

A Morphometric study of Foramen Ovale

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Abstract

Introduction: Foramen Ovale is present in the posterior part of the greater wing of sphenoid. The Foramen Ovale transmits the mandibular nerve, the accessory meningeal artery, the lesser superficial petrosal nerve and the emissary vein. **Aims & Objective:** The objective of the study was to evaluate the morphometry of foramen ovale in dry adult human skulls. **Material & Methods:** The study was conducted on 110 foramen ovale of 55 dry human skulls available in the Department of Anatomy of a private medical college. Exclusion criteria included the damaged skulls, the foramina ovalae that were confluent with nearby foramina such as foramen spinosum and foramen lacerum. The dimensions of the foramen ovale were measured using vernier calipers and the values obtained were statistically analysed. **Observation & Results:** The study was done on total of 110 foramen ovale in 55 dry adult skulls. The foramen ovale was located bilaterally in all the specimens under study. The mean anterior posterior diameter (length) of foramen ovale on the right side is 8.4 ± 1.562 and on the left was 8.5 ± 1.323 . Mean transverse diameters (width) of foramen ovale on right was 4.5 ± 0.783 and on the left was 4.1 ± 0.561 . Oval FO was frequently observed than round, Almond shaped foramen ovale. **Conclusion:** Considering the clinical importance of Foramen Ovale in various neurosurgical procedures, this study was useful to document the morphometric data of foramen ovale in South Indian population.

Keywords: Foramen ovale, dry skulls, morphometry

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Introduction

The Foramen Ovale is located in the posterior part of the greater wing of the sphenoid. The important structures which pass through it are the mandibular nerve, the accessory meningeal artery, the lesser superficial petrosal nerve and the emissary vein [1]. The Foramen Ovale opens into the infratemporal fossa [2]. Variations in the morphology of Foramen Ovale has resulted in severe adverse events due to failure to properly cannulate the foramen ovale. This study was undertaken to evaluate the morphometry of foramen ovale in adult dry skulls belonging to South Indian population.

Materials and Methods

The study was performed on a sample of 55 dry human crania from the Department of Anatomy of a private medical college. Exclusion

criteria included the damaged skulls, the foramina ovalae that were confluent with nearby foramina such as foramen spinosum and foramen lacerum.

Results

The study was done on total of 110 foramen ovale in 55 dry adult skulls. The foramen ovale was located bilaterally in all the specimens under study. The mean anterior posterior diameter (length) of foramen ovale on the right side is 8.4 ± 1.562 and on the left was 8.5 ± 1.323 . Mean transverse diameters (width) of foramen ovale on right was 4.5 ± 0.783 and on the left was 4.1 ± 0.561 . as shown in Table 1.

Table 1: The mean anterior posterior and transverse diameter of the foramen on right and left.

	Foramen Ovale length (Left) mm	Foramen Ovale length (Right) mm	Foramen Ovale Width (Left) mm	Foramen Ovale Width (Right) mm
Maximum	9.5	9.7	4.5	4.8
Minimum	7.4	7.1	3.7	4.1
Mean	8.5	8.4	4.1	4.5
SD	1.323	1.562	0.561	0.783
P-Value	>0.05		>0.05	

Table 2: The variation in the shape of the foramen ovale in the present study.

Shape	Right	Left	Total
Oval	37	39	76
Round	12	8	20
Almond	6	8	14

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Fig 1: Foramen Ovale in one of the specimens under study

Fig 2: Figure showing Anteroposterior Diameter of foramen Ovale (Yellow arrow) and Transverse Diameter of foramen ovale (White arrow)

Discussion

The Foramen Ovale is present in the posterior part of the greater wing of the sphenoid in the middle cranial fossa. The important structures which pass through it are the mandibular nerve, the accessory meningeal artery, the lesser superficial petrosal nerve and the emissary vein [1]. As their essential component, all foramina in the greater wing of sphenoid contain venous plexuses. The venous plexus of the foramen ovale connects the cavernous sinus with the pterygoid venous plexus. The earliest perfect ring-shaped formation of the foramen ovale is observed in the 7th fetal month and the latest in 3 years after birth[3].

Table 3: Comparison of dimensions of foramen ovale with other studies

	Foramen Ovale – Length (mm)		Foramen Ovale – Width (mm)	
	Left	Right	Left	Right
Das et al [4]	6.53	7.11	3.2	3.148
Murugan et al [5]	8.5	8.9	3.7	3.9
Prakash KG et al[6]	7.64 ± 1.194	5.12 ± 0.827	7.56± 1.123	5.24± 0.950
Gupta et al[7]	6.48±1.131	7.22±1.139	3.50±0.75	3.57±0.70
Priyanka Katara et al.[8]	7.14±1.24	7.98±0.99	3.78±0.61	4.24±1.15
Present study	8.5±1.323	8.4±1.562	4.1±0.561	4.5±0.783

In a study by Adel et al, the size of the foramen ovale varied significantly, Obstruction from a calcified pterygoalar ligament occurred in 7.8% of specimens. 8% of the foramen ovale were found to be difficult to cannulate which may result in inadvertent cannulation of foramen lacerum[9].

