Patil et al, 2014[48]	60	5.4-10.3(7.8)	4.2-9.4(7.26)	2.8-6.2(4.0)	2.2-6.8(4.05)

Patel et al 2014[41]	**100**	**3-10(6.6)**	**3-10(6.5)**	**2-7(3.6)**	**2-7(3.5)**
Poornima et al, 2017[54]	**100**	**4.1-8.8(6.5)**	**3.3-8.6(6.4)**	**2.8-5.4(3.54)**	**2.4-6.1(3.5)**
Present study	**50**	**4.3-8.9(6.74)**	**4.01-9.0(6.53)**	**2.67-6.5(4.17)**	**2.9-5.9(4.27)**

Table-5 Comparison of dimensions of foramen ovale

Conclusion:

- Foramen ovale is present bilaterally in all human skulls.
- Shape of foramen ovale is variable.
- Bilateral variation in shape of foramen ovale exists.

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