Original Research Paper

Volume - 13 | Issue - 10 | October - 2023 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anatomy

THE STUDY OF OCCIPITAL EMISSARY FORAMEN IN HUMAN ADULT SKULLS

Dr Sarita Margam* Assistant Professor *Corresponding Author

Miss Megha Malvankar Junior scientific officer.

ABSTRACT An occipital emissary foramen has been described by several authors. This foramen is present in the squamous part of the occipital bone at occipital protuberance and it transmits a vein that connects sigmoid sinus with the veins of sub-occipital venous plexus. Anatomical variations of foramina of skull have been of interest for neuroanatomist due to clinical consequence that these structures can cause problems especially in areas such as neurosurgery and dentistry. Therefore, to analyze the incidence and location of the occipital emissary foramina in adult human skulls, present study was taken. The present study revealed that occipital emissary foramina occurred more frequently than that of which was described in the literature.

KEYWORDS : Emissary, Foramina, Protuberance

INTRODUCTION

An occipital emissary foramen has been traditionally described as a foramen present in the squamous part of the occipital bone at the occipital protuberance transmitting a vein, Occipital emissary Vein (OEV)[1]. OEV is located at or close to the midline of the occipital squama and connects the torcular herophili or distal superior sagittal sinus to the suboccipital veins that drain into the vertebral artery venous plexus, the deep cervical vein, or both[2].

The emissary foramina transmit the emissary veins which connect intracranial venous sinuses with the extracranial veins[3]. Emissary veins of the skull base and posterior fossa play an important role in directing cerebral venous blood toward cervical outflow pathways[4,5]. Emissary veins include the anterior, posterior, and lateral condylar emissary veins, the mastoid emissary vein, and the occipital emissary vein (OEV)[4]. They act as the outlet veins of the neurocranium and drain the venous blood from cephalic structures. Though they are valveless and blood may flow in both the directions, the flow is usually away from the brain. Under normal circumstances, blood flow through these veins is slow. However, in cases of raised intracranial tension they become an important source of blood drainage[6]. Emissary veins and foramens, as well as intracranial sinuses or dural venous sinuses, are important for the lateral and transcondylar approach to anterior foramen magnum surgery. The localization of this type of vessels and openings could prevent complications such as sinus thrombosis, bleeding, and air embolism[7]. Another clinical application of variations of the emissary openings is in fractures or injuries of the temporal, occipital or parietal bones. Emissary openings and vessels are important not only for preparing surgical techniques used for stopping bleeding or for lowering intracranial pressure, but also, they are a route of transmission of infections in the cranial cavity[8,9].

The OEV, when present, may connect with the diploic veins of the occipital and parietal bones. Due to its proximal location, the OEV is the only emissary vein of the skull base/posterior fossa that can provide a derivation pathway for the transverse sinus[10]. So, the knowledge of occipital emissary foramina is important because of the recent advances in neurointerventional and neurosurgical techniques[11] such as suboccipital craniotomies[6]. So according to an anatomical and neuro-surgical point of view, such morphological differences between the skulls of humans have been a subject of investigation[12]. According to Terminologia Anatomica, occipital emissary foramen (OEF) is not even mentioned in the textbook descriptions of occipital bone and posterior cranial fossa[13-16].

Hence, we decided to do the present study to throw some light on the anatomy of this foramen.

MATERIAL AND METHODS:

The study was done on 42 human adult skulls in the Department of Anatomy, Ashwini Rural medical college, hospital & research Centre, Solapur. The squamous part of occipital bone was analyzed for gross incidence and the position of occipital emissary foramina.

The anatomical landmarks used in the study were –

(1) External Occipital Crest (EOC);
(2) External Occipital Protuberance (EOP);
(3) posterior border of Foramen Magnum (FM).
The position and number of foramina were noted.
According to the position, we introduced classification as:

Type A: On the External occipital protuberance (EOP) (as traditionally described).

Type B: present on the External occipital crest (EOC)

Type B1: to the right of EOC

Type B2: to the left of EOC

Type C: Near EOP and

Type D: near the Foramen Magnum (FM)

RESULTS:

Out of 42skulls, the foramen was observed in 23/42(54.76%) skulls. Out of these 23skulls, 14 were of males and 9 were of females.

In Table 1.1, we can see incidence of single OEF is more common 26.19% as compared to a greater number of foramina.

In Table 1.2, we tabulated different types of foramina according to location. Out of which, most common type was to the left side of EOC (69.57%).

