POSTERIOR CONDYLAR CANAL VARIATION IN EAST INDIAN SKULL

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ABSTRACT

BACKGROUND

Posterior condylar canal, a foramen present within the condylar fossa, carries emissary vein which connects sigmoid sinus with the occipital vein, nerves supplying the dura mater of posterior cranial fossa and meningeal branches of the occipital artery. Injuries to these neurovascular bundles may occur during dissection involved in skull base surgeries, thereby requiring detailed knowledge of anatomical variations. Despite being the largest emissary foramen of the posterior cranial fossa, there are reports of rare absence of this canal. Both unilateral and bilateral posterior condylar canal have also been reported.
Aim of the study was to observe the variations of posterior condylar canal in dry adult skulls of East Indian population.

MATERIALS AND METHODS

The study was conducted on 35 dry adult skulls without asymmetry or deformity collected from the Department of Anatomy, Jawaharlal Nehru Institute of Medical Sciences (JNIMS) and Regional Institute of Medical Sciences (RIMS), Manipur. The study was conducted to evaluate the frequency of the presence of posterior condylar canal unilaterally, bilaterally or its absence using a malleable metallic probe, magnifying lens and measuring tape.

RESULTS

In the present study, out of 35 skulls studied, the posterior condylar foramen was present in 33 (94.3%) cases and absent in 2 (5.7%) cases. Among the 94.3% cases with the foramen, 31.3% were present bilaterally and 62.9% were present unilaterally (Right Side 34.3% and Left Side 28.6%). No skull exhibited multiple foramina.

CONCLUSION

There can be great anatomical variations in the posterior condylar canal such as absence- unilateral or bilateral. Unilateral presence is encountered more commonly, amongst which the right side patency predominates. Knowledge of such variations will provide valuable information to surgeons while carrying out operative procedures involving craniocervical region.

KEY WORDS

Condylar Fossa, Emissary Vein, Occipital Artery, Posterior Condylar Canal, Venous Sinus.

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BACKGROUND

The condylar canal, also known as condyloid canal or canalis condylaris, is a canal in the condyloid fossa of the lateral parts of occipital bone behind the occipital condyle. On resection of the rectus capitis posterior major and minor muscles, the bony recess leading to the condylar canal is revealed, which is situated posterior and lateral to the occipital condyle of the human skull. The canal is superior to the extradural vertebral artery, which makes a loop above the posterior first cervical ring before entering the foramen magnum. The anteromedial wall of the condylar canal thickens to join the rim of foramen magnum and connects to the occipital condyle. The canal transmits the emissary veins, which originate at the sigmoid sinus and drain into the occipital vein.[1] The condylar canal exhibits variable presence and may be incomplete or even absent in few cases, though more commonly the canal is seen bilaterally. It can have variations of being a single canal or multiple smaller canals in cluster.

Due research has been devoted to the identification of this canal and its role as an alternative source of venous drainage from the brain will help avoid misinterpretation. The posterior condylar canal is the largest emissary foramen of the posterior cranial fossa. It is apparent just postero-inferior to the jugular foramen and posterior to the hypoglossal canal. The condylar canal gives way to a condylar emissary vein from sigmoid sinus to vertebral vein between the axis and atlas in most cases or between the superior bulb of the internal jugular vein and suboccipital venous plexus. The posterior condylar foramen is located behind the condyle of the occipital bone. Through the condylar canal, the occipital emissary vein connects to the venous system including the sub-occipital venous plexus, occipital sinus and sigmoid sinus.

