

Variations in Foramen Ovale and Foramen Spinosum in Human Skulls of North Indian Population

Berjina Farooq Naqshi¹, Adil Bashir Shah², Sangeeta Gupta³

ABSTRACT

Introduction: The foramen ovale being one of the important foramina in the middle cranial fossa, is present in the superior surface of greater wing of sphenoid bone. Foramen spinosum is located posterolateral to foramen ovale. So an anatomical study was conducted to observe the shapes of foramen ovale and foramen spinosum with their anatomical variants.

Material and Methods: We studied 17 human skulls and 3 sphenoid bones from the Post graduate Department of Anatomy, Government Medical College, Jammu. Posterior part of the greater wing of sphenoid was observed for visualising the foramen ovale and foramen spinosum.

Results: Out of 40 sides in 20 bones, 28 (70%) foramen ovale were oval in shape, 7 (18%) were almond shaped, 4 (10%) were round and 1(2%) was slit shaped. Among 40 foramen ovale, 2 showed presence of spine and 1 had bony plate. Confluent foramen ovale and spinosum was seen in one of the skulls on the left side. Moreover, in one of the skulls, duplication of foramen spinosum was seen on the right side. Absence of foramen spinosum was also noticed in one of the skulls on the right side

Conclusion: Foramen ovale is of surgical importance in percutaneous trigeminal rhizotomy in trigeminal neuralgias. For surgical procedures in the middle cranial fossa, the knowledge about the variations of these foramina should be taken into account. This data will add to the knowledge of clinicians as well as anatomists.

Keywords: Middle Cranial Fossa, Skull, Trigeminal Neuralgia, Anatomical Variation.

INTRODUCTION

The foramen ovale being one of the important foramina in the middle cranial fossa, is present in the superior surface of greater wing of sphenoid bone. It opens into the infratemporal fossa.¹ It gives passage to important structures i.e. mandibular nerve, the accessory meningeal artery, the lesser petrosal nerve and the emissary vein.² It is one of the foramen of importance which is present between the intracranial and extracranial structures. Venous part of foramen ovale may be separated from other structures of the foramen by means of a bony spur. These spurs are located anteriorly and medially.³ It is usually oval in shape but its shape shows variations when compared to rest of the foramina in the skull. It is of great significance to neurosurgeons as transcutaneous approach to skull base is possible via it in cases of trigeminal neuralgias.^{4,5} A careful observation of these foramina will be helpful in the diagnosis of the lesions present in the nasopharynx and middle cranial fossa. Neuroma of the fifth cranial nerve can lead to enlargement of the foramen ovale.⁶ Moreover, bony outgrowths in the form of spurs, can compress the passing

mandibular nerve and henceforth could lead to dysfunction of the muscles supplied by it.⁷

Foramen spinosum being a circular foramen, is present in the greater wing of the sphenoid, posterolateral to foramen ovale. It is present at root of spine of sphenoid. It gives passage to middle meningeal artery.^{8,9,10} In 0.4% of cases, foramen spinosum may be absent and in that case the middle meningeal artery arises from ophthalmic artery. Moreover, foramen spinosum can be duplicated in some cases.¹¹ So an anatomical study was conducted to observe the shapes of foramen ovale and foramen spinosum with their anatomical variants.

MATERIAL AND METHODS

The study was conducted on 17 human skulls and 3 sphenoid bones from the Post graduate Department of Anatomy, Government Medical College, Jammu. Posterior part of the greater wing of sphenoid was observed for visualising the foramen ovale and foramen spinosum. Their patency was checked by means of bristle. Skulls used for study were not damaged or broken. For each skull, general features and anatomical variations of the foramen ovale and spinosum were carefully noted. Bony spur in any oval foramina was noticed.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the analysis. Descriptive statistics like mean and percentages were used for the analysis.

RESULTS

The study was conducted on a total of 40 foramen ovale and 40 foramen spinosum, since 17 skulls and 3 sphenoid bones were used. In each bone, pair of foramen ovale and a pair of spinosum are found making a total count of 40 foramen ovale and 40 foramen spinosum.

