

Presence of Foramen Vesalius and Canaliculus Innominatus & its morphometric study Srivastava Monika¹, Srivastava NN¹, Asgar A¹, Jain A¹, Rani M¹, Gupta NK²

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Abstract

The greater wing of sphenoid bone has multiple foramina. The consistent foramina of middle cranial fossa are Foramen Ovale, Foramen Rotundum and Foramen Spinosum. Foramen Vesalius (FV) and Canaliculus Innominatus (CI) are inconsistent. So the present study was conducted to investigate the presence and absence of FV and CI in dry human skulls and to study the location and frequency of both foramina in 30 human skulls available in the Department of Anatomy. The skulls were examined from external and internal aspects. In the present study three skulls reported to have FV and two skulls have CI out of thirty skulls. Two skulls out of three skulls contained FV on right side only and one skull has FV on both sides. Two skulls have CI in which one has bilateral presentation and one has single opening on right side. Knowledge about the characteristics of FV and CI and its frequency is not only important for anatomist but equally essential for clinicians who approach middle cranial cavity for various procedures.

Keywords: Foramen Vesalius, Canaliculus Innominatus, Middle Cranial Cavity

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Introduction

The greater wing of sphenoid has some consistent foramina and few small variable foramina. Foramen Rotundum, Foramen Ovale (FO), and Foramen Spinosum are steady. [1] The Foramen Vesalius (FV) and Canaliculus Innominatus (CI) may infrequently present. FV also known as Canaliculus Sphenoidal or emissary sphenoidal foramen or foramen venosus. FV is situated anteromedial to FO and lateral to the Foramen rotundum, present close to FO in the middle of cranial fossa. [2] It passes an emissary vein, "vein of Vesalius" which communicates with the cavernous sinus and pterygoid venous plexus. [1] An extra-cranial septic thrombus may reach cavernous sinus and often leading to cavernous sinus thrombosis. Infection can be spread from orbit, paranasal sinuses, & dangerous area of face may cause cavernous sinus thrombosis. Normally blood flow via emissary vein is slow but in case of raised intracranial pressure these veins play an important role in drainage of blood. Lang reported that a small nerve (nervous Sphenoidal Lateralis) may also pass through FV into cavernous sinus. [3] The knowledge of anatomical variability of these foramina may help the surgeon for effective planning and safer execution of various invasive procedures in their approach to middle cranial fossa through FO and CI. Detail knowledge of presence & position of canaliculus sphenoidalis & CI are very useful for clinicians who perform various invasive procedures through middle cranial fossa. Treatment of Trigeminal Neuralgia through FO can be confused with FV due to its close proximity resulting in grave

consequences like cavernous sinus puncture, hematoma of temporal lobe etc. Very few studies reported on the incidence of FV and CI. [4,5] Therefore the current study aimed to investigate the frequency of FV and CI and their morphometric consideration.

Material and method

The present study was a descriptive study. We studied 30 human skulls available in the Department of Anatomy. These skulls were the part of boneset obtained as a part of undergraduate training in the department. We examined skull B/L both from external and internal aspects. Criteria for exclusion were those in which the partially surrounding bone of the FV and CI were broken. The skulls were studied to examine the presence of FV and CI in middle cranial fossa and the incidence (unilateral and bilateral) was noted. Only those foramina which allowed the probe to be passed through them were considered. Measurement of FV and CI was taken with the help of Vernier caliper with the precision of 0.01 mm. Distance of FV from the ipsilateral FO was measured as well. Each measurement was performed three times and averaged. Shapes of these foramina were also recorded. The data were recorded in tabular form. All the data was entered into the Microsoft Excel software and descriptive statistics were applied.

Result

Out of 30 dry skulls studied, 3 skulls showed the presence of FV thus giving the incidence of 10%. However out of 3 skulls, 2 skulls showed the presence of unilateral FV (Right side) and one skull showed bilateral FV, thus giving the incidence of 6.67% and 3.37% respectively. Therefore, unilateral presentation is more common as compared to bilateral & in unilateral more common of right side. (Fig 1 & 2)

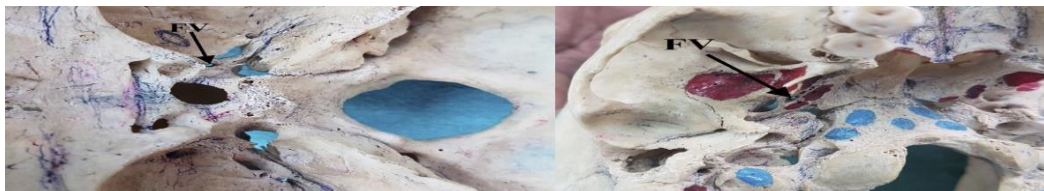
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**Fig 1: Skull 1- Inner and outer aspects
FV= Foramen Vesalius**