In the posterior part of the inferior surface of skull, the occipital condyles overlap the anterior margin of the foramen magnum and are for articulation of superior articular facets on the lateral masses of the atlas. The condylar fossa present just behind the occipital condyle accommodates the posterior margin of the atlas when the head is fully extended. The posterior condylar canal, largest emissary foramen of the posterior cranial fossa, usually transmits an emissary vein to the sigmoid sinus and nerves supplying the dura mater of the posterior cranial fossa. Emissary veins connects intracranial

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vein with the extracranial vein through the cranial apertures. Some are relatively constant, while others may be absent like the posterior condylar vein. Such types of connections are clinically important in determining the spread of infection from extracranial foci to venous sinuses including the spread of infection from the mastoid to the venous sinuses or from the paranasal sinuses to the cavernous sinus. They also provide alternative drainage pathways in cases of venous sinus thrombosis. These emissary veins provide an alternative venous drainage when the jugular vein is blocked or tied.[1]

According to some authors, the posterior condylar canal acts as an important route for venous circulation connecting intracranial with extracranial venous system during embryonic period. With gradual change from foetal to neonatal circulation, this venous system atrophies leading to closure of venous bone tunnel. Failure of closure will lead to persistence of posterior condylar canal.[2] So the posterior condylar canal presence is variable. It may not be present all the time. If present it may be unilateral, bilateral or multiple. Meningeal branches of the occipital artery also course through posterior condylar canal. Such kind of anatomical variation information is important to the surgeons doing operative work on the base of skull to avoid damage to the neurovascular structures.[3,4] The study was to see the presence of posterior condylar canal unilaterally, bilaterally or its absence.

MATERIALS AND METHODS

The study was conducted on 35 dried adult skulls from the Department of Anatomy of Jawaharlal Institute of Medical Sciences and Regional Institute of Medical Sciences, Manipur. Posterior condylar foramen being bent is sometimes difficult to assess whether it is complete or incomplete. Whenever posterior condylar foramen was present as pit, depression or as small blind canal, it was recorded as absent. Posterior condylar foramen was observed for its presence on one or both sides and whether it was absent on both sides. A thin malleable metallic probe gently passed into the foramina to check the patency into the unilateral or bilateral canal determines whether they open into the posterior cranial fossa in their complete sequence. Photographs were taken with the probe placed in the canal for recording the patency or absence of each of the cases. The data obtained were tabulated and analysed. The descriptive study is to observe the morphology of posterior condylar canal and its variations with regards to unilateral or bilateral presence and its occasional absence.

RESULTS

Of the 35 human cadaveric skulls studied for the presence and completeness of posterior condylar foramina, its presence was noted in 33 skulls (Table 1). Among these foramina present skulls, 22 (62.9%) skulls showed unilateral presence and bilateral presence were seen in 11 (31.4%) skulls. Out of the unilaterally present foramen, right side is predominant at 34.3% as compared to 28.6% seen on left side (Table 2). Posterior condylar foramina is absent in 2 (5.7%) skulls in this study. No skull exhibited multiple (more than two) foramina. In the present study, we observe that 62.9% cases are of unilateral posterior condylar canal and 31.4% cases are of bilateral condylar canal. The study had the limitation of less number of specimens due to the availability.

	n	%
Present	33	94.3
Absent	2	5.7
Total	**35**	**100**

Table 1. Posterior Condylar Canal

		n (%)
Unilateral PCF	Right	12 (34.3)
	Left	10 (28.6)
	Total	**22 (62.9)**
Bilateral PCF		11 (31.4)

