Foramen of Vesalius

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ABSTRACT

الأهداف: فحص تكرار حدوث ثقب فيساليوس (FV) وحيد الجانب أو على الجانبين، عدد الثقوب الـ(FV) الموجودة على الجانب الواحد، ووجود الحاجز على ثقب فيساليوس (FV).

الطريقة: قمنا بفحص 347 عظم وتدي من قسم التشريح بكلية الطب باسطنبول وكلية إليول دوكوز – أزمير – تركيا، خلال عام 2007م.

النتائج: من 347 جمجمة تم فحصها على الجانبين، تبين أن 87 منها لديها ثقب فيساليوس (FV) على الجانبين (25.1%). مائة وواحد وتسعون عينة (55%) لم يكن لديها أي ثقب فيساليوس (FV) على كلا الجانبين، و69 عينة (19.9%) لديها ثقب فيساليوس (FV) على جانب واحد 33 جمجمة لديها ثقب فيساليوس (FV) على الجانب الأيمن وبقي 36 جمجمة لديها ثقب فيساليوس (FV) على الجانب الأيسر). من 156 جمجمة مصابة بثقب فيساليوس (FV)، فقط أربعة جماجم (ثلاثة على الجانب الأيمن وجمجمة واحدة على الجانب الأيسر) لديها ثقب فيساليوس (FV) مزدوج على نفس الجانب. لم نجد أي عينة لديها ثلاثة ثقوب نوع فيساليوس (FV) أو أكثر على نفس الجانب. من 156 جمجمة مصابة بثقب فيساليوس (FV)، إجمالي عدد 11 جمجمة لديها حاجز على ثقب فيساليوس (FV). ثلاثة جماجم لديها حاجز على ثقب فيساليوس (FV) على الجانب الأيمن، و6 جماجم لديها حاجز على ثقب فيساليوس على الجانب الأيسر. جمجمتين لهما حاجزين على كلا الجانبين.

خاتمة: نعتقد أن بياناتنا حول ثقب فيساليوس (FV) سوف تسلط الضوء ليس فقط على المفاغرة ولكن أيضاً من أجل السريريات.

Objectives: To investigate the frequency of unilateral or bilateral foramen of Vesalius (FV), number of FV present on one side, and presence of a septum on FV.

Methods: We bilaterally examined, 347 sphenoid bones of collections of the Department of Anatomy, Istanbul Faculty of Medicine, Istanbul University, Istanbul and Dokuz Eylul Faculty of Medicine, Izmir, Turkey in 2007.

Results: Of the 347 bilaterally examined skulls, 87 (25.1%) had bilateral FV, 191 (55%) specimens did not have any FV on both sides, and 69 specimens (19.9%) had unilateral FV (33 skulls had FV on the right side, and the remaining 36 skulls had FV on the left). Of the 156 skulls which had FV, only 4 skulls (3 on the right, one on the left) had double FV on the same side. We have not observed any specimens which had 3 or more FV on the same side. Of the 156 skulls which had FV, 11 skulls had a septum on FV, 3 skulls had a septum on FV on the right side, and 6 skulls had a septum on FV on the left side. Two skulls bilaterally had a septum on both sides.

Conclusion: We believe that our data about FV will be enlightening not only for anatomists, but also for clinicians.

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Foramen of Vesalius (FV) is an inconstant foramen of sphenoid bone, which is located anteromedial to the foramen ovale, between the foramen ovale and scaphoid fossa.[1-5] When present, it contains an emissary vein, linking the pterygoid venous plexus in the temporal fossa with the cavernous sinus in the middle cranial fossa, thus FV is defined as a sphenoidal emissary foramen.[5,6] Bergman et al[7] reported that FV might even transmit the accessory meningeal artery (observed in 20% of specimens). They did not mention if the accessory meningeal artery was found in place of, or in addition to a sphenoidal emissary vein.[7] Foramen of Vesalius is present (on one or both sides) in 40% of skulls.[5] According to James et al,[8] it is shown that