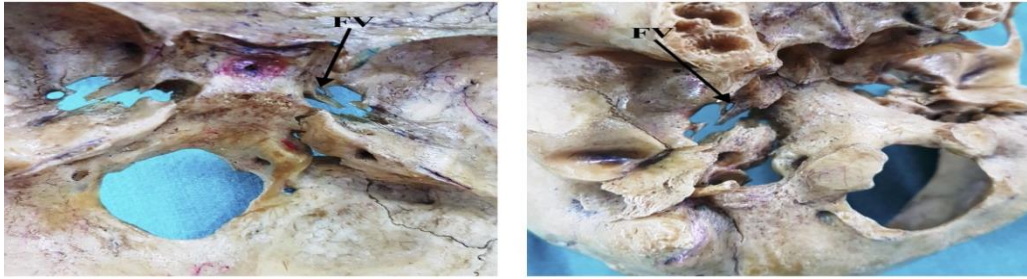


Fig 2: Skull 2- Inner and Outer Aspects
FV= Foramen Vesalius

Similarly, out of 30 dry skulls we noted that only 2 skulls have CI, thus giving a incidence of 6.67%. Out of these one skull show bilateral foramina and one skull show unilateral foramen(right side) thus having a incidence of 3.3% each. (Fig 3 & 4)

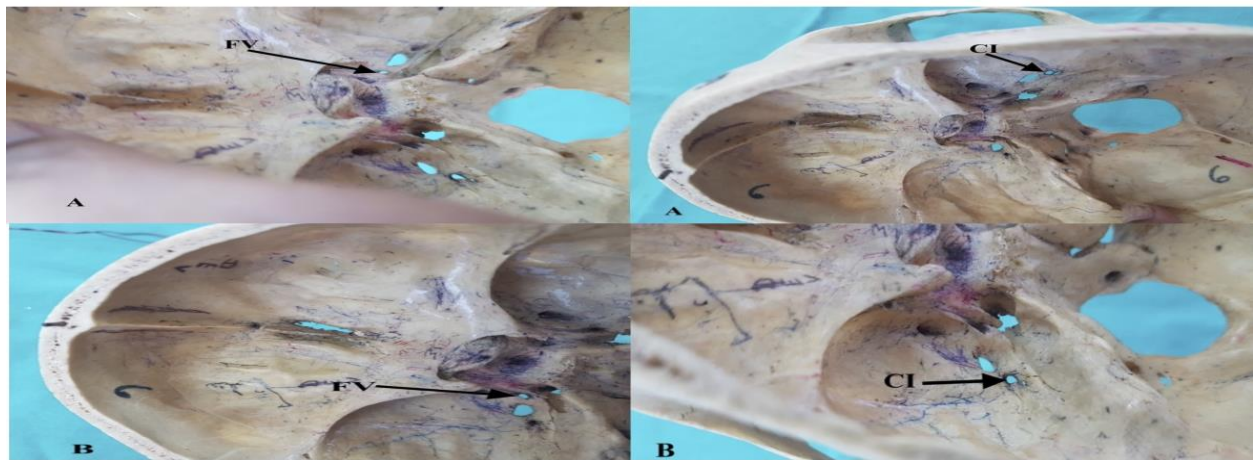


Fig 3: Skull 3 - Inner Aspect
A= Right Side; B= Left Side; FV= Foramen Vesalius; CI= Canaliculus Innominatus



Fig 4: Skull 4- Inner and Outer Aspects
CI=Canaliculus Innominatus

Furthermore out of 30 skulls only one skull reported presence of both foramina bilaterally. (Fig 3)

On doing morphological evaluation, we found the mean diameter of FV and CI to be 1.37(± 0.52)mm and 1.35(± 0.06)mm respectively. (Table1).