Table 2. Showing Incidence of Posterior Condylar Canal in Dried Skulls

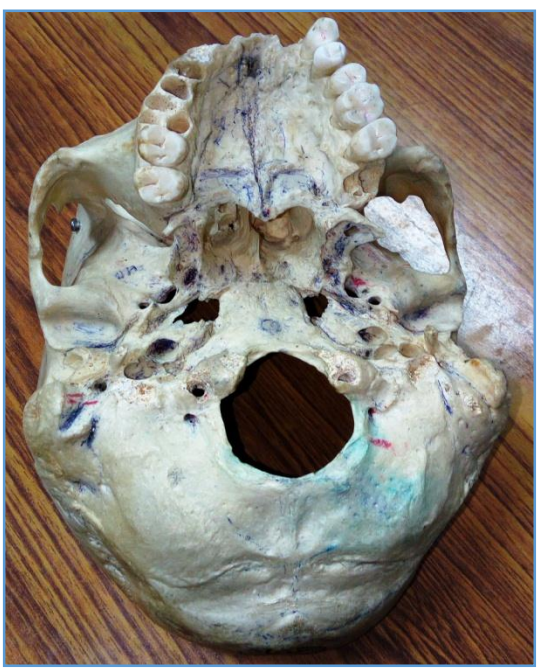

Figure 1. Both Condylar Canal Present

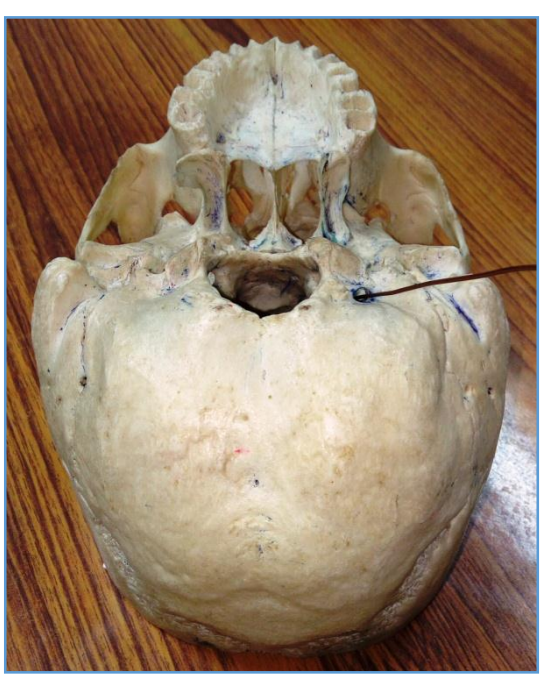

Figure 2. Condylar Canal present on the Left Side

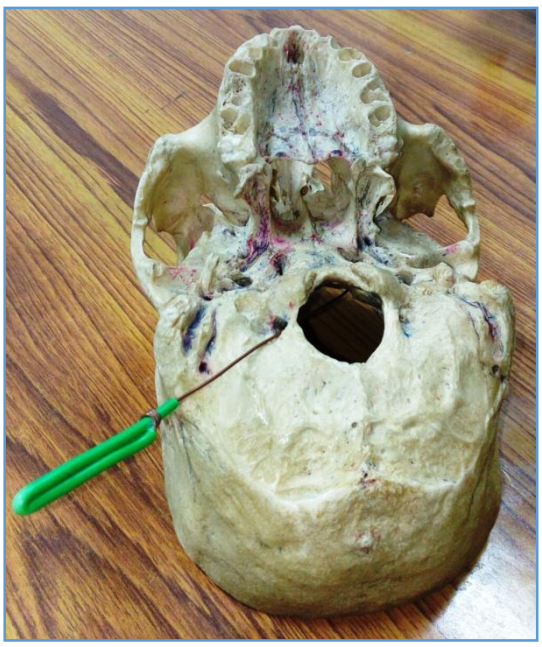

Figure 3. Condylar Canal present on the Right Side

Figure 4. Both Posterior Condylar Canal Absent

DISCUSSION

Posterior condylar foramen is one of the largest emissary foramina of the posterior cranial fossa. It opens in the condyloid fossa of the lateral parts of occipital bone behind the occipital condyle at the base of skull. The foramen is present posterior to the hypoglossal canal and postero-inferior to the jugular foramen and can be either unilateral, bilateral or occasionally multiple and may or may not be patent. The patency depends upon the emissary vein that passes through it. The emissary vein also known as the posterior condylar vein is the primary content, other structures being meningeal branches of occipital artery and nerves to dura mater. The posterior condylar vein connects the veins present in the suboccipital triangle with that of the sigmoid sinus. The posterior condylar vein courses between the superior bulb of the internal jugular vein and deep cervical vein. It also communicates with the horizontal portion of the vertebral artery venous plexus. Emissary veins are the output veins of the neurocranium and drain venous blood from cephalic region. These veins being valve less allow the blood flow in both directions. Normally blood flow through these veins is slow, but in cases of increased intracranial pressure the emissary veins play crucial role in drainage of blood. Posterior condylar canal is usually described as permanent venous emissary channel. The condylar canal is the source of venous circulation during the embryonic period and provides connection between endovenous and exocranial systems. By the third month of development, the mastoid and anterior and posterior condylar emissary veins are easily identifiable. Subsequently, the venous system atrophies from foetal to neonatal circulation. This atrophy which is accompanied by venous closure of the bony canal, however, persists for at least 70% of the adult skulls unilaterally.

