

Study of anatomical variations of foramen ovale and pterygoalar bar with it's clinical significance

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Abstract

Background: The foramen ovale is present in the greater wing of the sphenoid bone. The foramen ovale gives passage to mandibular nerve, lesser petrosal nerve, accessory meningeal artery and emissary vein. The present study gives details of variations of foramen ovale and also the incidence of pterygoalar bar in dry human skulls. **Materials and Methods:** The present study was carried out by using 112 adult dry human skulls. The skulls were examined from the department of Anatomy, Government Medical College Aurangabad. The skulls were carefully observed for the presence of foramen ovale and it's variations. The length and width of Foramen ovale was measured using digital vernier calliper. **Results:** The oval shaped foramen was present in 66.07% of skulls. Almond shaped foramen were observed in 14.28% of skulls and round shaped in 10.72% of cases. D shaped foramen was noted in 7.15% cases whereas 1.78% of skulls showed presence of triangular foramen ovale. The mean length of foramen ovale on right side was 7.52±1.15 mm and 7.29±1.06 mm on left side. The mean width of foramen was 4.18±0.78 mm and 4.28±0.81 mm on right and left side respectively. **Conclusion:** The present study shows wide anatomical variations in foramen ovale. The different shapes like oval, almond, rounded, D shape, triangular were found and abnormal outgrowth like presence of bony pterygoalar bar, spur were also noted in the present study.

Key Words: Foramen ovale, human skulls, spur, pterygoalar bar

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INTRODUCTION

The foramen ovale lie lateral to the Foramen lacerum on infratemporal surface of greater wing of the sphenoid bone. It is present near to the posterior margin of lateral pterygoid plate.¹ foramen ovale is located posterior to foramen rotundum, posterior end of carotid groove and just lateral to lingula.² The foramen ovale transmits the mandibular nerve, lesser petrosal nerve, accessory meningeal branch of maxillary artery and a venous plexus that connects the

cavernous sinus to the pterygoid venous plexus in the infratemporal fossa.^{1,3,4} The mandibular branch of trigeminal nerve passes from the trigeminal ganglion in the cranium through the foramen ovale in the plane of the lateral pterygoid plate. In the foramen ovale it is joined by the entire motor root of the trigeminal nerve and emerges from the skull as a mixed nerve.⁵ Sphenoid bone ossified by intramembranous and enchondral ossification during 7th month of intrauterine life, the foramen ovale appears as a prominent ring shaped area. The foramen ovale clearly visible 3 year after the birth of the baby.⁶ The foramen ovale is located at a transition zone between intracranial and extracranial structures.⁷ It has intense clinical significance in various therapeutic procedures. It gives best neurological information by placing electrodes at foramen ovale during electroencephalography⁸. Percutaneous biopsy can be done through the foramen ovale in patients with cavernous sinus tumours.⁹ Study of variations of foramen ovale is very essential in order to treat the patients of trigeminal neuralgia as Gasserion ganglion can be approached transcutaneously through the skull base via

foramen ovale.¹⁰ The present study provides detailed information regarding variations in shape, size of foramen ovale, morphometric measurements like length and width of foramen ovale and incidence of pterygoalar bar in 112 dried adult human skulls.

MATERIALS AND METHODS

In this study 112 was adult dry human skulls of unknown sex were used. The skulls were examined from the department of Anatomy, government medical college Aurangabad during the year 2019-2020. The skulls were carefully observed for the variations of foramen ovale at the greater wing of sphenoid bone by naked eyes. The anteroposterior (length) and transverse (width) diameter of foramen ovale was measured by using digital Vernier calliper. Measurements were taken in millimeters. The obtained data was properly recorded and tabulated. The photographs were taken and findings were compared with previous studies by different authors.

RESULT

In the present study 112 dry adult human skulls were used. The shape of the foramen ovale was observed for its variations. The oval shaped Foramen was found in majority of skulls, about 148 (66.07%) foramen were oval in shape. Almond shaped foramen was observed in 32 (14.28%) cases. Twenty four, 24 (10.72%) foramen were

rounded in shape and 16 (7.15%) were 'D' shaped. Only four (1.78%) skulls showed presence of triangular shaped foramen. All the skulls showed presence of foramen ovale on both sides, none of the skull was with absent foramen ovale. Slit shaped foramen ovale was not observed in any of the skull. Double and confluent foramen ovale was also not found in any skull. (Table no.1)

The mean length of foramen ovale on right side was 7.52±1.15 mm and on left side was 7.7.29±1.06 mm. The maximum length of foramen ovale on right and left side was 10.1mm and 9.7mm respectively. The minimum length of foramen ovale on right side was 5.52mm and on left side was 5.43mm. The mean width of foramen ovale was 4.18±0.78 mm on right side and on left side was 4.28±0.81 mm. The maximum width was 6.56mm and 6.30mm on right and left side respectively. The minimum width was 2.87mm on right side and on left side was 2.5mm. Statistical analysis was done by using paired t test to calculate the difference between right and left side. In all parameters (length and width) comparison between two sides was not significant statistically. (Table no.2) In the present study the bony spur in foramen ovale was present unilaterally in 4 cases. None of the skull shows bilateral presence of bony spur. The complete pterygoalar bar was found unilaterally in seven cases whereas one skull shows incomplete presence of unilateral pterygoalar bar. Bilateral complete pterygoalar bar was present in only one skull.(Table no.3)

