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A Study on Morphology, Morphomertric and Duplication of The Foramen Ovale in Human Skulls of South Indian Population

KEYWORDS: foramen Ovale, skull, anatomical variation,morphology,duplication.

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ABSTRACT *AIM AND OBJECTIVE: To study the morphology, morphomertric and duplication of the foramen ovale in human skulls of south indian population.*

BACKGROUND: The foramen ovale is an oval opening in the greater wing of sphenoid bone transmitting the mandibular nerve as its major content. The foramen ovale connects the middle cranial fossa with the infra temporal fossa. It serves as an important landmark for neurosurgeons in certain procedures as to gain access to trigeminal nerve. Therefore, its topographic position in relation to adjacent bony landmarks provides useful tool during these procedures. Duplication of the foramen ovale is a rare phenomenon. It is seen in both sexes and presents at various ages.

REASON: The focus on this assessment is to verify the morphology and morphometric variation in dry skulls of South Indian origin .. Knowledge regarding duplication of foramen ovale is useful during surgical exploration of the same especially during trigeminal neuralgia.

INTRODUCTION:

The foramen ovale is present in sphenoid 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 linguala 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 [1,2].It connects infratemporal fossa to the middle cranial fossa and transmits the mandibular nerve, accessory meningeal artery and lesser petrosal nerve and emissary vein which connects the cavernous venous sinus to the pterygoid venous plexus in the infratemporal fossa.Regarding the developmental aspects of foramen ovale, it is situated at the posterior border of greater wing of sphenoid. This sphenoid bone has both intramembranous and endochondral ossification centers and it consists of the body (basisphenoid), the paired lesser wings (orbitosphenoids), and the greater wings (alisphenoids). The basisphenoid is derived mainly from presphenoid and postsphenoid centres and 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 22 weeks (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.The emissary vein and other structures are separated by a layer of dense connective tissue which may occasionally be ossified to result in the duplication of the foramen ovale[3]. The present study focused on the different diameters such as length and width of foramen ovale and its shape and duplication, the knowledge of this study may help in surgeries of neurological diseases.

This study was carried out on 80 FO using 40 adult human skulls obtained from preserved sets of bones received at Department of Anatomy,Saveetha dental college, Chennai,Tamil Nadu, India. FO was identified as an oval aperture located in the posterior part of greater wing of sphenoid bone. Skulls with damaged surroundings of the foramen ovale were not considered. Maximum length and width of FO was measured with the help of divider and transferred to a meter scale for readings. Various shapes of foramina and bony growth around the margins of the foramen were noted. Incidence of variation of shape and dimensions evaluated. Variation in right and left side and sex difference in dimensions calculated. Statistical analysis was done by using student's t test.

RESULTS:

Shape	Right(40)	Left(40)	Total(40)
Oval	24(60%)	21(52.5%)	45 (56.5%)
Almond	10(25%)	12(30%)	22 (27.5%)
Round	4(10%)	6(15%)	10 (12.5%)
Irregular	2(5%)	1(2.5%)	3 (3.75%)

Table 1: Morphological variation in appearance of foramen Ovale

The mean value of length of left foramen ovale is 8.3+1.41mm and right was 8.6+1.57mm.The mean value of width of left foramen ovale is 3.9+1.03mm and right was 3.6+0.98mm.The shape of foramen ovale was oval in 56.5% of skulls, almond in 27.5% of skulls, round in 12.5% of skulls and irregular was 3.75% of skulls.

Dimensions of values	Foramen Ovale Length (left mm)	Foramen Ovale Length (Right mm)	Foramen Ovale Width (Left mm)	Foramen Ovale Width (Right mm)
Maximum	11.3	11.6	4.6	4.5
Minimum	4.2	4.7	2.6	2.3
Mean	8.3	8.6	3.9	3.6
S.D	1.41	1.57	1.03	0.98
P-value	>0.05	>0.05	>0.05	>0.05

Table2:Morphometric variations of foramen ovale

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Number of skulls studied	Number of skulls with duplicated foramen ovale	Bilateral	Right	Left	Total
40	1	0	0	1	1

Table 3: Duplication of foramen Ovale

Chart1:Morphological variation in appearance of foramen Ovale (Right)

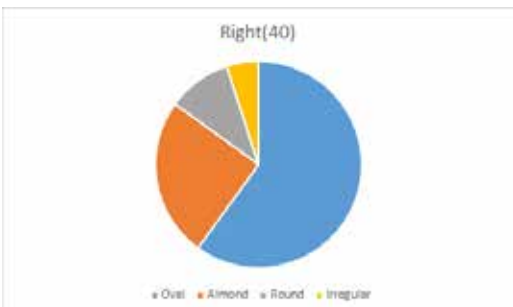


Chart2:Morphological variation in appearance of foramen Ovale (left)

