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Case Report Open Access

Bilateral Duplication of the Sphenoidal Emissary Foramen: A Case Report with Implications for Surgeries using Transovale Cannulation

Zdilla MJ[1*], Cyrus LM[1], Laslo JM[1] and Lambert HW[2]

[1]*Department of Natural Sciences and Mathematics, West Liberty University, West Liberty, West Virginia, USA*

[2]*Department of Neurobiology and Anatomy, West Virginia University School of Medicine, Robert C. Byrd Health Sciences Center, Morgantown, West Virginia, USA*

[*]**Corresponding author:** Matthew J Zdilla, Department of Natural Sciences and Mathematics, West Liberty University, CSC 139; P.O. Box 295, West Liberty, WV, USA 26074, Tel: +1 304-336-8631; Fax: +1 304-336-8266; **E-mail**: mzdilla@westliberty.edu

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Abstract

The sphenoidal emissary foramen (SEF) is an inconsistent foramen located in the middle cranial fossa. The SEF may transmit a sphenoidal emissary vein (of Vesalius), dural venous sinus, nervolulus sphenoidalis lateralis, or an accessory middle meningeal artery. Prior reports have noted SEF to exist unilaterally and bilaterally. Duplication of the SEF has also been documented to occur unilaterally. This case study documents a bilateral duplication of the SEF. Also, this case represents the first anatomical photograph of a bilateral duplication of SEF. Because the SEF are occasionally cannulated by mistake in procedures which attempt to access the middle cranial fossa via the foramen ovale, knowledge of the bilateral duplication of the SEF is important for neurosurgeons and radiologists.

Keywords: Emissary vein; Foramen ovale; Foramen of vesalius; Neurosurgery; Trigeminal neuralgia

Introduction

The sphenoidal emissary foramen/foramina (SEF), also known as the foramen of Vesalius, foramen Vesalii, foramen venosum, sphenoidal canaliculus, and canaliculus sphenoidalis, is an inconsistent foramen in the middle cranial fossa [1-4]. It is typically located anteromedial to the foramen ovale and posteromedial to the foramen rotundum [5]. The SEF transmits a small emissary vein (of Vesalius) which serves as a venous connection between the cavernous sinus and the pterygoid venous plexus and, therefore, is of clinical importance due to its potential to transmit an infected thrombus from an extracranial location to the cavernous sinus [6]. Henderson (1966), however, has suggested that the SEF, houses a dural sinus, rather than an emissary vein [7]. Other structures including a small nerve, the nervoulus sphenoidalis lateralis, may be transmitted through the SEF [8]. Likewise, in 20% of cases, the SEF transmits an accessory meningeal artery [9].

Reports have noted the occurrence of the SEF to range from 16.1% [10] to 79.7% [11] of skulls. Occasionally, the SEF has been reported to be duplicated unilaterally. Unilaterally duplicated SEF have been reported to occur in between 0.06% [12] to 13.8% [11] of skulls. To date, only one study has mentioned a bilateral duplication of the SEF, noting occurrence in 2 of 123 skulls (1.62%) [11].

Case Report

Examination of the middle cranial fossae of a dry human skull, housed in the anatomical collection within West Virginia University School of Medicine, revealed a bilateral duplication of the SEF (Figure 1A).

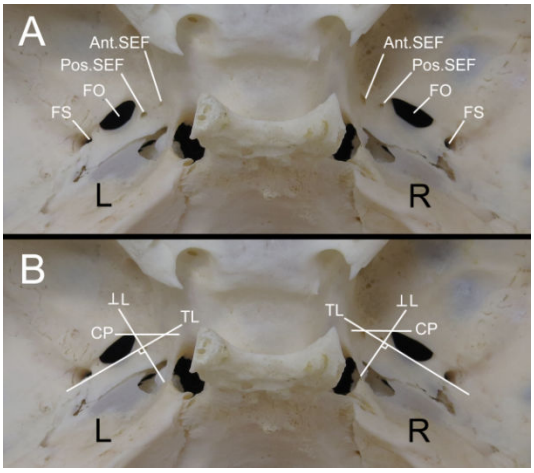

Figure 1: A) Cranial view of the sellar region and bilateral middle cranial fossae demonstrates a bilateral duplication of the sphenoidal emissary foramen. (Ant.SEF: anterior-most sphenoidal emissary foramen; Pos.SEF: posterior-most sphenoidal emissary foramen; FO: foramen ovale; FS: foramen spinosum). B) Cranial view of the sellar region and bilateral middle cranial fossae with lines demonstrating the relative spatial relationships and bilateral symmetry of the foramina. (CP: line drawn in the coronal plane from the anterior-most aspect of the foramen ovale that traverses the anterior-most sphenoidal emissary foramen; TL: tangential line drawn from the medial aspects of the foramen spinosum and foramen ovale that traverses the sphenoidal emissary foramina; L: perpendicular line from the tangential line that, itself, is tangential to the anterior aspect of the foramen ovale which traverses the posterior-most sphenoidal emissary foramen)