Out of 40 sides in 20 bones, 28 (70%) foramen ovale were oval in shape, 7 (18%) were almond shaped, 4 (10%) were round and 1(2%) was slit shaped (Figure-1)(Table no. 1). Among 40 foramen ovale, 2 showed presence of spine and 1

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had bony plate (Figure-2) (Figure-3) (Figure-4) (Table no.2). Confluent foramen ovale and spinosum was seen in one of the skulls on the left side (Figure-5). Moreover, in one of the skulls, duplication of foramen spinosum was seen on the right side (Figure-6). These duplicated foramen spinosum were separated by means of thin bony plate. Absence of foramen spinosum was also noticed in one of the skulls on the right side (Figure-7).

DISCUSSION

The sphenoid bone has two type of ossification centres i.e. the intramembranous and endochondral ossification centres which form body, lesser wings and greater wings.⁷ Foramen ovale shows variations in shape and size throughout natural life. In the 7th fetal month, the earliest formation of ring shaped foramen ovale was observed and latest it was observed at 3 years after birth.¹²

Foramen ovale is of significance in various invasive and diagnostic procedures. In cases going for amygdalohippocampectomy, the electroencephalographic analysis is done by placing electrodes at the foramen ovale. It provides good neurophysiological information.¹³ Percutaneous biopsy of cavernous sinus tumours can be successfully achieved through foramen ovale which definitely is of significance before making any move for open surgical procedures.¹⁴ Nasopharyngeal carcinoma spreads intracranially and usually spreads via foramen ovale.¹⁵ Anatomical variations of foramen ovale is of importance in operative treatment of trigeminal neuralgia which is performed through the opening of foramen ovale. Moreover, any stenosis or bony plate leads to reduced patency and difficulty in approaching for surgical procedures through this route.^{16,17}

Yanagi (1987) reported that foramen ovale in majority cases was found to be oval in shape and furthermore they were irregular in shape in comparison to the other foramina present in the sphenoid bone.¹² There are some developmental reasons for the variations in the shape of foramen ovale.¹⁸ Tubbs et al., (2009) in their work revealed that pterygospinous (ligament of Civinini) and pterygoalar (ligament of Hyrtl) ligaments lead to division of foramen ovale into two compartments. These ligaments could make transcuteaneous needle placement into the foramen ovale very difficult.¹⁹ Ray et al., (2005) observed in their study

on anatomic variations of foramen ovale that a spine was present on the margin of the foramen ovale. It was seen in 3 cases.³

Studies on the morphology of foramina of greater wings of sphenoid have revealed variations in the foramen spinosum. The foramen spinosum may be absent, when the meningeal

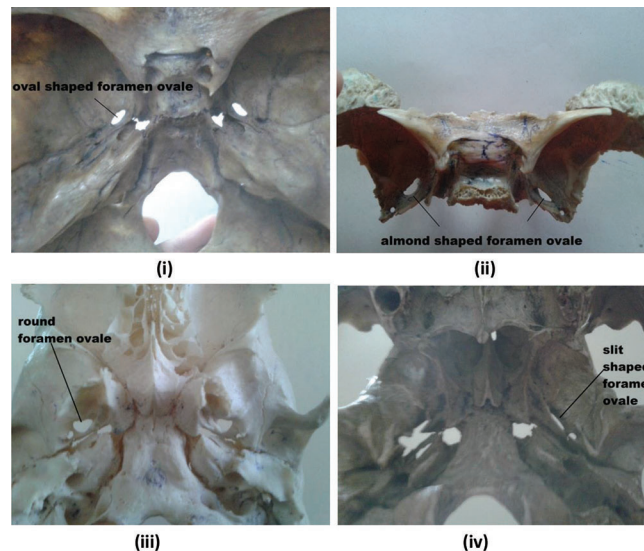


Figure-1: Different shapes of foramen ovale: (i) Oval. (ii) Almond shaped. (iii) Round. (iv) slit shaped.

