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ORIGINAL ARTICLE

THE DUPLICATION OF THE FORAMEN OVALE IN HUMAN SKULLS OF SOUTH INDIAN POPULATION

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ABSTRACT: Foramen ovale connects the middle cranial fossa to the infratemporal fossa. It is traversed by 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. Duplication of the Foramen ovale is a rare phenomenon. It is seen in both sexes and presents at various ages. Racal difference has also been reported. The presence of duplication of Foramen ovale was studied in 100 adult human skulls, collected from the department of Anatomy & Forensic medicine. It includes 30 skulls aged below 40 years of age and 70 skulls aged above 40 years. Duplication of foramen ovale was found in 3 skulls. All were unilateral (2 left and 1 Right). Knowledge regarding duplication of foramen ovale is useful during surgical exploration of the same especially during trigeminal neuralgia. Also the knowledge is useful in radio diagnosis of such conditions. The case may be mis - interpreted as any bony deformations.

KEYWORDS: Duplication, Emissary vein, Foramen ovale, Skulls, Trigeminal neuralgia.

INTRODUCTION: Sphenoid bone is one of the unpaired bone in the skull. Sphenoid bone has body, lesser wing and greater wing. Greater wing of the sphenoid bone contains foramen ovale. Shape of the foramen ovale is oval, and it is placed obliquely at the base of the skull. Position of the foramen ovale in the greater wing of sphenoid bone is close to the upper end of posterior margin of lateral pterygoid plate, lateral to the foramen lacerum and most commonly medial to foramen spinosum.[1]

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.

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. Duplications of foramen ovale have been reported earlier by Tubbs[1] et al, Ray et[2] al and Reymond[3] et al. We took up this study to know the incidence of the duplication of the foramen ovale in the skulls in our state, as there were no previous studies regarding the same.

Knowledge regarding duplication of foramen ovale is useful during surgical exploration of the same especially during trigeminal neuralgia. Also the knowledge is useful in radio diagnosis of such conditions. The case may be mis - interpreted as any bony deformations.

Percutaneous trigeminal nerve radiofrequency rhizotomy guided by computerized tomography is being done as the treatment to relieve pain from trigeminal neuralgia. So the basic Anatomy with all these variations should be known to the clinicians and surgeons to treat such conditions effectively.

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MATERIAL AND METHODS: The present study was carried at the Department of Anatomy DM-Wayanad Institute of Medical Sciences, Wayanad, Kerala. The foramen ovale of 100 dry human skulls was examined for variations. The skulls were divided into two age groups i.e.

i) Below 40 years, and ii) Above 40 years.

This was done with the help of Department of Forensic Medicine, DM- Wayanad Institute of Medical Sciences, Wayanad, Kerala. Damaged skulls in and around the foramen ovale were not considered for the study. Standard accepted criteria were followed to classify the skulls according to age.

RESULTS:

Fig 1: Green arrow showing the foramen Vesalius, Yellow arrow showing the Duplication of the foramen ovale and Brown arrow showing the foramen spinosum.

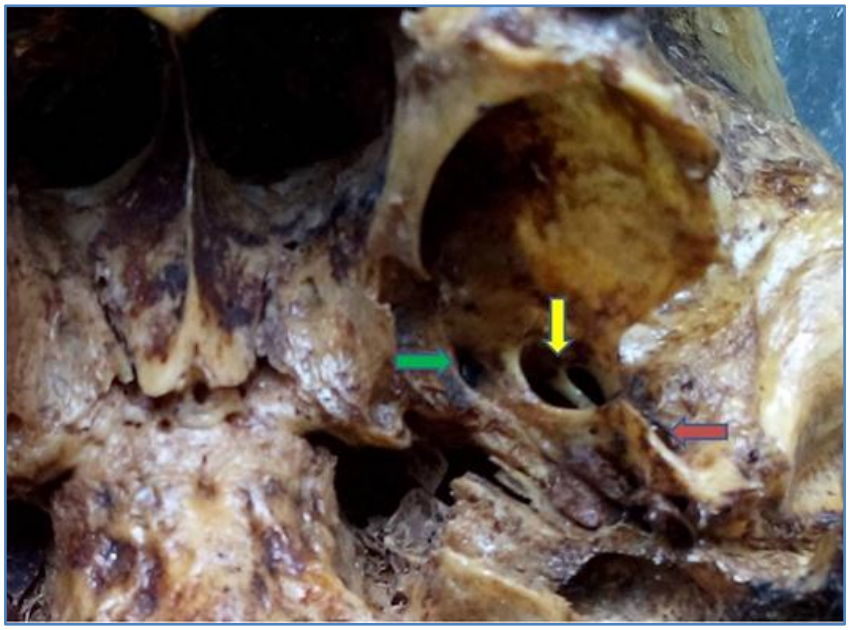

Fig. 1

Overall, 3 (3%) of the 100 human skulls which were studied, showed the duplication of the foramen ovale. In the skulls of group I (below 40 years), there were no duplications. In the skulls of group II (above 40 years), 3 (4.29 %) exhibited the duplication of the optic canal. The duplication was unilateral in all the 3 duplication detected skulls, 2 (2.86 %) skulls showed on Left side and 1 (1.43 %) skull showed on the right side.