the foramen ovale of man is enclosed by a membrane bone, derived from a medial process associated with the scaphoid fossa, and a lateral tongue, the most dorsal part of which is present in many adults as a process on the lateral margin of the foramen. Foramen of Vesalius represents the site of fusion between this membrane bone and the more medial, cartilaginous, ala temporalis. Various inconstant patterns of grooves and foramina in the vicinity of foramen ovale can be interpreted as arising from the interplay of the various parts of the membrane bone, and the emissary venous plexus from the middle meningeal veins to the pterygoid plexus.[8] The importance of FV lies in the fact that it gives passage to an emissary vein. Emissary veins traverse cranial apertures and make connections between intracranial venous sinuses and extracranial veins. These connections are of clinical significance in the spread of infection from extracranial foci to venous sinuses. Some emissary veins are relatively constant, others are sometimes absent. The FV is not seen in all individuals but when present, it contains a vein in the emissary sphenoidal foramen, which connects the cavernous sinus with the pharyngeal veins and the pterygoid plexus.[2,5] Consequently an infected thrombus from an extracranial source may reach cavernous sinus by a FV.[2] The aim of this study is to investigate the frequency of unilateral or bilateral FV, the number of FV present on one side, and the presence of a septum on FV, in a large series of 347 dry adult skulls.

Methods. We performed our study on dry adult skulls of the collections of the Department of Anatomy, Istanbul Faculty of Medicine, Istanbul University, and Faculty of Medicine, Dokuz Eylul University, Turkey in 2007. The sphenoidal bones, which could not be evaluated bilaterally were excluded. The Local Research Ethics Committee confirmed that ethics approval was not needed for this study. We examined 347 sphenoid bones of 215 craniums, and 67 craniums whose calvariums were removed, and 65 separate sphenoid bones. We searched for a foramen on the anteromedial side of the oval foramen on both sides. In order to understand if the structures we determined were FV indeed, we used acupuncture needles of 0.30 x 0.40 mm. We evaluated the foramina, from which an acupuncture needle could pass, as FV. We did not accept the structures, which looked like FV, but from which an acupuncture needle could not pass, as FV. We calculated the frequency of unilateral or bilateral FV. Then we noted the number of FV found on one side. Afterwards, we examined the FV's for having a septum. The foramina which had a common opening at the base of skull, rather than having separate openings, were considered as one FV with a septum.

Results. Of the 347 bilaterally examined specimens, 87 skulls had bilateral FV (25.1%) (**Figure 1**). A total of 191 specimens (55%) did not have any FV on both sides (**Figure 2**), and 69 specimens (19.9%) had unilateral FV (**Figure 3**). Of these 69 specimens, 33 had unilateral FV on the right side, and the remaining 36 bones had FV on the left side. Data on the frequency of the FV is shown in **Table 1**. Of the 156 skulls which had FV, only 4 skulls (3 on the right, one on the left) had double FV's on the same side. We did not find any specimens which had 3, or more FV on the same side. Of the 156 skulls which had FV, a total of 11 skulls had septum on FV. Three skulls had a septum on FV on the right side, and 6 specimens had a septum on FV on the left side and 2 skulls bilaterally had a septum on both sides. In one of the skulls which had double FV's on the right side, one of the FV's had a septum (**Figure 4**).

