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Original Research Article

MORPHOMETRY AND VARIATIONS OF FORAMEN VESALIUS: SIGNIFICANCE IN SURGICAL APPROACH TO MANDIBULAR NERVE

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ABSTRACT

Background: Foramen Vesalius a small inconsistent foramen in the base of skull for passage of emissary vein from pterygoid plexus of veins to cavernous sinus. Variations in incidence and morphology are reported in literature. The objective of this study as to estimate its incidence in south Indian population and to evaluate the morphometric variations.

Materials and Methods: Twenty-two dry skulls belonging to department of anatomy, Azeezia Institute of Medical Sciences, Kollam was studied with respect to base of the skull foramens. Wherever the foramen Vesalius was noted, the specimens were photographed and incidence, laterality was noted. Maximum, minimum and perimeter were noted. Any difference between male and female skulls and differences in right and left side were studied for statistical significance. $P<0.05$ was considered as significant.

Results: We found foramen Vesalius in 40.9% of 44 sides examined. Six skulls had this foramen bilaterally. Three specimens had foramen Vesalius unilaterally and six specimens had it bilaterally. Average diameter of foramen was 1.35 (±0.56) mm from extra cranial aspect. The average diameter and perimeter of foramen in males were significantly lower than females. The average distance between foramen Vesalius and foramen ovale was significantly more in females than in males.

Conclusion: Foramen ovale is an inconsistent and asymmetrical foramen in base of skull near foramen ovale. Forty percent of the skulls studied had foramen Vesalius. There is significant difference measurements of right and left side foramens. Considering these variations in infratemporal fossa decreases complications while approaching mandibular nerve and trigeminal ganglion.

KEY WORDS: Foramen Vesalius, base of skull, foramen ovale, emissary veins, mandibular nerve.

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BACKGROUND

There are many small foramens at the base of the skull acting as conduit for the vessels and nerves into and out of the cranial cavity. One such small foramen in relation to the foramen ovale is foramen Vesalius (FV). This inconstant foramen that gives passage to an emissary vein that connects pterygoid venous plexus with cavernous sinus. FV is located in the greater wing of sphenoid bone between foramen ovale and foramen rotundum. In relation to foramen ovale, FV is often posteromedially located and in relation to foramen rotundum it is often anteromedial [1].

FV is more closer to foramen ovale and surgeries involving mandibular nerve and trigeminal ganglion, presence of structures in this region have to be considered with care [2]. FV can be the pathway for spread of infection and cancers from extracranial location to cavernous sinus [3,4]. Tumors of nasopharyngeal origin are the most likely infracranial tumors to invade the middle portion of the skull base through above mentioned foramen [2]. However, there are many reports regarding variable occurance of this FV in literature [1,2,5–8]. Surgical procedures in infratemportal fossa have to meticulously consider lateral pterygoid muscle and related structures like maxillary artery, pterygoid plexus of veins, mandibular nerve with otic ganglion and chorda tympany nerve. In relation to these structures, the base of skull foramen and structures passing through them gains significance. The objective of this study was to evaluate the likely incidence and variations of foramen Vesalius.

MATERIALS AND METHODS

This descriptive study was carried out using 22 skulls taken from Department of Anatomy, Azeezia Institute of Medical Sciences, Kollam. A detailed study of norma basalis was undertaken particularly the middle cranial fossa and sphenoid bone. In the skulls where the foramen Vesalius (FV) was present in middle cranial fossa and extra cranial view, a digital camera (8Megapixel resolution, in auto ISO) was used to capture the extra cranial image of the skull base under normal day light with reference scale. Photographs were analyzed using Adobe software to calculate the circumference of the foramen. Shortest distance between foramen ovale and FV was noted using Vernier calipers (with minimum reading of 0.1mm). The topographic relation of these two foramens was noted. Distance between FV and carotid canal was measured. All measurements was done three times and average values were expressed in mm. To ensure the patency of FV a wire with diameter of 0.2mm was made to pass through FV from base of skull in norma basalis view. All measurements were tabulated and any significant variation between right and left side was noted using student t test. P value <0.5 was assumed to be statistically significant.

