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ANATOMIC VARIATIONS OF FORAMEN OVALE – CLINICAL IMPLICATIONS

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ABSTRACT

The foramen ovale is of great surgical and diagnostic importance in procedures like percutaneous trigeminal rhizotomy for trigeminal neuralgia, transfacial fine needle aspiration technique in perineural spread of tumour, and electroencephalographic analysis. This study presents the anatomic variations in dimensions, appearance and number of foramen ovale. We studied 30 dried human skulls available in the Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar. Variations in appearance and number of foramen ovale were noted. Length and width of foramen ovale was measured and compared with previous literature. Out of 60 sides in 30 adult skulls, mean length and width of foramen ovale was 6.5 mm and 3.7 mm on right side and 6.8 mm and 4mm on left side. Shape of foramen ovale was typically oval in 42 (19 on right, 23 on left), almond shape in 9 (6 right, 3 left), round in 6(3 right, 3 left) and slit-like in 3 (2 right, 1 left). Bilateral oval foramen was observed in 18 and bilateral almond was in 3. Out of 60 sides in 30 adult skulls 1 (1 right) side had spine on the margin of the foramen , 3 (2 right,1 left)) had tubercle protruding from the margin and 6 (4 right, 2 left) had bony plate on the margin of foramen ovale. This study is of clinical and anatomical significance to medical practitioners in cases of trigeminal neuralgia and in diagnostic detection of tumors and abnormal bony outgrowths.

Key Words: *Foramen Ovale, Sphenoid and Tubercle*

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 common location of foramen ovale is in the infratemporal surface of greater wing of the sphenoid bone posterior and lateral to the foramen rotundum and lateral to the lingual and posterior end of the carotid groove. Foramen ovale lies close to the upper end of the posterior margin of the lateral pterygoid plate (Williams *et al.*, 2000). 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 (Ray *et al.*, 2005). Knowledge of anatomical variations in the appearance and number of foramen ovale is of immense surgical importance in various procedures such as percutaneous trigeminal rhizotomy and biopsy of cavernous sinus tumour, and in the event of anaesthesia of the mandibular nerve (Ray *et al.*, 2005; Skrzat *et al.*, 2006). According to Blaszczyk *et al.*, (1980) the foramen ovale occasionally can be covered by the bony bridges which results from ossification of the ligaments that are stretched between the lateral pterygoid process and sphenoid bone. Sometimes the venous part of foramen ovale may be compartmentalized by a bony spur located anteromedially looking like as double foramen ovale. Anatomical knowledge of the foramen ovale is important for all neurosurgical procedures involving the trigeminal nerve and administration of anaesthesia in the mandibular nerve. Interestingly, the percutaneous biopsy of the cavernous sinus is also performed through the foramen ovale. Prior knowledge of the presence of an accessory foramen ovale may be important for academic, anthropological, forensic and clinical purpose.

MATERIALS AND METHODS

For the present study 30 dry adult human skulls of unknown sex were taken from the Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar. The posterior part of greater wing of sphenoid was carefully examined for existence of an oval aperture or foramina and foramen ovale was identified. Patency was confirmed by inserting a bristle through each. Anteroposterior and transverse diameters of

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foramen ovale were measured by a pair of dividers and then transferred to a meter rule for the reading to be taken. Various shapes of foramen ovale were observed and the presence of bony spur was also recorded.

RESULTS

Present study was conducted on a total of 60 sides in 30 dry adult human skulls. Mean length of foramen ovale was 6.8mm on right side and 6.5mm on left side (Table-1). Maximum width of foramen ovale was 5mm on both right and left sides. Mean width on right side was 3.7mm and 4mm on left side (Table-1). Shape of the foramen ovale was also observed. Foramen ovale was typically oval in 42 sides, almond in 9 sides and round in 6 sides and slit-like in 3 sides (Table-2). Incidences of oval, almond, round and slit-like foramen were 70%, 15%, 10% and 5% respectively.