Table 1: Variations of Foramen Ovale with percentage

Sr.no	Shape	Number	Percentage
1	Oval	148	66.07%
2	Almond	32	14.28%
3	Round	24	10.72%
4	D shape	16	7.15%
5	Triangular	4	1.78%

Table 2: Measurements of foramen ovale In millimeters (mm) with statistical analysis

Parameter	Right + Left Mean + SD (N=224)	Right Side Mean + SD (N=112)	Left side Mean + SD (N=112)	Paired 't' test	P value
Length	7.41 ± 1.11	7.52 ± 1.15	7.19 ± 1.06	t= 0.186	P>0.05 NS
Width	4.23 ± 0.79	4.18 ± 0.78	4.28 ± 0.81	t= 0.037	P>0.05 NS

Table 3: Incidence of pterygoalar bar in the present study

Sr.no.	Type of pterygoalar bar	Incidence in number	Incidence in percentage
1	Complete unilateral	7	6.25%
2	Complete bilateral	1	0.89%
3	Incomplete unilateral	2	1.78%
4	Incomplete bilateral	0	0
5	Total incidence	10	8.92%

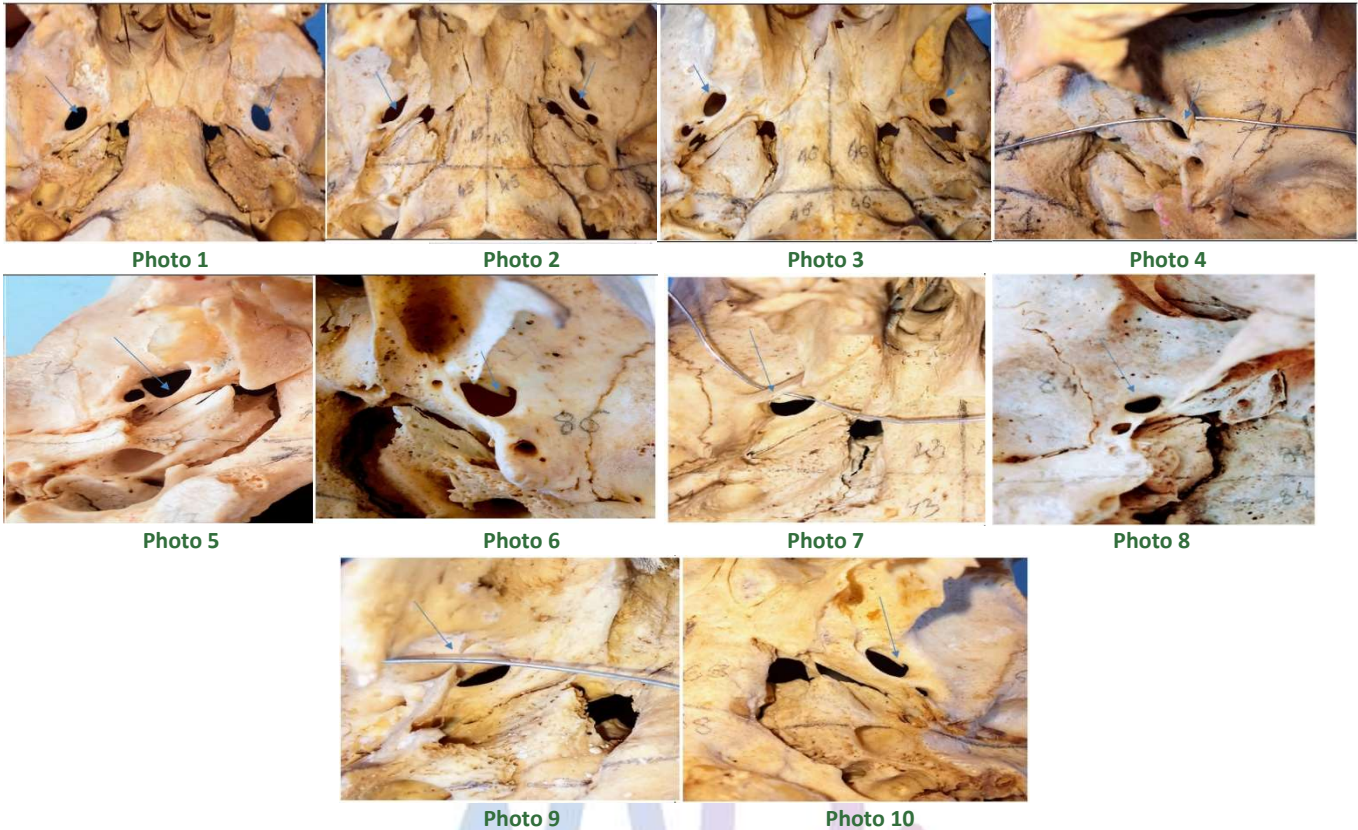


Photo 1: Bilateral oval shaped Foramen ovale; **Photo 2:** Bilateral almond shaped Foramen ovale; **Photo 3:** Oval shaped foramen on right and rounded on left side; **Photo 4:** Presence of Complete pterygoalar bar; **Photo 5:** Triangular foramen ovale; **Photo 6:** Foramen ovale with bony spur; **Photo 7:** Complete pterygoalar bar present; **Photo 8:** D shape foramen ovale present; **Photo 9:** Incomplete unilateral pterygoalar bar; **Photo 10:** small spur in foramen ovale