Discussion. According to Wood-Jones,[9] FV in its classical form is confined to man, and is essentially an expression of the differentiation of cranial venous outlets, which is characteristic of Homo. Foramen of Vesalius does not occur in any primate other than man.[9] The data about the frequency of the inconstant foramen, FV, is variable. Standring[5] reported that the frequency of FV was 40%. The results of the studies, in which the frequency of FV was examined, are presented in (**Table 2**). Our results are also included in this table in order to be easily compared with the others. We believe that the difference of our results from some of these studies may result from the difference of numbers of specimens, race, or different method. Kodama et al[3] reported that the skulls with one FV were most frequent, and those with 2 followed it, and those with 3 FV were least frequent.[3] In the present study, skulls with one FV on one side were also found to be most frequent (43.8%). Skulls with double FV's on one side were less frequent (1.15%), and any skulls with 3 FV's on one side was not determined. Consequently, our results were compatible with Kodama et al.[3] Related with the morphometry of FV, different results of measurements of its size have been reported. Berge and Bergman[10] reported the average size of FV as 0.79 x 0.59 mm, the largest size of FV as 3 x 2 mm, and the smallest size of FV as 0.3 x 0.3 mm. Boyd[11] reported that the FV was 0.5 mm in 65% of his specimens. Boyd[11] added that the FV was larger than one mm in 5% of the specimens examined. Nevertheless, Lindblom[12] noted that the FV had been never larger than 1 mm in diameter. Related with the size of FV, Wood-Jones suggested that when the Vesalian emissary vein was present on one side, the ipsilateral foramen ovale had been frequently smaller than the opposite side.[9] Quite the contrary, when a large oval foramen exists, it is related to the presence of a large anterior emissary venous sinus.[12] As we did not measure the size of FV and foramen ovale, we could not confirm

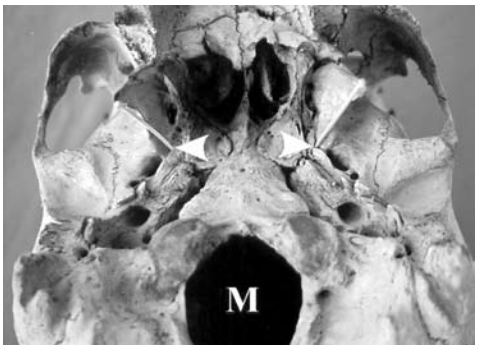


Figure 1 - The acupuncture needles are inserted into the foramina of Vesalius bilaterally. White arrows show the foramina bilaterally. M - foramen magnum



Figure 2 - Black arrows indicate the absence of foramina of Vesalius bilaterally. M - foramen magnum

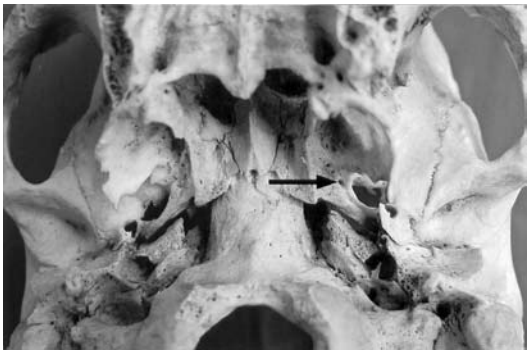


Figure 3 - The black arrow shows the unilateral foramen of Vesalius.

Table 1 - Our data about the frequency of the foramen of Vesalius.

Distribution	No. of skulls	(%)
Bilateral presence of FV	87	(25.1)
Bilateral absence of FV	191	(55.0)
Unilateral FV	69	(19.9)
Right side	33	(9.5)
Left side	36	(10.4)
Total	**347**	**(100)**

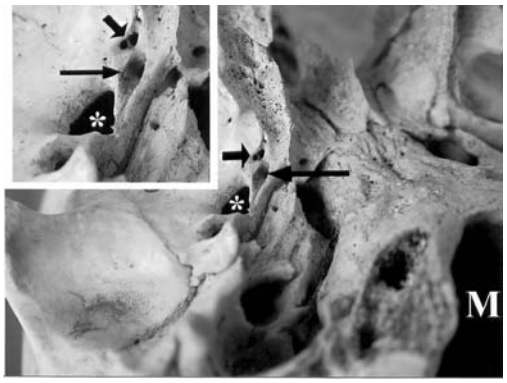


Figure 4 - The black arrows show the foramina of Vesalius on the same side. The short black arrow shows the foramen of Vesalius, which is divided into 2, by a septum. The long black arrow shows the second foramen of Vesalius on the same side. Asterisk shows the foramen ovale. M - foramen magnum. The magnified vision of the related region is shown in the inlet.

