

# Occipital Emissary Foramina in Human Skulls: An Anatomical Investigation with Reference to Surgical Anatomy of Emissary Veins

## *İnsan Kafatası İçinde Oksipital Bölgede Yer Alan Delikler: Delici Venlerin Cerrahi Anatomisi: Referans ile Anatomik Bir Soruşturma*

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*This paper has been presented at the 12th state-level conference of Karnataka Chapter of Anatomists which was held at Kolar, INDIA on 6th to 8th August 2010.*

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### ABSTRACT

**AIM:** The objectives were to find the incidence and topography of the occipital emissary foramina in skulls of South Indian Region.

**MATERIAL and METHODS:** In the present study, 78 dried adult human skulls were examined. They were analyzed for the gross incidence and position of the occipital emissary foramen. The observations were made in the squamous part of the occipital bone from the posterior margin of the foramen magnum to the external occipital protuberance.

**RESULTS:** From our observations, the occipital emissary foramen was present in 11 (14.1%) skulls. Left sided foramen was observed in 5 cases (6.4%), right-sided foramen in 4 (5.1%) and the median foramen was seen in 2 (2.6%) of the cases.

**CONCLUSION:** The occipital emissary vein is present in a small percentage (14.1%) of cases. It was also demonstrated that its location is variable as to left, right or midline. Its location was closer to the foramen magnum than to the external occipital protuberance in all the specimens. The morphology of this subject is important to the neurosurgeons and plastic surgeons. The knowledge is of importance in suboccipital craniotomies as this foramen transmits the occipital emissary vein and will keep awareness among the surgeons to avoid the excessive bleeding.

**KEYWORDS:** Emissary vein, Foramen, Foramina, Neurosurgery, Skull, Suboccipital

### ÖZ

**AMAÇ:** Güney Hindistan bölgesinde yaşamış insanların oksipital kemiklerindeki venöz deliklerin yerleşiminin ve sıklığının belirlenmesi.

**YÖNTEM ve GEREÇ:** Bu çalışmada, 78 erişkin insan kafatası incelendi. Oksipital kemiğin skamöz parçasının foramen magnum ile eksternal oksipital kabarıklık arasında kalan bölümü oksipital emisser delik açısından incelendi.

**BULGULAR:** İncelenen kafataslarından 11'inde (%14,1) emiser delik bulundu. Beş kafatasında (%6,4) emisser delik solda, 4 kafatasında (%5,1) sağda, 2 kafatasında (%2,6) ise orta hatta izlendi.

**SONUÇ:** İncelenen kafataslarının % 14.1'inde oksipital emisser ven deliği bulundu. Bulunan bu delikler sabit bir yerde değil sağ, sol ve orta hatta yerleşim gösteriyordu. Emiser oksipital deliğin farklı yerleşiminin bilinmesi plastik cerrahlar ve beyin cerrahları açısından özellikle önemlidir; çünkü bu delikten geçen venin hasarlanması durumunda önemli ölçüde kan kaybedilmektedir.

**ANAHTAR SÖZCÜKLER:** Emisser ven, Foramen, Foramenler, Nöroşirürji, Kafatası, Suboksipital

### INTRODUCTION

It is known that the morphological differences exist between the skulls of different races (9). Many anatomical studies have focused on the different skull foramina including various emissary foramina and detailed descriptions of the occipital emissary foramina are scarce in the literature. The emissary foramina transmit the emissary veins which connect intracranial venous sinuses with the extracranial veins (8). 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). The knowledge of these foramina, especially occipital emissary foramina is important because of the recent advances in neurointerventional and neurosurgical techniques (4). The occipital sinus and suboccipital venous

plexus are proposed to be connected by an occipital emissary vein. The occipital emissary foramen has received significant attention during suboccipital craniotomies since it transmits the occipital emissary vein (2). The developed occipital emissary vein is sometimes troublesome for hemostasis if injured in suboccipital craniotomy. 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 skulls of South Indian region.