Table 1.1: Number of foramina present

Sr no	Number of Foramina	Number of skulls	% of number of skulls
1	Nil	19	45.24%
2	One	11	26.19%
3	Two	9	21.43%
4	Three	4	9.52%
5	Four	0	0
6	Five	1	2.38%

Table 1.2: Types of foramina according to Location

Sr No	Type of OEF	Number of skulls	% of number of skulls
1	B (On EOC)	3	13.04%
2	B1 (Right of EOC)	15	65.22%
3	B2 (Left of EOC)	16	69.57%
4	C (Bilateral)	9	39.13%
5	D (N ear FM)	3	13.04%

DISCUSSION:

Anthropological studies show that from prehistoric man to Homo

sapiens, the skull undergoes changes not only in terms of brain volume, smoothing of the supraciliary arches and several protrusions, but also with respect to the openings (foramens)[12]. Emissary foramina are a byproduct of selection of bipedalism by extant humans[17]. As an upright posture necessitated delivery of blood from the brain to the vertebral veins, venous channels like the enlarged occipital/marginal sinus system, multiple hypoglossal canals, and emissary foramina that conduct the emissary veins developed[18]. These are epigenetic adaptations for delivering blood preferentially to the vertebral plexus of veins[19]. The occipital foramen occurs at low frequencies throughout the hominid record and is generally seen near the inion[18].

In our study, the incidence of the foramen is 54.76%. this is higher if we compare it to other studies as in Table 1.3

Table 1.3: Incidence of OEF in different population

Sr No	Study	Presence of foramen	Bilateral foramen	Position of OEF			
				B	B1	B2	D
1	Premsagar et al. (1990)20	7/338 (2.07%)	Nil	0	0	0	7
2	B.V. Murlimanju et al (2011)21	11/78 (14.10%)	Nil	2	5	4	0
3	Suruchi Singhal and Roopa Ravindranath (2013)22	18/221(8.14%)	3	2	6	10	20
4	Kabilamurthi S (2015)23	14/60(23.33%)	Nil	3	5	6	0
5	Subashri A & M S Thenmozhi (2016)24	35/60 (58.33%)	11	3	5	9	1
6	Present study (2023)	23/42 (54.76%)	9	3	15	16	3

So, in comparison with other studies, we got similar results as per study of Subashri A & M S Thenmozhi.

Based on the location, the occipital emissary foramen connects:
1) Confluence of sinuses with the occipital vein if seen on the EOC near the EOP;
2) Marginal sinuses to the occipital vein if seen on either side of FM (11 unilateral and 3 bilateral in the study);
3) occipital sinus to occipital vein if seen on the EOC near the FM (3 case in the present study);
4) It may also receive the occipital diploic vein.

Presence of bilateral foramina may imply that instead of a single vein, there may be two emissary veins connecting the occipital veins to the occipital sinus or to the marginal sinuses near the foramen magnum. These veins serve to link the vertebral venous plexus with intracranial sinuses above and vertebral, brachiocephalic, and intercostal veins below[22].

The position of the foramen is more important than its incidence especially in suboccipital exposure as this procedure is one of the commonest neurological practices for the management of pathologies involving the posterior cranial fossa. These procedures always include the posterior edge of foramen magnum which is either removed en bloc or piecemeal and then replaced[25].

CONCLUSION:

With the increased application of magnetic resonance imaging (MRI) and computed tomography (CT), the foramina of the skull are being observed as never before in the clinical setup. The knowledge of theses foramina, especially occipital emissary foramen is important because of the recent advances in neurointerventional and neurosurgical techniques. The present study was therefore undertaken with respect to its clinical relevance and the objectives of the study were to find the incidence and topography of the occipital emissary foramina in human skulls.

Acknowledgement:

With sincere gratitude, we acknowledge Dr. Kishore Khushale (HOD of Anatomy Department, Seth G S Medical College & KEM Hospital, Mumbai) for the extended support.

Abbrevations:
1. Occipital emissary Foramen (OEF)
2. Occipital emissary Vein (OEV)
3. External Occipital Crest (EOC);
4. External Occipital Protuberance (EOP);
5. Foramen Magnum (FM).