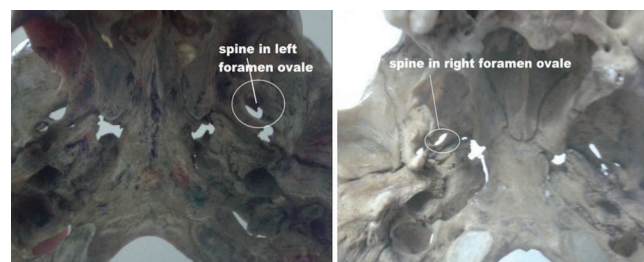


Figure-2: Spinous process in left foramen ovale; **Figure-3:** Spinous process in right foramen ovale

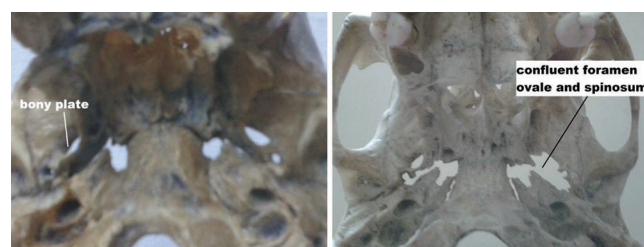


Figure-4: Bony plate in right foramen ovale; **Figure-5:** Confluent foramen ovale and spinosum



Figure-6: Duplicated foramen spinosum; **Figure-7:** Absent foramen spinosum on right side

Shape	Right	Left	Total
Oval	17	11	28
Almond	3	4	7
Round	3	1	4
Slit	1	0	1

Table-1: Variations in appearance of foramen ovale

Bony outgrowths	Right	Left	Total
Spine	1	1	2
Tubercle	0	0	0
Bony plate	1	0	1

Table-2: Bony outgrowths seen in foramen ovale

artery arises from ophthalmic artery instead of arising from the maxillary artery or in circumstances, when meningeal artery enters the cranial cavity through foramen ovale.²⁰ Ginsberg et al. (1994), also observed that the foramen spinosum may be absent when middle meningeal artery follows an aberrant pathway.²¹ Berge and Bergman (2001) conveyed that the foramen spinosum was found to be unilateral in (1%) skulls or (0.5%) of foramina which were examined had no evidence of assimilation with foramen ovale.²² Lindblom (1936) observed that the foramen spinosum was small or was not present in 0.4% cases. It was observed by him in his roentgenographic study of the vascular channels of the skull.²³

Lindblom and Sondheimer also reported a variant in which double foramen spinosum were found on the same side of the skull. A bony bar was a partition which led to the duplication of foramen spinosum which can be because of division of middle meningeal vessels before entering the foramen spinosum.^{23,24} Osunwoke et al. (2010) made thorough study on 87 dried human skulls from the southern Nigerian population and they noticed that all skull had foramen spinosum. They were not able to find any skull with absence of foramen spinosum.²⁵

CONCLUSION

The present study was conducted to provide information regarding the foramen ovale and foramen spinosum as the knowledge about these foramina is still scarce. Some foramen ovale present with tubercles or bony plates. The mandibular nerve passes through the foramen ovale and it is via this foramen that trigeminal rhizotomy is done. So, the patency of the foramen ovale is very important for this procedure. In case of stenosis of foramen ovale as is seen in foramen with tubercles, the surgeries procedures are difficult. For surgical procedures in the middle cranial fossa, the knowledge about the variations of these foramina should be taken into account and the present data will suffice for that purpose. Refined surgical techniques in microsurgery are available for which the foramen spinosum acts as an identifiable landmark. So, the knowledge about the anatomical features of foramen spinosum alongwith its variations will enlighten the minds and will be fruitful. For medical practitioners this data will be of significance in dealing the cases of trigeminal neuralgia and will aid in diagnosing various vascular lesions in cranial cavity. This data will add to the knowledge of clinicians as well as anatomists.

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