#### MATERIAL and METHODS

In the present study, 78 dried adult human skulls were examined from the neuroanatomy teaching collection of Manipal University. The skulls were derived from male (47) and female (31) subjects with an age range from approximately 50 to 80 years. Our institutional ethics committee has confirmed that the present study does not require its clearance. The skulls were analyzed for the gross incidence and position of the occipital emissary foramen. The patency of the foramen in each case was confirmed by passing a probe. The observations were made in the squamous part of the occipital bone from the posterior margin of the foramen magnum to the external occipital protuberance. In order to avoid observational errors, each specimen was examined by three members of the team, independently.

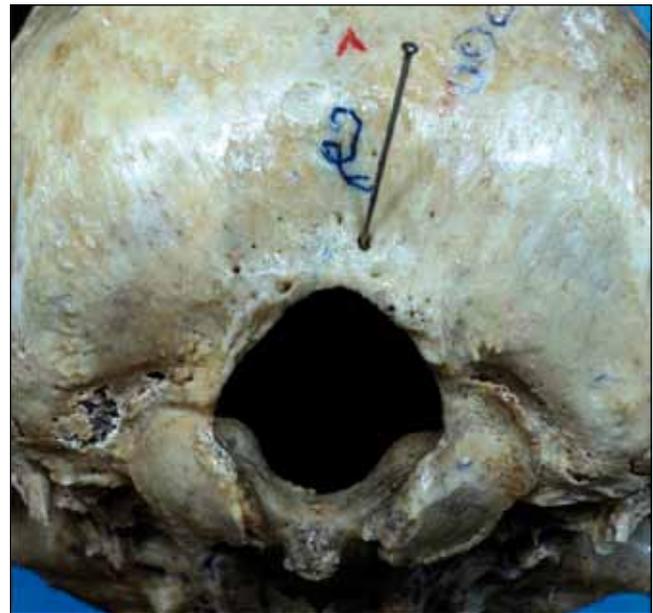
#### RESULTS

The occipital emissary foramen was present in 11 (14.1%) skulls out of a total of 78 dry human adult skulls. Left-sided foramen (Figure 1) was observed in 5 cases (6.4%), right-sided foramen (Figure 2) in 4 (5.1%) and a median foramen (Figure 3) was seen in 2 (2.6%) of the cases. In all the specimens, its location was closer to the foramen magnum than the external occipital protuberance. A pin has been passed through all the foramina to confirm the patency. This foramen was absent in a majority of our specimens (67, 85.9%) (Figure 4). The

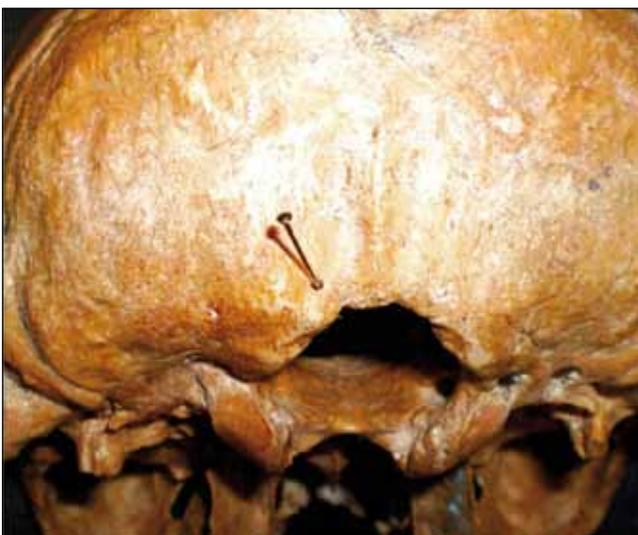
observations of this study were compared with those of other investigators. There were a few differences and similarities observed. The results are summarized and contrasted with those of other investigators in the discussion section, allowing the direct comparison.