REFERENCES:

1. Wikipedia
2. Boyd GI. The emissary foramina of the cranium in man and the anthropoids. J Anat 1930;65:108 –21 Medline
3. Standring S, ed: Gray's Anatomy, 39th Ed. Edinburgh: Churchill Livingstone, 2005: 281
4. San Milla´n Ruí´z D, Gailloud P, Ru¨fenacht DA, et al. The craniocervical venous system in relation to cerebral venous drainage. AJNR Am J Neuroradiol 2002;23:1500 –08.
5. Pekc¸evik Y, Pekc¸evik R. Why should we report posterior fossa emissary veins Diagn Interv Radiol 2014;20:78 –81.
6. Reis C, Deshmukh V, Zabramski JM, Crusius M, Desmuskh P, Spetzler RE, Preul MC: Anatomy of the mastoid emissary vein and venous system of the posterior neck region: Neurosurgical implications. Neurosurgery 61:ONS193–ONS201, 2007
7. Jadhav SD, Ambali MP, Zambare BR. Sphenoidal emissary foramen and its clinical consideration. Int J Res Med Sci. 2016 Jul;4(7):2926-2929
8. Zdilla MJ, Cyrus LM, Laslo JM, Lambert HW. Bilateral duplication of the sphenoidal emissary foramen: A case report with implications for surgeries using transovale cannulation. Anat Physiol. 2014; 4:4.
9. Leonel LCPC, Peris-Celda M, de Sousa SDG, Haetinger RG, Liberti EA. The sphenoidal emissary foramen and the emissary vein: Anatomy and clinical relevance. Clin Anat. 2020 Jul;33(5):767-781
10. A. Hedjoudje, A. Piveteau, C. Gonzalez-Campo, A Moghekar, P. Gailloud and D. San Millán. The Occipital Emissary Vein: A Possible Marker for Pseudotumor Cerebri. AJNR Am J Neuroradiol 2019, 40 (6): 973-978.
11. Louis Jr RG, Loukas M, Wartmann CT, Tubbs RS, Apaydin N, Gupta AA, Spentzouris G, Ysique JR: Clinical anatomy of the mastoid and occipital emissary veins in a large series. Surg Radiol Anat 2009; 31:139–144.
12. Ivan Maslarski, Lyudmila Belenska-Todorova. Variants Of Mastoid And Occipital Emissary Foramens And Their Clinical Correlation. Journal of IMAB - Annual Proceeding (Scientific Papers). 2021 Oct-Dec;27(4):4004-09.
13. Federative Committee of Anatomical Terminology (FCAT). Terminologia anatomica: international anatomical terminology. Stuttgart: Georg Thieme Verlag; 1998. p. 1–292.
14. Clemente CD (ed). Anatomy of the human body. 30th ed. Philadelphia: Lea and Febiger; 1985. p. 1–1676.
15. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MWJ (eds). Gray's anatomy. 38th ed. Edinburgh: Churchill Livingstone; 1995. p. 1–2092.
16. Standring S (ed). Gray's anatomy: the anatomical basis of clinical practice. 41st ed. London: Elsevier; 2016. p. 1–1562.
17. D. Falk and G. C. Conroy, "The cranial venous sinus system in australopithecus afarensis," Nature. 1983; 306(5945):779-81.
18. D. Falk, "Evolution of cranial blood drainage in hominids: enlarged occipital/marginal sinuses and emissary foramina," American Journal of Physical Anthropology. 1986; 70(3): 311-24.
19. W. H. Kimbel, "Variation in the pattern of cranial venous sinuses and hominid phylogeny," American Journal of Physical Anthropology. 1984; 63(3): 243-63.
20. I. C. Premsagar, P. K. Lakhtakia, and K. K. Bisaria, "Occipital emissary foramen in Indian skulls," Journal of Anatomy. 1990; 173: 187-88.
21. B.V. Murlimanju, Latha V. Prabhu, Mangala M. PAI, Mir Jaffar, Vasudha V. Saralaya, Mamatha Tonse, Prameela M.D. Occipital Emissary Foramina in Human Skulls: An Anatomical Investigation with Reference to Surgical Anatomy of Emissary Veins. Turkish Neurosurgery 2011, 21(1) 36-38.
22. Suruchi Singhal and Roopa Ravindranath. Occipital Emissary Foramina in South Indian Modern Human Skulls. Hindawi Publishing Corporation ISRN Anatomy Volume 2013, 1-4.
23. Kabilamurthi S. International Journal of Science and Research (IJSR). 2017 October; 6(10): 1853-54.
24. Subashri. A, M.S. Thenmozhi. Occipital Emissary Foramina in Human Adult Skull and Their Clinical Implications. Research J. Pharm. and Tech. Jun 2016; 9(6):716-718.
25. J. T. Park, "A simple technique for posterior fossa craniotomy in adult," Journal of Korean Neurosurgical Society. 2006; 40: 206–209.