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A Study on Morphological and Morphometric Features of Foramen Ovale

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Abstract

Background: The foramen ovale is present in spenoid 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 spenoid 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. *Materials and Methods:* A total 350 skulls were used for this study. The skulls were collected with I MBBS student from different medical institutions in south India. The following measurements were recorded. 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 9.5±1.92mm and right was 9.1±1.77mm. The maximum length was 12.1mm at left side and it was 11.9mm on right. The mean width was 4.1±0.92mm on right side and it was 3.9±1.01mm on left side. The shape of foramen ovale was ovale in 79% of skulls, almond in 18.28% of skulls and round was 2.57% of skulls. *Conclusion:* the findings of present study conclude that there is no 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 significance difference. The knowledge of foramen ovale morphometric observations has practical significance to both neurosurgical and functional cranial neuroanatomy.

Keywords: Foramen Ovale; Foramen Rotendum; Base of Skull; Spenoid Bone.

Introduction

The cerebral surface of each greater wing of sphenoid bone forms part of the middle cranial fossa of the skull containing numerous foramina and fissures, which transmits several vessels and nerves. Foramen ovale is located in the posterior part of the greater wing of the spenoid bone for the passing of the mandibular nerve, the accessory meningeal artery, lesser petrosal nerve and an emissary vein. This foramen ovale is normally located in the greater wing of the spenoid bone and it is posteriolateral to the foramen rotundum and it opens into the infratemporal fossa through its other opening on the lateral surface of greater wing [1,2]. The emissary and middle meningeal vein which are transmits through foramen ovale connects cavernous sinus with pterygoid venous plexus [3]. There are some studies which indicates 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 [4,5,6] or its venous part may be compartmentalised by a bony spur located antero-medially resulting in doubled foramen ovale. Another study conducted has found foramen ovaleto be divided into 2 or 3 components in 4.5% of the 100 macerated skulls

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studied with some irregularities [1]. Regarding the developmental aspects of foramen ovale, it is situated at the posterior border of greater wing of sphenoid.

The sphenoid bone has both intramembranous and endochondral ossification centres and it consists of the body, the paired lesser wings, and the greater wings. The basisphenoid is derived mainly from presphenoid and postsphenoid centres. 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 7th foetal month, 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 [7]. The mean length of the foramen ovale is about 3.85 mm in the newborn and about 7.2 mm in adults and its width extends from 1.81mm in the newborn to 3.7 mm in case of adults [8,9].

Information on various foramina of the humanskull gives insight into associations betweenneurovascular 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 undergoingselective amygdalohippocampectomy [10], microvascular decompression by percutaneous trigeminal rhizotomy for trigeminal neuralgia[11] and percutaneous biopsy of cavernoussinus tumours [12]. The technique of CT-guided transfacial fine needle aspiration technique through the foramen ovale is used to diagnose squamous cell carcinoma, meningioma, meckeland allows biopsy of deep lesions that would otherwise require craniotomy or open surgical biopsy [13,14]. The present study was conducted to observe the morphometric and morphological features of foramen ovale.

Materials and Methods

A total 350 skulls were used for this study. Theskulls were collected with I MBBS student fromdifferent medical colleges in south India. Skullsin poor conditions or skulls with partly damagedsurroundings of the foramen ovale were notconsidered. Maximum length (Anteroioposterio-diameter) and width (transverse diameter) offoramen ovale were measured with help of Vernier calliper's scale. Variation in right and leftside and sex difference in length and width werecalculated, the variations in shape also recorded.

Results

The mean length of formenovale on left side it was 9.5±1.92mm and 9.1±1.77mm was on right side. The mean length of formenovale in female skulls it was 9.2±1.42mm and 9.3±1.93mm was in male skulls(Table 1). The mean width of formenovale on left side it was 3.9±1.01mm and 4.1±0.92mm was on right side. The mean width of formenovale in female skulls it was 4.12±0.69mm and 3.85±1.09mm was in male skulls (Table 2). The shape of foramen ovale was ovale in 79.2% skulls, almond was 18.28% and 2.5% skulls were round (Table 3). The was no significant difference between any parameter.

Table 1: Length and width of bforamen ovale.