#### DISCUSSION

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 set up. The evaluation of these foramina has become an important part of diagnostic medicine (1) but the absence of essential



**Figure 2:** Skull with occipital emissary foramen on right side (n=4, 5.1%).



**Figure 1:** Skull with occipital emissary foramen on left side (n=5, 6.4%). A pin has been passed through the foramen.



**Figure 3:** Skull with median occipital emissary foramen (n=2, 2.6%).



**Figure 4:** Skull with no occipital emissary foramen (n=67, 85.9%).

anatomic data on these foramina is a severe deficiency of modern anatomy textbooks. The occipital emissary foramen is present in the squamous part of the occipital bone at the occipital protuberance and transmits a vein that connects the confluence of the sinuses with veins of the suboccipital venous plexus (5). Sharma et al. (7) reported a rare finding of a single occipital emissary foramen present in the squamous portion of the occipital bone in only one skull out of 214 skulls studied by them. This was refuted by Premsagar et al. (5), who reported that the occipital emissary foramen appears to be much more common than found by Sharma et al. (7) and observed this foramen in 7 out of 338 of the specimens. They also reported that the site of this emissary foramen corresponds to the site of the occipital sinus present in the attached margin of falx cerebelli, so that it probably connects the occipital sinus with the suboccipital venous plexus. They stated that it is important for neurosurgeons to recognise the presence of this vein during suboccipital craniotomy.

This foramen was later studied by a few authors and the incidence rates reported. Wysocki et al. (9) observed this foramen in 3% of their specimens. The overall prevalence of this foramen according to Louis et al. (4) was 7% on right and 4% on the left side. Gozil et al. (2) studied the skulls from Central Anatolia and reported the incidence of this foramen as 2.6% and reported that the foramina were closer to the foramen magnum and not to the external occipital protuberance. This foramen was also studied by Hossain et al. (3) and their observations from 150 dry Bangladeshi skulls reported the occipital emissary foramen in 21 (14%) skulls. They observed left- and right-sided foramen in 7 (4.7%) and 10 (6.7%) cases respectively. They also observed the median foramen in 4 (2.7%) cases. Our results are higher than other

studies, but similar to observations by Hossain et al. (3). We observed this foramen in 11 (14.1%) skulls. Left-sided foramen was observed in 5 cases (6.4%), right-sided in 4 (5.1%) and a median foramen was seen in 2 (2.6%) of the cases. In all the specimens, its location was closer to the foramen magnum than the external occipital protuberance.

In the present study, the occipital emissary foramen was observed in 14.1% of the cases and was nearer to the foramen magnum in all the specimens. This is a slightly higher incidence compared to others and may be because of racial variations. The fact as revealed in the present study is that the occipital emissary vein is only present in a small percentage of cases. It was also demonstrated that its location is variable as to left, right or midline. The incidence and positions of the occipital emissary foramina are important for the neurosurgeons during suboccipital craniotomies as these will transmit the occipital emissary veins and will provide awareness to avoid unnecessary blood loss during posterior fossa surgery. These veins may be a major problem in the sitting surgical position since they can cause air embolism when injured. They may be a real problem in the surgical treatment of arteriovenous fistula and malformations. The morphology of this subject is also important to the plastic surgeons who are involved in the surgical procedures of sub occipital region. The examination of these foramina is also important in evaluating the possibility of neoplastic and non-neoplastic processes. With these observations, the researchers and clinicians examining the occipital emissary foramina may have an anatomical reference. Implications for future study would involve radiological examination of these foramina with the aid of CT scans and MRI studies. More details of this venous system, size, depth and correlation with other emissary veins can also be studied with these radiological investigations.

## REFERENCES

1. Berge JK, Bergman RA: Variations in size and in symmetry of foramina of the human skull. *Clin Anat* 14:406-413, 2001
2. Gozil R, Kadioglu D, Calguner E: Occipital emissary foramen in skulls from Central Anatolia. *Acta Anatomica* 153:325-326, 1995
3. Hossain SMA, Rahman L, Karim M: Occipital emissary foramen in Bangladeshi skulls. *Pak J Med Sci* 17:156-158, 2001
4. 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* 31:139-144, 2009
5. Premsagar IC, Lakhtakia PK, Bisaria KK: Occipital emissary foramen in Indian skulls. *J Anat* 173:187-188, 1990
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. Sharma PK, Malhotra VK, Tewari SP: Emissary occipital foramen. *Anat Anz* 162:297-298, 1986
8. Standring S, ed: *Gray's Anatomy*, 39th Ed. Edinburgh: Churchill Livingstone, 2005: 281
9. Wysocki J, Reymond J, Skarzynski H, Wrobel B: The size of selected human skull foramina in relation to skull capacity. *Folia Morphol* 65:301-308, 2006