Table 4: Comparison of various shapes of foramen ovale with other studies

Shape	Gupta et al [7]	Sarbani Das et al[4]	Priyanka Katara et al.[8]	Present study
Oval	54.29%	53	88	76
Round	8.57%	21	16	20
Almond	35.71%	21	-	14

The most frequently observed shape of the foramen ovale in the present study is Oval (76%) followed by round (20%) and almond (14%). This is similar to the observations of other studies[4,7,8]. A study on 174 adult human dry skulls analyzed using anatomical and surgical orientations in photographs from standardized projections. The study identified 6 distinctive shapes of the FO and 5 anomalous variants.[9] The shape of the FO may contribute to operative difficulties. The diverse shapes of foramina ovalae have been described as “banana-like,” “triangular,” “oval,” “truly oval,” “elongated oval,” “elongated,” “semicircular,” “almond,” “round,” “rounded,” “slit,” “irregular,” “D shape,” and “pear”.[10] Multiple foramen ovale, foramen ovale with spine, septa, tubercles were found in several studies[11,12,13,14]. Ossified ligaments near the foramen ovale (e.g., pterygospinous and pterygoalar ligaments) could interfere with transcutaneous needle placement into the foramen ovale or distort anatomic relationships during approaches to the cranial base. Failure to cannulate the FO has been reported to occur due to suspected variation in Foramen Ovale morphology[15].

Conclusion

Variations in Foramen Ovale morphology are frequently reported which interfere with neurosurgical procedures in the vicinity of foramen ovale. Hence, the present study is important in establishing reference data of foramen ovale in South Indian population.

References

- Gray Henry. *Gray’s Anatomy of Human Body*. 37th. New York and London: Churchill Livingstone; 1989. Osteology. In: Peter L Williams, Warwick, Roger; pp. 267–447.
- Soames RW. *Gray’s Anatomy of the Human Body*. 38th. Churchill Livingstone; 1995. pp. 425–736
- Yanagi S (1987). "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): 485-96.
- Das Saurjyanjan, Champatrayay Sreepreeti, Nayak Gyanaranjan. An anatomical study of foramen ovale with clinical implications. *Int J Anat Res* 2018;6(4.2):5921-5925.
- Murugan, Magi & Saheb, Shaik. Morphometric and morphological study on foramen ovale. *International Journal of Anatomy and Research*. 2014; 2. 664-67.
- Prakash KG, Saniya K, Honnegowda TM, Ramkishore HS, Nautiyal A. Morphometric and anatomic variations of foramen ovale in human skull and its clinical importance. *Asian J Neurosurg* 2019;14:1134-7
- Anju Lata Rai. "foramen ovale-morphometry and its surgical importance". *Innovative Journal of Medical and Health Sciences*. 2013;3(12):23
- Priyanka Katara, Abhilasha Dadhich, Anirudh Saxena, Shivangi Sharma, Devasheesh Sharma. Morphological and Morphometric

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- Study of Foramen Ovale and Foramen Spinosum in Human Skull. *Int J Med Res.* 2020 Mar; 6(2): 94-96.
9. Elnashar, Adel, Smruti K. Patel, Almaz Kurbanov, Kseniya Zvereva, Jeffrey T. Keller, and Andrew W. Grande. "Comprehensive anatomy of the foramen ovale critical to percutaneous stereotactic radiofrequency rhizotomy: cadaveric study of dry skulls". *Journal of Neurosurgery JNS* 132.5 (2020): 1414-1422.
 10. Zdilla, Matthew J., et al. "Circularity, solidity, axes of a best fit ellipse, aspect ratio, and roundness of the foramen ovale: a morphometric analysis with neurosurgical considerations." *The Journal of craniofacial surgery* 27.1 (2016): 222.
 11. Latiff, Azian & Das, Srijit & Sulaiman, I & Hlaing, K & Suhaimi, F & Ghazalli, H & Othman, Faizah. (2009). The accessory foramen ovale of the skull: An osteological study. *La Clinica terapeutica.* 160. 291-3.
 12. Khairnar KB, Bhusari PA. An anatomical study on the foramen ovale and the foramen spinosum. *J Clin Diagn Res.* 2013 ;7(3):427-9.
 13. Sharma, Shikha & Thakur, Chetna & Modi, Bhawani & Singh, Tejendra. Study of anatomic variant of foramen ovale and spinosum in dried human skulls. *International Journal of Anatomy and Research.* 2016; 4:9
 14. Mishra, S. R., Shobhana, S., Singh, S., Singh, R., & Gaharwar, A. (2018). Morphometric and Topographic Study of Foramen Ovale in Indian Skulls. *Malaysian Journal of Medical and Biological Research*, 5(2), 75-84.
 15. Georgiopoulos M, Ellul J, Chroni E, et al. Minimizing technical failure of percutaneous balloon compression for trigeminal neuralgia using neuronavigation. *ISRN Neurol.* 2014:630418.

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