Figure 1: Typical Oval Foramen on Both Sides

Table 1: Dimensions of Foramen Ovale in Right and Left Side

Values	Length (Right)	Length (left)	Width (Right)	Width (Left)
Maximum	9mm	11mm	5mm	5mm
Minimum	3.5mm	5mm	2mm	3mm
Mean	6.5mm	6.8mm	3.7mm	4mm

Table 2: Variations in Appearance of Foramen Ovale

Shape	Right (n=30)	Left (n=30)	Total (n=60)
Oval	19	23	42
Almond	6	3	9
Round	3	3	6
Slit	2	1	3

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Figure 2: Bony Plate Protruding From the Margin of Foramen Ovale on Right Sidefo- Foramen Ovale



Figure 3: Spine at the Margin of Foramen Ovale on Right Sidefo- Foramen Ovale; Fs- Foramen Spinosum, Esf- Emissary Sphenoidal Foramen

Out of 60 sides in 30 adult skulls 1 (1 right) side had spine on the margin of the foramen, 3 (2 right, 1 left) had tubercle protruding from the margin and 6 (4 right, 2 left) had bony plate on the margin of foramen ovale.

DISCUSSION

Foramen ovale is one of the important foramina situated at the transition zone between intracranial and extracranial structures. Therefore, it is used for various invasive surgical as well as diagnostic procedures. Electroencephalographic analysis of seizure by electrode placed at foramen ovale is done. Foramen ovale electrode technique provided good neurophysiological information in candidates for selective amygdalohippocampectomy (Wieser and Siegel 1991). During development the foramen ovale is located within a membranous bone derived from a medial pterygoid process, the appearance of spine, spur, tubercle, bony plate surrounding foramen ovale indicates that bony overgrowth during its developmental process, between its first appearance and perfect ring formation and also the various inconstant patterns of grooves and foramen in the vicinity of the foramen ovale can be interpreted as arising from the interplay of various parts of membrane bone and the emissary venous plexus from the middle meningeal veins to the pterygoid plexus. An accessory or ectopic foramen ovale can develop in the process when those inconstant foramina disappear leaving behind foramen ovale as one large oval opening (James *et al.*, 1980).

This study has revealed that the maximal length of foramina ovale was 11 mm and minimal length was 3.5mm. This falls within the range of the research carried out by Arun (2006) in Nepal, in which the maximal length of foramina ovale of 25 unknown adult human skulls was 9.8mm and the minimal length was 2.9mm. Lang *et al.*, (1984) and Yanagi (1987), in different studies, inferred that the length of foramen ovale was about 7.2mm in adults. The knowledge of foramen ovale is very helpful for neurosurgeons. Certain earlier workers have reported bony overgrowth also. A bony spur is located anteriorly and medially according to Radiojevitc and Jovanovic (1956) cited by Lang (1883). Bony spur has been described by Ray *et al.*, . (2005) who observed spurs on 3 sides out of 35 skulls. In the present study 10% sides showed such a bony plate protruding from the margin and 1.6% case showed spine at the margin of foramen ovale. 5% had tubercle protruding from margin A slit like foramen ovale was found in 5% cases. Perfect oval, almond and round shaped foramen were found in 70%, 15 and 10% cases respectively. So from the present study we found 21.6% (13 in 60 sides) of foramina ovale may be variant due to developmental reasons either have a spine, tubercle bony plate or a bridge like spur or a slit like narrow shape which may seriously hamper diagnostic and therapeutic procedures through the foramen ovale.

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REFERENCES

- Arun S Kumar (2006)**. Some observations of the foramina ovale and spinosum of human sphenoid bone. *55* 1.
- Blaszczyk B, Kaszuba A and Kochanowski J (1980)**. Atypical foramina of the base of the skull. *Folia Morphologica* **93** 201–209.
- James TM, Presley R and Steel FL (1980)**. The foramen ovale and sphenoidal angle in man. *Anatomy and Embryology* Berlin **160** 93–104.
- Lang J (1883)**. Clinical Anatomy of the Head Neurocranium Orbit and Craniocervical Region. *Springer-Verlag* Berlin.
- Lang J, Maier R and Schafhauser O (1984)**. Postnatal enlargement of the foramina rotundum ovale at spinosum and their topographical changes. *Anatomischer Anzeiger* **156**(5)351-387.
- Ray B, Gupta N and Ghose S (2005)**. Anatomic variations of foramen ovale. *Kathmandu University Medical Journal* **3** 64–68.
- Skrzat J, Walocha J, Srodek R and Nizankowska A (2006)**. An atypical position of the foramen ovale. *Folia Morphologica* **65** 396–399.
- Wieser HG and Siegel AM (1991)**. Analysis of foramen ovale electrode-recorded seizures and correlation with outcome following amygdalohippocampectomy. *Epilepsia* **32** 838-850.
- Williams PL, Bannister LH, Berry MM, Collin P, Dyson M, Dussek JE and Ferguson MWJ (2000)**. Gray's anatomy. 38th edition Churchill Livingstone New York.
- 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* **62**(3) 485-496.