The main foramen ovale was in the usual position and the accessory canal was found to be anterolateral to it in the greater wing of the sphenoid. The length and the thickness of the septa which separated the main and the accessory canals were variable in size, but they did not exceed 1 mm in thickness in our study.

Though there are reports of duplication in juvenile skulls, in our study, we found the duplication only in skulls which were aged above forty years, probably because of the increasing age, as there is more chance for the ossification of the fibrous tissue between the emissary vein and other structures which are passing through the foramen ovale.

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Age of skull	number of skulls studied (100)	Number of skulls with duplicated foramen ovale			
		Total	Bilateral	Right side	Left side
Below 40 years	30	0	0	0	0
Above 40 years	70	3 (4.29%)	0	1 (1.43%)	2 (2.86%)

Table 1: Duplication of the foramen ovale

DISCUSSION: Foramen ovale is used for various 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.[5, 6] The accuracy of percutaneous biopsy of cavernous sinus tumors through the foramen ovale is 84%.[7] Nasopharyngeal carcinoma frequently spreads intracranially and most common route of spread is through the foramen ovale (34%).[8]

All these diseases were previously being treated by opening the calvaria but now the CT-guided transfacial fine needle aspiration technique through foramen ovale to diagnose and to treat such catastrophic lesions is being followed. This results in decreased patient morbidity and also significant cost reduction.

Electroencephalographic analysis of seizure by electrode placed at Foramen ovale is now being done. Foramen ovale electrode technique provided good neurophysiological information in candidates for selective amygdalohippocampectomy. So knowledge of the exact topography and morphometry of the Foramen ovale electrodes is required for a more precise anatomo-electro-clinical correlation of seizures.[9]

The duplication of the foramen ovale is rare and it is seen in both sexes in different age groups.

These anatomical variations can be explained in terms of embryological basis. Sphenoid bone has a body formed by pre sphenoid and post sphenoid centers along with medial crus of orbito-sphenoid. The lesser and greater wings develop from orbito-sphenoids and ali-sphenoids respectively. First ossification centre appears for greater wings (ali-sphenoids).

It makes appearance between foramen rotundum, ovale and spinosum. At 22 weeks, foramen ovale is seen as a discrete opening and is contained in the area of un-ossified cartilage. Ossification takes place around the mandibular nerve and other structures passing through foramen ovale in later life (BW, Babcook CJ.[10]

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.

Tubbs[2] et al. (2009), in their study on ossification of ligaments near the foramen ovale revealed that ossified pterygospinous (ligament of Civinini) and pterygoalar (ligament of Hyrtl) ligaments divide the foramen ovale into two compartments. They concluded that such bony obstructions could interfere with transcutaneous needle placement into the foramen ovale. Similarly, Ray[3] et al.

In their study on anatomic variations of foramen ovale also reported a spine on the margin of the oval foramen in 3 cases, (2 left, 1 right) and 2 sides (1 left, 1 right) sides they found a bridge like

bony spur dividing the foramen ovale into two compartments. Reymond[4] et al also reported that in 4.5% of their cases, foramen ovale was divided into 2 or 3 compartments. Osunwoke[11] et al observed in his study on 87 dried skulls of Southern Nigeria, One foramen ovale was partially divided into two components by a bony spur.

CONCLUSION: Errors in identifying the duplication of the foramen ovale can occur, because of the presence of foramen spinosum and foramen Vesalius very very close to this foramen. Duplication of the foramen ovale is confirmed when we are seeing a separate foramen spinosum and foramen Vesalius nearer or very close to the duplicated foramen ovale variation.

The variations in the foramen ovale can pose a dangerous situation during surgical exploration of Foramen ovale while performing the open surgical, radio surgical, and radiotherapeutic treatment, especially during trigeminal neuralgia. This rare variation can also evoke confusion during the interpretation and the evaluation of the CT scans or the X-rays of the base of the skull region.

As this anomaly of the foramen ovale vary in different countries and regions, knowledge of specific regional observations of foramen ovale becomes necessary to aid in respective clinical and surgical procedures.

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