

# An Anatomical Study of Parietal Emissary Foramina in Dry Adult Human Skulls

MANJUNATH HALAGATTI, SRINIVASA SAGAR

## ABSTRACT

**Introduction:** Emissary foramina are of considerable surgical significance in the region of scalp. These will transmit the veins of the same name. Such foramina on the parietal bone, are called as parietal emissary foramina, which are usually located on either side of the sagittal suture. The number and location of these foramina helps in knowing the communications between intracranial dural venous sinuses and the veins of the scalp. Their location is also important for analysing the avulsion injuries of scalp and neurological surgeries. Incidence of parietal emissary foramina ranges from 50-80% in various population groups.

**Aim:** This study is done to find out the incidence of parietal emissary foramina, their number, location and distance from the sagittal suture.

**Materials and Methods:** Total 215 dry cadaveric skulls were collected from Department of Anatomy and Forensic Medicine, KIMS Koppal, India. The skulls were observed for the emissary foramina on the parietal bones. Each foramen is checked for its patency. Distance of the foramen is measured from the sagittal suture.

**Results:** Out of the 430 parietal bones, 326 bones showed emissary foramen (75.6%). Among these, one foramen was found in 283 parietal bones, two foramina in 35 bones and three in 7 bones. The mean distance of parietal foramen from sagittal suture was  $6.4 \pm 2.5$  mm on right side and  $6.6 \pm 2.6$  mm on left side.

**Conclusion:** There are very few studies on parietal emissary foramina. This study provides an important data of morphometry of parietal emissary foramina, which is important for neurosurgeons and radiologists.

**Keywords:** Obelion, Sagittal, Scalp, Suture

## INTRODUCTION

The parietal bones form the most of the cranial roof and side of the skull [1]. The parietal foramen is small inconsistent aperture, in posterior part of parietal bone, near the sagittal suture [2]. These foramina are of special interest for the neuroanatomists and neurosurgeons, due to their anatomical and surgical importance and are located at the junction of middle 1/3<sup>rd</sup> and posterior 1/3<sup>rd</sup> of parietal bone [1]. These are usually found 3.5 cm in front of the lambda, may be on one or both sides of sagittal suture [3]. Parietal emissary foramina transmit emissary veins connecting scalp veins with superior sagittal sinus [4]. Obelion is the term given for the point on the sagittal suture which is just medial to the parietal foramen. This area appears like the Greek symbol '÷' (obelos), dots of the symbol are the foramina and the line being the sagittal suture between them [5]. An emissary vein passes through this foramen, connecting extracranial scalp veins with the superior sagittal sinus. Rarely, these foramina may transmit an artery, a branch of occipital artery. The parietal foramina may show variations in relation to their number, topography, size and shape [6,7]. Being valveless, the emissary veins allow

passage of blood through them in both directions. Normally, there will be sluggish flow of blood in these veins, but in raised intracranial pressure, these veins will form important channels for draining the blood [8]. Boyd states that every foramen transmitting emissary vein is not a emissary foramen, but only for parietal, mastoid, condylar and sphenoidal emissary foramina [9]. Sometimes a solitary emissary foramen may be found at the squamous part of temporal bone [10]. Few studies are done on the morphometry of parietal foramina [11]. According to Mann, these foramina are normal feature of human skull, may alter nature of sagittal suture [12]. Murlimanju BV, did a study on dry south Indian skulls for the topography of these foramina [13]. A study on the presence, location, number of parietal emissary foramina will be helpful during surgeries over this area. These are the channel of blood flow and transmission of infection to the cranial cavity. This study was performed to study the topography of these foramina considering their importance in surgery. Objectives of the current study was to note the frequency of parietal foramina, to measure the distance between sagittal suture and the parietal foramen.

## MATERIALS AND METHODS

This observational study was conducted on 215 dry adult cadaveric skulls (430 parietal bones), during August 2016 to April 2017. The dry adult skulls were taken from the Department of Anatomy and Forensic Medicine, Krishna Institute of Medical Sciences, Koppal, Karnataka, India. Each parietal bone was observed for number and location of the parietal foramina. Every foramen was checked for patency using a needle. Distance from sagittal suture was measured, using manual vernier callipers. Mean and SD were calculated using SPSS software, version 2017. Deformed skulls, skulls with fractured parietal bones were excluded from the study.