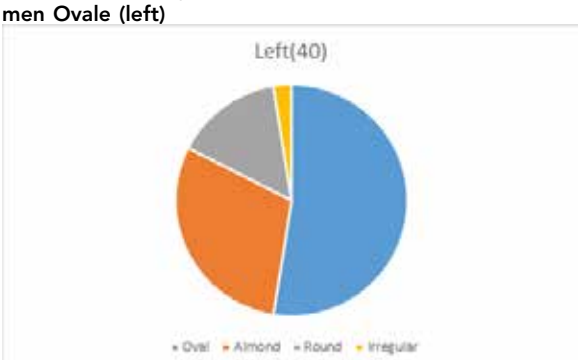
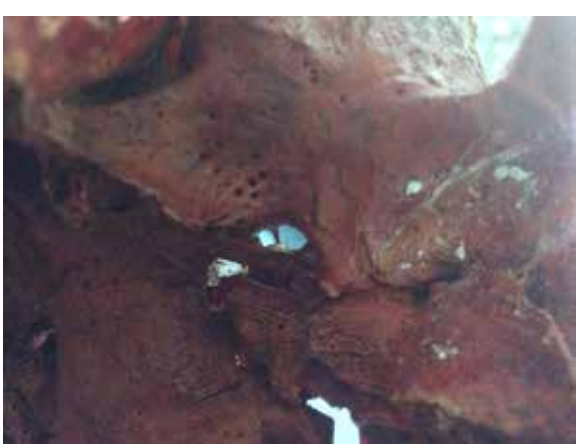


Figure 1: Duplication of foramen Ovale



DISCUSSION:

Foramen ovale(FO) is one of the important foramina used for various invasive surgical as well as diagnostic procedures. Knowing the anatomic variations of foramen ovale is important because surgical treatment of trigeminal neuralgia is most commonly accomplished by microvascular decompression by percutaneous trigeminal rhizotomy done through FO [7][8].

Morphometery :

In present study the mean value of length of left foramen ovale is 8.3+1.41mm and right was 8.6+1.57mm. our results are in agreement with study of Biswabina Ray et al conducted on a total of 70 sides in 35 dry adult skulls in their study the mean length of foramen ovale was 7.46±1.41 mm on right side 7.01±1.41 mm on left side. Mean length of foramen ovale in 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 5mm. in male and 4.9mm. in female skulls [10]. In Landl MK study reported 6.9mm on right side and 6.8mm on left side with range length 5.0-10.0mm [11].

In present study the mean value of width of left foramen ovale is 3.9+1.03mm and right was 3.6+0.98mm. In Landl MK study reported the average width on right side was 3.4mm and 3.8mm[11]. In the present study difference between the length and width of foramen ovale in male and female sex was not statistically significant this are in agreement with Biswabina Ray et al [10].

Morphology:

Variations in the shape of FO showed maximum number of foramen to be oval shaped (n=45; 56.5%) followed by almond shaped (n=22; 27.5%), round (n=10; 12.5%) and slit like (n=3; 3.75%).Developmental studies conducted in Japan also reported majority of the FO to be oval shaped [4].

Duplication:

The duplication of the foramen ovale is rare and it is seen in both sexes in different age groups[12]. The duplications of the foramen ovale are developmental in origin and they result from the anomalous growth of the bony spur, which grows further and divides the foramen ovale in to two foramen.

In this study on anatomic variations of foramen ovale also reported a spine on the margin of the oval foramen in 1 cases (1 left) they found a bridge like bony spur dividing the foramen ovale into two compartments.

A thorough understanding of fetal growth and development is the key to understanding both the completed normal anatomic structure and the abnormal variations. Most of the central skull base develops from endochondral ossification through an intermediary chondrocranium [5] .The sphenoid bone consists of the body (formed by the presphenoid and postsphenoid centres, with a contribution from the medial crus of the orbitosphenoid).The lesser and greater wings from orbitosphenoids, alisphenoids respectively [5]. Ossification of the skull progresses in an orderly pattern from posterior to anterior. The postsphenoid (14 weeks) and then presphenoids (17 weeks) of the sphenoid bone ossify.

Ossification is seen laterally in the orbitosphenoid (16 weeks) and the alisphenoids (15 weeks).A CT scan study of fetal specimen with a gestational age of 22weeks 3 days showed ossification of alisphenoid (that forms greater wings) and FO seen as large defect [5] . Ossification around the large trunk of mandibular nerve takes place later. Hence the variations observed in shapes and margins of FO indicate bony outgrowth during developmental process.

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FO is of great surgical and diagnostic importance. Knowledge of the variations of its anatomy may help to better identify and preserve important neurovascular structures during approaches to the middle cranial fossa because surgical treatment of TN is most commonly done by microvascular decompression by percutaneous trigeminal rhizotomy done through FO [6,9].

CONCLUSION

Morphometric analysis from the current study mostly falls well within the range of other study results pertaining to Asian population. Though, the morphometric measurements of foramen ovale of right and left side are statistically insignificant, the results of both sides mark the evidence of asymmetry in the morphometry of the foramina ovalia in South Indian population.This study is of clinical, diagnostic and anatomical significance to medical practitioners in cases of trigeminal neuralgia, detection of tumours, bony outgrowth that may lead to ischaemia, necrosis and possible paralysis of the parts of the body being supplied, drained or innervated by its contents.

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