RESULTS

Out of 22 skulls considered in this study, based on morphometric assessments, 14 males and 8 female skulls were noted. Patent FV was noted in nine sides. FV only in extra cranial view is seen in two incidences and only in middle cranial fossa in three incidences. Out of 44 sides from all bones considered, FV was seen in nine sides (40.9%). FV was found unilaterally (figure 1, 2 and 3) and bilaterally (figure 4) in three cases and six cases respectively and values are tabulated in table 1. FV occurance was significantly more in male skulls than in females ($p<0.05$). Non patent FV were not considered for morphometric measurements.

Table 1: Distribution of the foramen Vesalius (FV) found in analyzed skulls according to side and sex.

FV in	N	Unilaterally	Bilaterally
Males	14	2 (14.3%)	4 (28.6%)
Females	8	1 (12.5%)	2 (25%)

Average diameter of FV wherever it was patent was 1.35 (±0.56) mm from extra cranial aspect. Other measurements are tabulated in Table 2 and 3. The average diameter and perimeter of FV in males were significantly lower than females. The average distance between FV and foramen ovale (FV-FO distance) was significantly more in females than in males. The average diameter and perimeter of FV on right side were higher than the values on left side. FV was found to be at a significantly more distance to foramen ovale on right side than on the left side. In one instance, FV was partially fused with foramen ovale.

Fig. 1: Norma basalis view of foramen ovale (FO), posterolaterally located foramen Vesalius (FV), foramen spinosum (FS) and Carotid canal (CC).

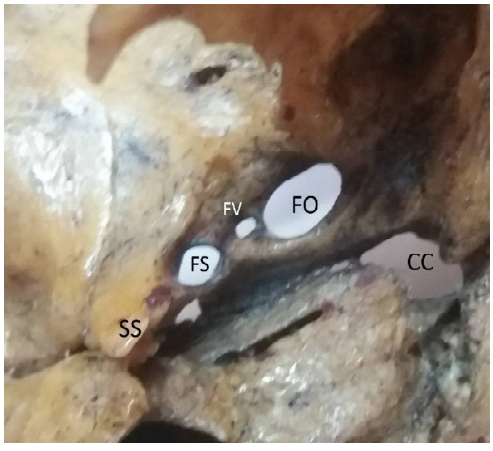


Fig. 2: Norma basalis view to show the location of foramen ovale (FO), foramen spinosum (FS) and foramen Vesalius (FV) on left side.

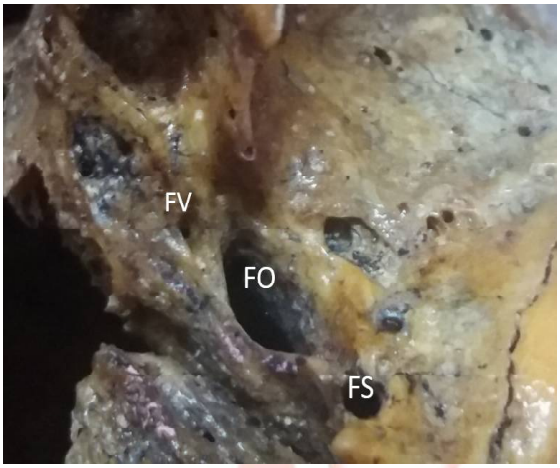


Table 2: Morphometric measurements of FV on right and left sides, expressed as mean and standard deviation (in parenthesis). All measurements in mm. FV – Foramen Vesalius, FO – Foramen Ovale, (n=9) †p<0.05

Measurements	Right Side	Left side
Maximum diameter	2.36 (±1.2)	1.50 (±0.1)†
Minimum diameter	1.08 (±0.2)	0.95 (±0.1)
Average diameter	1.44 (±0.5)	1.21 (±0.7)†
Perimeter	2.88 (±1.5)	3.44 (±1)†
FV – FO distance	1.45 (±0.1)	2.1 (±0.8)†

Fig. 3: Norma basalis view of a skull showing foramen ovale (FO) and foramen Vesalius (FV).