## RESULTS

Out of the 430 parietal bones, 326 bones showed presence of parietal foramen (75.6%) [Table/Fig-1].

All the foramina were located at the junction of middle 1/3<sup>rd</sup> and

Number of Foramina	Frequency		
	Right	Left	Total
1	153	130	283
2	19	16	35
3	05	03	08

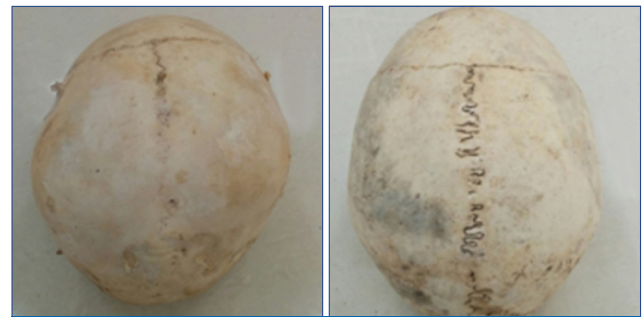
[Table/Fig-1]: Table showing frequency of parietal foramina.



[Table/Fig-2]: Skull with unilateral parietal foramen.



[Table/Fig-3]: Skull with bilateral parietal foramina. [Table/Fig-4]: Skull with three parietal foramina.



[Table/Fig-5]: Skull without parietal foramen. [Table/Fig-6]: Distance between sagittal suture and parietal foramina.

posterior 1/3<sup>rd</sup> of the parietal bone. Mean distance of parietal foramina from the sagittal suture was  $6.4 \pm 2.5$  mm on the right side and  $6.6 \pm 2.6$  mm on the left side [Table/Fig-2-6].

## DISCUSSION

The knowledge of the emissary foramina and their clinical implications are significant, due to their variations and their relation to the dural venous sinuses [1]. The parietal foramen is located 2 cm anterior to lambda in the new born. In case of adults, it is 2 to 5 cm anterior to the external occipital protuberance [6]. Yoshioka N et al., opined that, parietal foramina may be single or multiple, unilateral or bilateral. The variations may be due to differences in ossification [7]. A study showed parietal foramina transmitting an anastomotic artery, between middle meningeal artery and arteries of the scalp [7]. Parietal foramina are larger in Australian and Newzealand population than in other races [9]. A delayed ossification in the posterior 1/3<sup>rd</sup> of the parietal bone, especially at the obelion may result in a slit or V-shaped notch, which is called as the sub sagittal suture or 3<sup>rd</sup> fontonella [11]. Mann analysed the relationship of parietal foramina and the complexity of the sagittal suture and reported that the sagittal suture with presence of bilateral parietal foramina, was more complex [12]. Further, Mann added that, presence of emissary vessels in the parietal foramina alters the stresses at the obelion [12]. Murlimanju BV et al., reported incidence of 71.5% of parietal foramina, in his study on dry parietal bones of South Indian skulls [13]. Current study reports incidence of 75.6% of parietal foramina, which is similar to that of latter study [13]. Parietal bone is intramembranous in ossification, with a single ossification centre, which appears at the parietal eminence during the 8<sup>th</sup> week of IUL [11, 14]. It has been reported that, these foramina are byproduct of bipedalism [15]. According to Falk D et al., the erect posture needed delivery of blood from the brain to vertebral venous system. Hence, enlarged marginal sinus system and emissary foramina to transmit emissary veins developed [16]. There are reports of absence of these foramina in some races [17]. Few studies revealed abnormally large parietal foramina [18,19]. Large parietal foramen is due to heterozygous mutations of MSX2, which is autosomal dominant [19].

## LIMITATION

Current study is on dry skull bones. A better study can be in cadaveric scalp, with a special attention in the area of emissary veins or by means of radiological studies.

## CONCLUSION

With our study we report an incidence of 75.6% of emissary foramina and we would like to conclude that knowing the location and frequency of these foramina helps to have better knowledge about route of spread of infection from the scalp. By knowing number and location of parietal foramina blood loss during scalp surgeries or neurological studies can be minimised.