DISCUSSION

The position of foramen ovale is very important in different surgical and diagnostic procedures like compression of Gasserian ganglion in trigeminal neuralgia cases, electroencephalographic study of temporal lobe in the epileptic patients.¹¹ The reason behind variations in shape of foramen ovale were lies in the developmental process.¹² The pterygoalar and pterygospinous ligaments divide the foramen ovale into two compartments, due to these ligaments the transcutaneous needle placement into the foramen ovale become very difficult.¹³ The surgeon should have knowledge of variations of foramen ovale while performing transovale procedures, as the presence of spur, confluent emissary sphenoidal foramen affects the outcome of cannulation.¹⁴ The present study shows variations in shape of foramen ovale. The maximum length of Foramen ovale on right side was 10.1mm and minimum length was 5.52mm. The mean length of foramen ovale on right side was 7.52 ± 1.15 mm. The maximum length of foramen ovale on left side was 9.7mm and minimum length was 5.43mm. The average length on left side was 7.29 ± 1.06 mm. Biswabina Ray *et al.*⁷ reported that the mean length of foramen ovale was 7.46 ± 1.41 on right side

and 7.01 ± 1.41 mm on left side. These findings of Biswabina Ray *et al.* regarding length of foramen ovale are consistent with the findings of present study. Osunwoke *et al.*¹⁵ concluded that the maximum length of foramen ovale was 9.5mm and minimum length was 5mm, these findings are more or less similar to the present study. Arun SK¹⁶ reported the maximum length of about 9.8mm and minimum length of about 2.9mm. Landle MK¹⁷ stated in flurosopically assisted laser targetting study of Foramen ovale that the average length on right side and left side was 6.9mm and 6.8 mm respectively and the average width was 3.4mm on right side and 3.8mm on left side. The findings of Arun SK¹⁷ and Landle MK¹⁷ did not matches with the present study. In the present study the maximum width of foramen ovale was 6.56mm on right side and 6.3mm on left side, whereas the minimum width of foramen ovale was 2.87mm on right side and 2.5mm on left side. The mean width of foramen ovale was 4.18 ± 0.78 mm and 4.28 ± 0.81 mm on right and left side respectively. These findings of present study regarding width of foramen ovale was found to be higher than that of other studies described by different authors. Lang J¹⁸ showed that the average length and width of foramen ovale was 7.2mm and 3.7mm

on right and left side respectively. The Biswabina Ray⁷ stated that the average width of foramen ovale was 3.21±0.02mm on right side and 3.29±0.85mm on left side. The present study observed the ovale shaped (66.07%) foramen in majority of the skulls, this findings was in accordance of Biswabina Ray⁷ that reported the oval shaped foramen in 61.4% cases. Biswabina *et al.* found the almond shaped foramen in 34.3%, round shaped foramen in 2.9% and slit like foramen ovale in 1.4% of cases. The present study showed presence of almond shaped foramen in 32(14.28%) cases, rounded foramen in 24(10.72%) cases, D shaped foramen in 16(7.15%) and triangular shaped foramen was noticed in 4(1.78%,) of cases. Daimi SR *et al.*¹⁹ found oval shaped foramen in 29.87%, almond shaped in 10.41%, rounded in 12.52%, slit like in 1.04% and D shaped in 46.16% of cases. Raymond *et al.*¹⁰ noticed bony spur in 4.5% of cases. The study conducted by Ray *et al.*⁷ revealed that spur was present in about 3 cases. The present study shows presence of bony spur unilaterally in 4 cases. The pterygoalar bar was noticed in 5 cases by skrzat *et al.*¹⁴ Lepp and sander²⁰ showed presence of osseous bridge in about 8-10% of skulls. About 7.05% unilateral and 0.89% bilateral pterygoalar bar was noticed by chouke and Hodes.²¹ Kapur *et al.*²² stated that complete unilateral pterygoalar bar was present in 5% of antolian skulls with lower frequency of bilateral pterygoalar bar. The present study revealed that the complete pterygoalar bar was found unilaterally in 7 cases whereas one skull shows incomplete presence of unilateral pterygoalar bar. Bilateral complete pterygoalar bar was found in only one skull.

CONCLUSION

The present study is of clinical significance to the neurologist in cases of trigeminal neuralgia, aneurysm and in cases of diagnostic detection of tumours when surgeon planned to approach the middle cranial fossa through foramen ovale. The present study revealed wide variations in morphometry of foramen ovale. The abnormal outgrowth like presence of bony bar, spur may lead to widespread symptoms of ischemia and necrosis.

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