All SEF were cannulated with a thin copper wire to assess patency and all four SEF were found to be patent. All SEF were located medial to foramina ovalae. The anterior-most SEF on each side was located directly medial to the anterior-most aspect of the foramen ovale (Figure 1B). If one were to make a line tangential to the medial borders of the foramen spinosum and foramen ovale, each SEF would fall on the line (Figure 1B). Also, if a perpendicular line were made with the aforementioned tangential line that is, itself, tangential to the foramen ovale, the lines would intercept at the location of the posterior-most SEF (Figure 1B). The morphometric measurements of the foramina can be found in Table 1.

Side	Foramen	Area (mm2)	Perimeter (mm)	Maximum diameter (mm)	Minimum diameter (mm)	Lateral to medial distance from the foramen ovale to the SEF	Distance from the foramen spinosum to the SEF
Left	Ant. SEF	0.16	2.14	0.31	0.91	15.99	33.34
	Pos. SEF	0.51	3.05	1.98	1.28	13.99	32.61
	Ovale	13.08	18.45	6.54	2.78	23.51	24.09
Right	Ant. SEF	0.54	4.44	1.39	0.60	10.42	33.34
	Pos. SEF	0.17	2.00	0.78	0.56	11.36	29.87
	Ovale	14.18	18.38	7.22	2.77	20.00	24.40

Table 1: Morphometric measurements of the sphenoidal emissary foramina (SEF)

Discussion

Unilateral SEF may occur in as many as 36% of skulls [13]; however, the occurrences of unilateral duplicated SEF are rarer, ranging from 0.06% [12] to 13.8% [11]. In this study, a bilateral duplication of the SEF was noted in one of 83 skulls (1.2%), though, judging by the paucity of its mention in anatomical literature, its occurrence is likely to be much rarer when examined among a larger sample size. To date only one other study has documented a bilateral duplication of the SEF, occurring in two out of 123 skulls (1.6%) [11]. However, the study utilized computed tomography rather than direct observation and also provided no detailed morphometric information or photographic documentation of the bilateral duplication of the SEF, and it also did not comment on the patency of these foramina. The present case report presents both the first detailed morphometric measurements of a bilateral duplication of the SEF as well as the first photographic evidence of a bilateral duplication of the SEF.

Lanzieri et al. (1988) noted that the SEF is usually bilaterally symmetrical and that asymmetry of the SEF is due to pathologic processes including invasion by nasopharyngeal melanoma, angiofibroma, and carotid cavernous fistula with drainage through the sphenoidal emissary vein [14]. Based upon the observations of Lanzieri et al. (1988), that non-pathological SEF are typically symmetrical, the SEF documented herein demonstrate bilateral symmetry and, therefore, are not likely the result of a pathologic process [14].

The SEF is of particular clinical relevance with regard to procedures which cannulate the foramen ovale including percutaneous treatment of trigeminal neuralgia including trigeminal nerve radiofrequency rhizotomy, percutaneous balloon compression, and glycerol injection [4,5,10,15], percutaneous biopsy of parasellar space-occupying lesions located at the Meckel trigeminal cave, cavernous sinus compartment, and petroclival region [16], and treatment of carotid cavernous fistulae [17]. Insertion of a needle through the SEF, rather than the foramen ovale, may puncture the cavernous sinus which one report described in eight cases, one of which resulted in a temporal lobe hematoma [18]. Another report also reported mistakenly cannulating the SEF in seven of 200 (3.5%) percutaneous procedures [19].

The case presented herein documents a bilateral duplication of the SEF with all SEF located directly medial to the foramen ovale, contrary to reports noting the SEF to be anteromedial to the foramen ovale. Therefore, neurosurgeons should be aware of the possibility of one or two SEF existing directly medial to the foramen ovale during percutaneous procedures utilizing fluoroscopic guidance to cannulate the foramen ovale. Likewise radiologists/neurosurgeons should be cognizant of bilateral symmetry, even as it applies to the SEF during computed tomography and magnetic resonance imaging screening procedures. Knowledge of the potential occurrence of a bilateral duplication of the SEF may prevent unwanted surgical complications including temporal hematoma.

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