Table 1: Showing Morphological dimension of Foramen Versalius and Canaliculus Innominatus

S. No	Skull Number	Foramen Versalius						CaniculusInnominatus					
		Right Side			Left side			Right Side			Left side		
		D	S	DFO	D	S	DFO	D	S	DFO	D	S	DFO
1	Skull 1	0.9	R	4.2	-	-	-	-	-	-	-	-	-
2	Skull 2	2.1	O	1.1	-	-	-	-	-	-	-	-	-
3	Skull 3	1.1	R	3.9	1.41	O	2.1	1.31	R	1.9	1.42	I	2.1
4	Skull 4	-	-	-	-	-	-	1.34	I	2.4	-	-	-

D= Diameter, S= Shape, DFO=Distance from Foramen Ovale , R= Round, O= Oval, I= Irregular

We also measured the distance between FV and CI from FO. Nearest distance was measured between the two foramina. The average distance between FV and FO was $2.82 \text{ mm} \pm 1.47$ and between CI and FO is $2.13 \text{ mm} \pm 0.25$. Therefore CI foramina are more closer to the FO as compare to FV. On doing further morphological evaluation, we noted that out of four FVs, two have rounded shape and two have oval shape. Similarly, of three CI, two have irregular shape and one have round shape.

Discussion

Morphological knowledge of FV and CI imperative for neurosurgeons when they approach the middle cranial fossa. Emissary vein passing through the FV are the important route for the transmission of infected thrombus from pterygoid venous plexus to the cavernous sinus. FV and CI are the inconsistent foramina which are found either unilaterally or bilaterally between Foramen Rotundum and FO. In the present study, the incidence of FV was 10%. This was much lower than the incidence reported by other researchers. [4-10]. The incidence of bilateral FV was much lower around 3.34%. Similarly, the incidence of CI in the present study was only 6.67% and of this 3.34% of the skull reported to have bilateral presentation. Studies carried out by Ginsberg et al using high resolution radiography reported as high as 80% incidence of FV. [11] The present study also reported that out of thirty skulls only one skull had both FV and CI. Rates reported in the present study are lowest among all the literature searches. This could be attributed to the fact that we have excluded those skulls who had partially broken parts.

Majority of the times FV and CI are present unilaterally. In the present also 6.67% and 3.34% of FV and CI are present unilaterally on right side. This is similar to the studies conducted by Gupta N et al and Nayak G et al. [6,12] On doing morphological evaluation the mean diameter of FV&CI were $1.37 (\pm 0.52) \text{ mm}$ and $1.35 (\pm 0.06) \text{ mm}$. Furthermore the distance of FV and CI from the FO noted in the present study was $2.82 (\pm 1.4) \text{ mm}$ and $2.13 (\pm 0.25) \text{ mm}$ respectively. Ramalho et al. and Kaplan et al. noticed a very high incidences i.e. 71.87% and 100%, respectively [13]. According to Williams et al., Bergman et al., and Lang et al., documented 40% incidence of FV in dry skulls. [1,3,14] Gupta et al. and Boyd observed the incidences of FV 32.85 and 36.5% respectively. [4,15] In Sinohara et al 2009 documented similar incidence (33.75%) of FV in 400 CT scan of skulls. They observed 46% incidence rate of bilateral FV. [8] Shapiro and Robinson found that FO may fuse with FV occasionally. [16] Williams et al. observed lower frequency (8.5%) of FV appeared the dry skulls. [1] Kodama et al and Reymond et al reported almost similar frequency (22%) in adult skulls. [5,17]

Reymond et al. mentioned only 5% of bilateral occurrence of FV. [17] Boyd noticed 12.5% of bilateral occurrence. Gupta et al. and Kodama et al. documented approximately 22% of bilateral foramina of FV. [5,6] Berge and Bergman got slightly higher bilateral occurrence (35%). [14] Boyd measured the diameter of FV and observed a diameter of 0.5–1 mm in 65% of skulls, 1–2 mm in 5% of the skulls, and very rarely more than 2 mm. [15] The linear measurements of FV taken by Berlis et al. which found to be $1-2 \times 1-3.5 \text{ mm}$. [18] Schelling reported $1.32 \times 1.22 \text{ mm}$ dimension of FV in left side and $1.24 \times 1.16 \text{ mm}$ on the opposite side. [19] Kaplan et al noticed mean diameter of 1 mm (range 0.8–1.2 mm) of FV which was similar with Lanzieri et al and Sinohara et al. [8, 20, 21] Few studies presented similar finding with current observations. [22-24] Lastly, the present study gather the information that could help the clinician and researchers to improve the knowledge of middle cranial fossa anatomy. Authors speculate that the data may be utilized to improving the operating scenario.

Conclusion

The present study concludes that FV and CI are inconsistent foramina. However the incidence can be much lower than that reported in other studies which was might be due to lower sample size. The lower sample size is a major limitation of present study. FV are mostly present on the right side and sometime they may be

bilaterally present & CI having equal incidence of bilateral and unilateral.

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