Original Research Article

A study on morphometric analysis of foramen ovale among south Indian population

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Abstract

Background: Greater wing of sphenoid has many foramens, of which foramen ovale is of great importance as mandibular nerve passes through it, any alterations from the normal foramen leads to vascular compromise and nerve compression. **Materials and Methods:** 40 dry adult human skulls were chosen during routine demonstration to undergraduate medical students. The Foramen ovale of the entire chosen specimens was evaluated in terms of size, shape using Vernier caliper from the base of the skull. **Results:** The mean length of foramen ovale on right side is (6.93mm ±0.85mm) and (6.88mm ±0.87mm) on left side. The mean breadth of foramen ovale on right side is (3.99mm ±0.59mm) and (3.85mm ±0.56mm) on left side. Oval shaped foramen ovale was about 65% on right side and 75% on left side, followed by almond shape was about 17% on right side and 12% on left side and circular shape was about 17% on right side and 12% on left side. **Conclusion:** The study has made it evident that the different shapes of foramen might be a reason for nerve compression, further studies with larger sample size and comparing them with real clinical patients will throw light on other morphological variations which would help clinicians for diagnosis and treatment of Neuralgia.
Key Words: Foramen Ovale, TrigeminalNeuralgia, Skull, Sphenoid bone.

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Received Date: 02/07/2018 Revised Date: 27/08/2018 Accepted Date: 12/09/2018
DOI: https://doi.org/10.26611/1001733

Access this article online

Quick Response Code:

Website: www.medpulse.in

Accessed Date: 28 September 2018

INTRODUCTION

Foramen ovale is an essential foramen present on infratemperol surface of greaterwing of sphenoid. It transmits various neurovascular structures which include mandibular nerve, lesser petrosal nerve, accessory middle meningeal vessels and emissary vein[1]. Foramen ovale has great surgical and clinical significance in nerve compression causing trigeminal neuralgia and to perform percutaneous procedure for cavernous sinus by clinicians. Many eminent researchers have studied about the morphometrics of foramen ovale based on shape and length; the knowledge of anatomy of foramen ovale is not only helpful for anatomist but also useful for radiologist, orofacial-maxillary surgeons and neurosurgeons. The present study was carried out to identify various morphometric analysis of foramen ovale to identify the variations in the morphology so as to aide in the diagnosis of compression leading to neuralgia.

MATERIALS AND METHODS

This study was performed in 40 dry adult human skulls during routine demonstration for undergraduate students in the department of Anatomy, Karpaga Vinayaga Institute of Medical Sciences, Madhuranthagam, Kanchipuram District, Tamil Nadu, India. Parameters like shape and size were studied using Vernier calipers from the base of the skull. The shape of foramen ovale on both sides was measured. Maximum length and breadth was calculated using Vernier caliper. The results were analyzed statistically using SPSS version 20.The study was cleared by internal ethical committee.

How to cite this article: Durai Pandian K, K V K Sundaravadhanam, T L Anbumani. A study on morphometric analysis of foramen ovale among south Indian population. *MedPulse International Journal of Anatomy*. September 2018; 7(3): 31-34.
http://www.medpulse.in/Anatomy

RESULT

All the skulls showed bilateral presence of foramen ovale. The frequency of oval shaped foramen was maximum about 65% on the right side and 75% on the left side. The frequency of almond shape was 17.5% on right side and 12.5% on left side. The frequency of circular shape was 17.5% and 12.5%.The mean length and breadth of foramen ovale on right side was 6.93mm and 3.99mm.The mean length and breadth of foramen ovale on left side was 6.88mm and 3.85mm.

Table 1: Shape of Foramen Ovale on the right side

Shape Right	Frequency	Percent%
Almond	7	17.5
Circular	7	17.5
Oval	26	65
Total	**40**	**100**

Table 2: Shape of Foramen Ovale on the left side

Shape left	Frequency	Percent%
Almond	5	12.5
Circular	5	12.5
Oval	30	75
Total	**40**	**100**

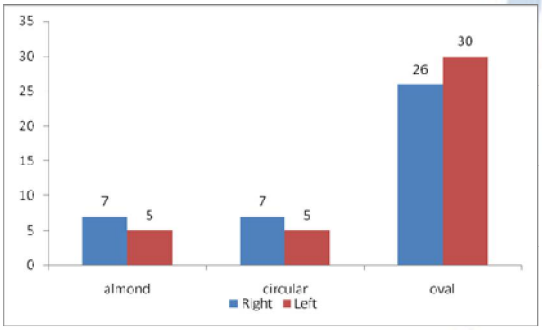

Figure 1: Bar Diagram of Shape Vs Side

Table 3: Chi square tests to find the association b/w right and left side in shapes at 5%α

Shape R vs L	almond	circular	oval	Total	
almond	1	2	4	7	Chi sq = 4.81
circular	2	1	4	7	p = 0.3
oval	2	2	22	26	
Total	**5**	**5**	**30**	**40**	

There is no association b/w right and left side of shapes, Breath right vs. left = 33.9%, p = 0.03**, Breath vs. Shape = - 36 % with p = 0.001*, *Significant by Spearman Rank correlation. There is significant relationship between the two variables, ** Significant by Kendal's correlation. There is significant relationship between the left and right side.