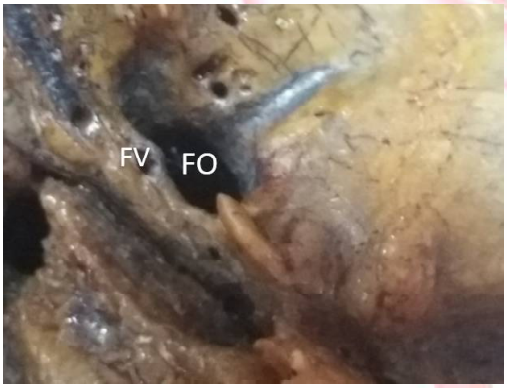
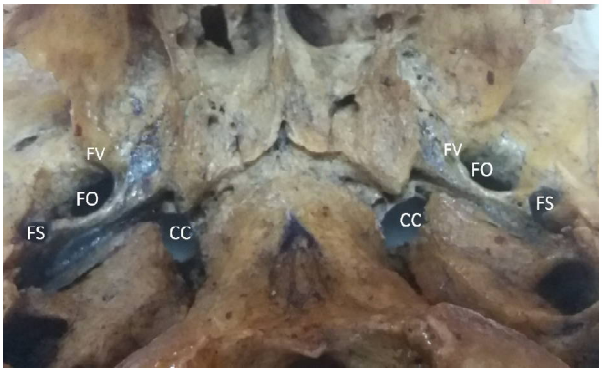


Fig. 4: Norma basalis view of a skull showing bilateral foramen Vesalius (FV); other important foramina are labelled - FO, foramen ovale; FS - foramen spinosum; CC - carotid canal.



DISCUSSION

Various studies have reported occurrence and laterality of FV. Our study, percentage of FV found is more than reported frequency from other Indian studies [5]. However, there are few foreign studies with frequencies more than what is reported in this study [3]. Many other researchers have found lower incidence of FV in dry skulls [1,2,6–9]. Consideration of FV from both middle cranial fossa and extra cranial view may account for higher incidence in our study. Even though Chaisuksunt et al have reported 39% incidence of FV as appreciated from middle cranial fossa and extra cranial fossa, the patent FV were only 16.1% [9]. We found much higher incidence of patent FV (40.9%). Wysocki et al dissected 17 intratemporal fossa in cadavers and found FV in all specimens.[10] In line with previous studies by Kodama et al. [7] and Gupta et al. [5] we report more bilateral occurrence of FV than unilaterally. In contrast, Ginsberg et al. [11] and Chaisuksunt et al. [9] reports more unilateral FV than bilateral. Knowledge about laterality of FV may be of significance when evaluating infratemporal fossa pathology.

The veins traversing FV, communicates cavernous sinus and pterygoid plexus of veins within parapharyngeal space. The extra cranial opening can be found most often in relation to medial surface of lateral pterygoid plate and spine of sphenoid [12]. Useful landmark for identification in CT scans of base skull is pterygospinous ligament which is medial to FV [13]. Anatomical studies have revealed that FV may not be a thorough fare channel, it may end in diploe of bone [13]. Whenever FV is absent the respective emissary vein traverses foramen ovale.

Sondheimer describes FV as inconsistent symmetrical foramen [13]. Lanzieri et al have studied Fifty high-resolution CT scans of the skull base and reinforces that FV is symmetrical and more constant finding in the base of skull.[2] However, various dry bone studies do not support this finding [2,5–7]. We too noted significant difference between right and left sides in cases of bilateral FV. The average diameter, minimum and maximum diameters of foramen varied on both sides. Such asymmetri-

-cal FV will be of significance in evaluating unilateral large or obliterated FV. Our study has added to the literature that such asymmetrical FV is a normal finding.

As shown in the present study, occurrence of FV is nearly 40% in normal population. This can be translated to likely incidence of spread of infection and carcinoma from infratemporal fossa to middle cranial fossa is significant. Such spread can happen through emissary veins traversing from infratemporal fossa to middle cranial fossa through foramen ovale and FV [3,6,13]. Surgeons approaching the trigeminal ganglion via foramen ovale should be aware of FV anteromedially and structures passing through it. At times FV may be fused with foramen ovale giving a larger space for maneuvering in this area. Bigger the FV lesser the distance between foramen ovale and FV, calls for greater vigilance while operating in this area.

CONCLUSION

Foramen ovale is an inconsistent and asymmetrical foramen in base of skull near foramen ovale. It is found in 40% of the skulls studied. There is significant difference of incidence in males and females. We report more bilateral FV than unilateral. There is significant difference measurements of right and left side foramens. Considering these variations in infratemporal fossa decreases complications while approaching mandibular nerve and trigeminal ganglion.

Conflicts of Interests: None

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