## REFERENCES

- [1] Freire AR, Rossi AC, De Oliveira VC, Prado FB, Caria PH, et al. Emissary foramina of the human skull: anatomical characteristics and its relations with clinical neurosurgery. *Int J Morphol.* 2013;31:287-92.
- [2] Moore, K. L. & Dalley, A. F. *Clinical Oriented Anatomy*. 5<sup>th</sup> ed. Philadelphia, Lippincott Williams & Wilkins, 2006. Pp:829-30.
- [3] Dutta AK. *Essentials of Human Osteology*. 2<sup>nd</sup> ed. Current Books International. Kolkata, India. 2005. Pp:130-31.
- [4] Susan Standing. *Gray's Anatomy The Anatomical basis of Clinical Practice*, 41<sup>st</sup> Edn. Churchill Livingstone, Elsevier. 2016. Pp:416,418,477.
- [5] Jamieson EB. *Dixon's Manual of Human Osteology*. 2<sup>nd</sup> ed. London: Humphrey Milford. 1937.
- [6] Wysocki J, Reymond J, Skarzyński H, Wróbel B. The size of selected human skull foramina in relation to skull capacity. *Folia Morphol (Warsz)*. 2006;65(4):301-08.
- [7] Yoshioka N, Rhoton AL, Abe H. Scalp to meningeal arterial anastomosis in the parietal foramen. *Neurosurg.* 2006;58(1):123-26.
- [8] Reis CV, Deshmukh V, Zabramski JM, Crusius M, Deshmukh P, Spetzler RF, et al. Anatomy of the mastoid emissary vein and venous system of the posterior neck region: neurosurgical implications. *Neurosurgery.* 2007;61(Suppl 2):193-200; discussion 200-01.
- [9] Boyd GI. The emissary foramina of the cranium in man and the anthropoids. *J Anat.* 1930;65(Pt 1):108-21.
- [10] Williams PK, R Warlock, M Tyson and LH Banister. *Gray's Anatomy*. 37<sup>th</sup> edition. Churchill Livingstone, London, UK. 1989. Pp:805.
- [11] Currarino G. Normal variants and congenital anomalies in the region of the obelion. *AJR Am J Roentgenol.* 1976;127:487-94.
- [12] Mann RW, Manabe J, Byrd JE. Relationship of the parietal foramen and complexity of the human sagittal suture. *Int J Morphol.* 2009;27:553-64.
- [13] Murlimanju BV, Saralaya VV. Morphology and topography of the parietal emissary foramina in South Indians: an anatomical study. *Anat Cell Biol.* 2015;48(4): 292-98.
- [14] Hoheisel WF. An anomalous Indian occiput. *Anat Rec.* , 1930;45(2):129-35.
- [15] Falk D, Conroy GC. The cranial venous sinus system in *Australopithecus afarensis*. *Nature.* 1983;306:779-81.
- [16] Falk D. Evolution of cranial blood drainage in hominids: enlarged occipital/marginal sinuses and emissary foramina. *American Journal of Physical Anthropology.* 1986;70(3): 311-24.
- [17] Le Double AF. *Treatise on the variations of the bones of the skull of the man, and their significance from the point of view of anthropology zoological*. Foreword by Edmond Perrier. Paris: Vigot Freres; 1903. Pp: 67, 116-124, 176, 317-33 [Translated from Google].
- [18] Thottath J, Aswathy AN, Rajendran VR, Perumpalath N. Enlarged parietal foramina: a report of two cases and review of literature. *European Journal of Pharmaceutical and Medical Research.* 2016;3(9):456-58.
- [19] Wu YQ, Badano JL, McCaskill C, Vogel H, Potocki L, Shaffer LG. Haploinsufficiency of ALX4 as a potential cause of parietal foramina in the 11p11.2 contiguous gene-deletion syndrome. *Am J Hum Genet.* 2000;67:1327-32.

### AUTHOR(S):

1. Dr. Manjunath Halagatti
2. Dr. Srinivasa Sagar

### PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anatomy, Krishna Institute of Medical Sciences, Koppal, Karnataka, India.
2. Assistant Professor, Department of Anatomy, Krishna Institute of Medical Sciences, Koppal, Karnataka, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Srinivasa Sagar,  
Assistant Professor, Department of Anatomy KIMS,  
Koppal-589231, Karnataka, India.  
E-mail: drmanjunathhalagatti@gmail.com

### FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Publishing: Apr 01, 2018