Table 4: Paired t test to find the diff b/w two related variable at 5%α

	Side	Mean ±SD	Median	Range	Paired t test	p value
Length	Left	6.88 ±0.87	6.79	5.3 - 9.8	0.31	0.7
	Right	6.93 ±0.85	6.85	5.5 - 9		
Breath	Left	3.85 ±0.56	3.85	2.88 - 5.1	1.32	0.19
	Right	3.99 ±0.59	3.96	2.98 - 5.49		

There is no significant difference b/w right and left side in length. There is no significant difference b/w right and left side in breath.

Figure 1

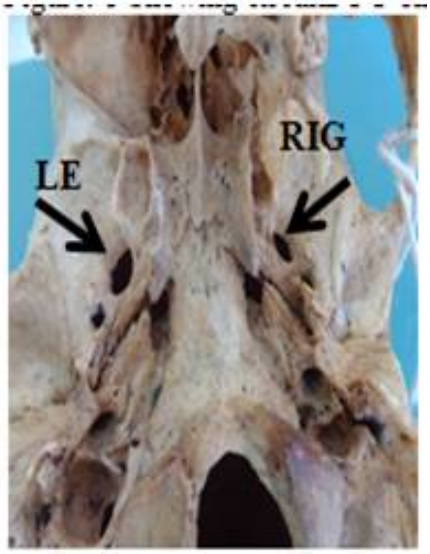

Figure 2

Figure 1: Showing circular FO on both sides; **Figure 2:** Showing almond shaped FO in Left and oval shaped FO on Right

DISCUSSION

Complete knowledge of development of foramen ovale is essential to identify the variations and abnormal foramens. The greater wing of sphenoid is embryologically complex structure developed by endochrondral ossification by a piece of cartilaginous bar called Allispenoid which encloses the mandibular nerve and other vasculature to form greater wing of sphenoid. A complete ring shaped foramen ovale is seen in 7th month and 3rd year[2]. Many authors have demonstrated about the variations of shape of foramen ovale. Maximum percentage of oval shaped of foramen ovale was demonstrated by many authors, thus correlating with our study and in greys anatomy as the shape the foramen ovale is oval[1]. Daimi *et al* have showed 46%of D shaped foramen ovale[8]. The comparative study of various authors is tabulated in table 5.In the present study the shape of foramen ovale was 65% oval on right side and 75% on left side followed by almond shaped (17.5% in right side and 12.5% in left side). The percentage of circular shape was 17.5% in right side and 12.5% on left side. Thus any alteration of shape leads to nerve compression.

Table 5: Comparative study of shape of foramen ovale in previous study

Authors	Year	Oval (%)		Almond (%)		Circular (%)	
		Right	Left	Right	Left	Right	Left
Somesh *et al*[3]	2011	48	45	24	23	8	10
Rai *et al*[4]	2013	57	51.4	40	31.4	2	14.2
Mishra *et al*[5]	2016	30	36	13	9	2	1
Ashwini *et al*[6]	2017	69	63	9	9	4	1
Present study	**2017**	**65**	**75**	**17.5**	**12.5**	**17.5**	**12.5**
Ray *et al*[7]	2005	43		24		1	
Daimi *et al*[8]	2011	29.8		-		12.5	
Wadhwa *et al* [9]	2012	70		15		10	
Patel *et al*[10]	2014	59.5		12		27.5	
Shaik etal[11]	2014	62.8		23		11.8	

Study among Nigerian population showed a mean length ranging from 9.5mmto 5mm[12]. Study among Mangalore population showed a mean length 7.6mm to 7.01mm[3]. Landl *et al* studied among new york population using Fluoroscopic assisted laser showed a mean length of 6.9mm on right side and 6.8mm on left side[13]. A study among Kenyan population showed a higher values of mean length and breadth. Comparative study of morphometric analysis has been shown in table 6.Morphometric analysis of foramen ovale in the present study showed mean length (6.93 ±0.85) on right side and (6.88 ±0.87) on left side and mean Breadth (3.99 ±0.59) on right side and (3.85 ±0.56) on left side. There was on statical significance between the right and left side based on length and breadth.

Table 6: Comparative study of morphometric analysis of foramen ovale by various authors

Authors	Year	Mean Length (mm)		Mean Breadth (mm)	
		right	Left	right	left
Ray *et al*[7]	2005	7.46	7.01	3.21	3.29
Osunwake *et al*[12]	2010	7.01	6.89	3.37	3.33
Somesh *et al*[3]	2011	7.6	7.01	5.1	5.2
Ambica *et al* [14]	2012	6.5	6.8	3.7	4
Rai *et al*[4]	2013	7.2	6.4	3.5	3.5
kanyata D *et al*[15]	2015	7.69	7.68	4.24	4.28
Ashwini *et al* [6]	2017	6.5	6.3	4.8	4.5
Present study	2017	6.9	6.8	3.9	3.8

Investigative procedures like fine needle aspirationcytology through transfacial approach, Percutaneous trigeminal rhizotomyare performed through Foramen ovale. The normal anatomy of foramen ovale has a great clinical and surgical significance.

CONCLUSION

Foramen ovale is inconsistant in shape having a maximum percentage of oval shape, that is, 65% on right and 75% on left. The mean length was around 6.9mm on right side and 6.8mm on left side. The mean breadth was around 3.9mm on right side and 3.8mm on left side The study has made it evident that the different morphology of the foramens might be a reason for nerve compression, further studies with larger sample size and comparing them with real clinical patients may throw light on other morphological variations which would help clinicians for diagnosis and treatment of Neuralgia

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Source of Support: None Declared
Conflict of Interest: None Declared