Dimensionsof values	Foramen ovale length(left) mm	Foramen ovalelength(right) mm	Foramen ovale width (left) mm	Foramen ovale width (right) mm
Maximum	12.1	11.9	5.4	5.9
Minimum	6.3	6.1	2.2	1.9
Mean ±SD	9.5±1.92	9.1±1.77	3.9±1.01	4.1±0.92
P- value	P>0.05		P>0.05	

Table 2: Sex deference in Length and width of foramen Ovale

Dimensionsof values	Foramen ovale length female (mm)	Foramen ovalelength male (mm)	Foramen ovale width Female (mm)	Foramen ovale width male (mm)
Maximum	12.1	11.9	5.9	5.4
Minimum	6.1	6.3	2.2	1.9
Mean ±SD	9.2±1.42	9.3±1.93	4.12±0.69	3.85±1.09
P- value	P>0.05		P>0.05	

Table 3: Shapes of foramen ovale

Shape	Right	Left	Total
Ovale	265(75.71%)	289(82.57%)	554(79.1%)
Almond	72(20.5%)	56(16%)	128(18.28%)
Round	13(3.71%)	5(1.42%)	18(2.57%)

Fig. 1: Showing base of skull with foramen ovale

Discussion

There are several foramina piercing the greater wingof the human sphenoid bone and one amongst them is the foramen ovale. Foramen ovale is present medial to the foramen spinosum and foramen lacerum is locatedmedial to the foramen ovale. It transmits the mandibulardivision of the trigeminal nerve, accessory meningeal branch of the maxillary artery, lesser petrosal nerve andan emissary vein which connects the pterygoid venousplexus in the infratemporal fossa to the cavernous sinus. Foramen ovale is situated at the transition zone between the extra cranial and the intracranial structures [15,16,17].

In our present study the mean length of left foramen ovale is 9.5±1.92 mm and right was 9.1±1.7 7mm. In female it was 9.2±1.42 mm and male was 9.3+1.93 mm. The study of Biswabina Ray et alconducted on a total of 70 sides in 35 dry adult skulls in their study the mean length of foramenovale was 7.46±1.41 mm on right side 7.01±1.41 mm on left side. Mean length of foramen ovalein male was 7.27±1.39 mm and in female was 7.16±1.51 mm. 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 5 mm in male and 4.9mm was in female skulls [14], this study results are in agreement with present study. Yanagi Sdevelopmental study conducted in Japan anaverage maximal length of foramen ovale was 7.48 mm and average minimal length was 4.17 mm [7]. In study of Lang J the average length of forminaovale was 7.2mm [9]. In Landl MK study reported 6.9mmon right side and 6.8mm on left side with rangelength 5.0- 10.0mm [18]. In an Indian study of Somesh et al mean length of foramen ovale was 7.64 ± 1.194 mm on the right and 7.561 ± 1.123 mm on the left side[19]. In same study of Somesh et al found that the maximal length of foramen ovale was 11 mm and its minimal length was 4.5 mm[19]. In study of Arun the maximum length was 9.8 mmand 2.9 mm was minimum [20]. In study of Osunwoke et al. it was 9.5 mm maximum and minimum was 5.0 mm [21]. The study of Gupta N was similar with the results ofour study which was conducted on 35 dry adult skulls. Their study revealed that the mean length of foramen ovale was 7.228±1.39 mm on right side and 6.48±1.131mm on left side. On left side, mean width was 3.50±0.75 mm and on right side was 3.57±0.70mm [22]. These studies are in agreement with present study.

In present study the mean value of width of right foramen ovale is 4.1+0.92mm and left was 3.9+1.01 mm. In female it was 4.12+0.69 mm and male was 3.85+1.09 mm. The maximum width of foramen ovale was 5.9 mm and minim was 1.9 mm. The study Biswabina Ray et al also reported similar results, in their maximum width of foramen ovale was 5.0 mm on both right and left sides while minimum width was 1.0 mm on right side and 2.2mm on left side. Mean width on right side was 3.21+1.02 mm and 3.29+0.85 mm on left side[14]. 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 our study the shape of foramen ovale was ovale in 69% of skulls, almond in 29% of skulls and round was 2% of skulls. Biswabina Ray et al study also reported similar results 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% [14]. Yanagi et al study also reported similar results [7]. Foramen ovale is considered to be one of the vital foramina situated between intracranial and extra

cranialstructures across transition zone. Its application in thefield of invasive surgery and in diagnostic procedure isunparalleled. Thus, the knowledge of morphometric andmorphology of foramen ovale is essential for surgeons.