this in our study. Kodama et al[3] examined the adult skulls of 321 men and 79 women. Sixty-nine (21.5%) of men skulls, and 18 (22.8%) of women skulls had FV. Consequently, they reported that no remarkable differences were observed in the ratio of FV between men and women.[3] Gupta et al[2] declared in their study including 35 dried skulls that, the frequency of FV was higher in women compared to men skulls. In our study, a discrimination of skulls according to gender was not made. According to Kodama et al,[3] FV is classified as the open type, and the closed type. Nevertheless, as the FV is described as a sphenoidal emissary foramen, its closed type is in contradiction with its typical definition. In our study, we determined many FV-like structures from which the acupuncture needles could not pass (according to Kodama et al,[3] these structures were closed type FV's), and we did not evaluate them as FV. Lindblom[12] reported that FV sometimes ended in the diploic space. Probably, the FV's from which the acupuncture needles could not pass and the ones Kodama et al[3] described as closed type FV were the FV's, which ended in the diploic space. Still, as this condition was not acceptable for an emissary vein, these structures were not evaluated as FV in our study. As the radiologic studies might reveal the structure within the diploic space in detail, these structures might be comprehended as FV. Thus, the fact that the results of the radiologic studies related with the frequency of FV are remarkably higher than the results of the studies performed on skulls, may be due to this situation.[4] Clinically, as an infected thrombus from an extracranial source may reach cavernous sinus by FV, it is an important foramen.[2] Moreover, the FV is important from the surgical point of view, because during percutaneous trigeminal rhizotomy, needle insertion through the FV may cause cavernous sinus

Table 2 - Results of the studies, reporting the frequency of the foramen of Vesalius (FV).

Name of researchers	Year	Specimens examined	Determined frequency of FV according to sides %	Determined total frequency of FV %
Boyd[11]	1930	1500 skulls	Bilaterally: 14.7; Unilaterally: 21.8	36.5
Lanzieri et al[4]	1988	50 CT scans of the skull base		64.0
Gingsberg et al[13]	1994	123 CT		80.0
Kodama et al[3]	1997	20 juvenile skulls, 400 adult (321 men, 79 women) skulls	Men group: 21.5 Bilaterally 75.4, Unilaterally 24.6 Women group: 22.8 Bilaterally 72.2, Unilaterally 27.8	Juvenile group: 55.0 Adult group: 21.8
Berge and Bergman[10]	2001	100 skulls	Bilaterally 35, Unilaterally 24	59.0
Keskil et al[14]	2003	200 skulls		8.5
Kocaogullar et al[15]	2003	14 cadavers and 12 skulls		30.0
Gupta et al[2]	2005	35 dry skulls	Bilaterally 22.9, Unilaterally 20	42.9
Reymond et al[16]	2005	100 macerated skulls		17.0
Kale et al*	2007	347 skulls	Bilaterally 25.1, Unilaterally 19.9	45.0

*present study, CT - computed tomography

puncture, and this complication has been described in 8 patients.[2] Furthermore, Lanzieri et al[4] proposed that asymmetry of the FV was more likely the result of a pathologic process than a normal variant. They added that the abnormal causes of asymmetry in their specimens were: invasion by nasopharyngeal melanoma, angiofibroma, carotid cavernous fistula with drainage through the emissary vein, and neurofibromatosis.[4] Berge and Bergman,[10] and Ginsberg et al[13] reported that the data they obtained had not supported that asymmetry of FV indicated pathologic change. In our study, we determined the frequency of the skulls which had unilateral FV as 19.9%. We believe that this ratio is too much to indicate a disorder, and we support the idea proposing asymmetry of FV does not indicate a pathological condition.

As FV does not exist in all individuals, it can easily be misinterpreted as an abnormal structure. As our study carry detailed information about the frequency of FV, its being unilateral or bilateral, in 347 bilaterally examined dry skulls, we believe that our data will be enlightening not only for anatomic studies, but also for clinical procedures as well.

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