References

1. Reymond J, Charuta A, Wysocki J: The morphology and morphometry of the foramina of the greater wing of the human sphenoid bone. Folia Morphologica 2005;64(3):188-193.
2. Standring S. The Anatomical Basis of Clinical Practice, Gray's Anatomy, 39th edit. Elsevier Limited, 2006: 460-462.
3. Susan Standring. Gray's Anatomy; The Anatomical Basis of Clinical Practice. Thirty ninth Edition. Elsevier Churchill Livingstone. 2005;462-463.
4. Wood-Jones F. The non-metrical morphological characters of the skull as criteria for racial diagnosis. Part I: General discussion of the morphological characters employed in racial diagnosis. J Anat. 1931;65:179-95.
5. Blaszczyk B, Kaszuba A, Kochanowski J: Atypical foramina of the base of the skull. Folia Morphol 1980;93:201–209.
6. Kapur E, Dilberovic F, Redzepagic S, Berhamovic E: Variation in the lateral plate of the pterygoid process and the lateral subzygomatic approach to the mandibular nerve. Med Arh 2000;54:133–137.
7. Yanagi S: Developmental studies on the foramen rotundum, foramen ovale and foramen spinosum of the human sphenoid bone. The Hokkaido Journal of Medical Science 1987;62(3):485-496.
8. M.S. Somesh, H.B. Sridevi, Latha V. Prabhu, M.S. GangadharaSwamy, Ashwin Krishnamurthy, B.V. Murlimanju, Ganesh kumarchettiar, A Morphometric study of Foramen Ovale.Turkish Neurosurgery 2011; 21(3):378-383.
9. Lang J, Maier R, Schafhauser O: Postnatal enlargement of the foramina rotundum, ovaleet pinosum and their topographical changes. AnatomischerAnzeiger 1984;156(5):351-387.
10. Wieser HG, Siegel AM. Analysis of foramen ovaleelectroderecorded seizures and correlation with outcome following amygdalohippocampectomy. Epilepsia. 1991;32:838-850.
11. Gusmao S, Oliveira M, Tazinaffo U, Honey CR. Percutaneous trigeminal nerve radiofrequency rhizotomy guided by computerized tomography f l uoroscopy: Technical note. J Neurosurg. 2003;99: 785–786.
12. Sindou M, Chavez JM, Saint PG. Percutaneous biopsy of cavernous sinus tumours through the foramen ovale. Neurosurgery1997;40:106-111.
13. Barakos JA, Dillon WP. Lesions of the foramen ovale: CT-guided fi ne-needl e aspirati on. Radiology. 1992;182:573-575.
14. Biswabina Ray, Nirupma Gupta, SupriyaGhose. Anatomic variations of foramen ovale. Kathmandu University Medical Journal. 2005;3(9):64-68.
15. Poornima B, Sampada P K, Mallikarjun M, Santosh B S. Morphometric and morphological study of foramen ovale in dry adult human skull bones. Indian Journal of Clinical Anatomy and Physiology, January-March, 2017;4(1):59-62.
16. Magi Murugan, ShaikHussainSaheb. Morphometric and Morphological study on foramen ovale. Int J Anat Res 2014;2(4):664-667. DOI:10.16965/ijar.2014.518.
17. Hussain SS, Muralidhar PS, Desai SD, Thomas ST, Maavishettar GF, Haseena S. Study of Mastoid canals and grooves in South Indian skulls. IJMHC. 2012;1(1):32–33.
18. Landl MK Walter Grand. Trigeminal Neuralgia: Fluoroscopically–Assisted Laser Targeting of the Foramen Oval e: TechnicalNote. Minrad International, Inc.2005.
19. M.S.Somesh, H.B.Sridevi et al. A morphometric study of foramen Ovale. Turkish Neurosurgery. 2011;21(3):378-383.
20. Arun SK. Some observations of the foramina ovale and spinosum of human sphenoid bone. J AnatSoc India 2006;55(1):100-101.
21. Osunwoke EA, Mbadugha CC, Orish CN, Oghenemavwe EL, Ukah CJ: A morphometric study of foramen ovale and foramen spinosum of the human sphenoid bone in the southern Nigerian population. J ApplBiosci 2010;26:1631-1635.
22. Gupta N, Rai AL. Foramen ovale-morphometry and its surgical importance. Innovative Journal of Medical and Health Science: 2013;3(1):4-6.