The posterior condylar foramina situated in the posterior condylar fossa is absent in minimal percentage making it clinically significant. In the present study, out of 35 skulls studied the posterior condylar foramen was present in 94.3% cases and absent in 5.7% cases. Among the 94.3% cases, 31.3% were present bilaterally and 62.9% were present unilaterally.

In a study by Dimple et al,[2] the incidence of posterior condylar canal in South Indian skulls was found to be 90% which correlates well with the 94.3% incidence in our study. But their finding wherein unilateral canal is equally present on both right and left side with a percentage of 50 each differs from the findings obtained in the present study where the distribution is 34.3% on the right side and 28.6% on the left side.

Jayaswal observed the posterior condylar foramen to be bilateral in 25% of his study and 16% was located unilaterally.[5] Vanitha et al documented that in 49% cases posterior condylar foramen were present bilaterally and 37% unilaterally, majority being on the left side.[6] Their study of 84 dry adult skulls also found presence of double (1.1%) and triple (1.1%) canal on right side of 2 skulls each, whereas no such observations were seen in our study.

Zahid et al reported that out of 78 skulls studied in their series, 26 (33.3%) showed unilateral posterior condylar foramen (9 on left side and 17 on right side), 48 (61.6%) skulls had bilateral posterior condylar foramina and 4 (5.1%) skulls had no posterior condylar foramen. Out of 9 left-sided posterior condylar foramen 4 were patent and rest were not patent and that on the right side 13 were patent and only 4 were blind.[7] Their findings are the opposite of our study in regard to the bilateral and unilateral presence of the condylar foramen, which possibly hints at the variability of the canal amongst different races of human population.

Nishigandha et al observed posterior condylar foramen in 48.68% cases bilaterally, unilaterally on the right in 19.29% cases and on the left in 35 (15.35%) cases. They also found in 16.66% cases posterior condylar foramen was absent bilaterally.[8] Ginsberg et al in their study documented posterior condylar foramen to be bilateral in 55.9% and unilaterally in 17.6%.[9] Borkute and Shyam Kishore observed posterior condylar foramen was present bilaterally in 58%, unilaterally on the right 15% and unilaterally on the left side 10%. It was absent on both sides in 17% skull.[10] Kothandaraman and Lokanadham found that posterior condylar foramina was bilaterally present in 16% skulls and unilaterally in 10% skulls.[11]

Hetal et al reported the presence of posterior condylar foramen bilaterally in 40% of skulls, unilaterally in 33.3% out of which 20% were seen on the right and 13.33% on the left.

It was found to be absent in 26.66% skulls, which is in distinct contrast to the 5.7% observations we made in our study.[12] Kavitha observed posterior condylar foramen in 8.9% skulls and unilaterally in 21.1% skulls.[13]

Aslin Sanofer found posterior canal to be absent in 5.76%, bilaterally present in 78.9%, unilaterally in 21.1% out of which 61.3% were on the left and 38.7% were on the right.[14] In comparison to this finding, wherein our study results differ (except for the striking coincidence of percentage of absent canal in human skull), the present study reveals the wide variation in morphological anatomy of this occasionally elusive canal.

CONCLUSION

The posterior condylar canal is one of the larger emissary channels in the skull. The study of posterior condylar canal in the occipital bone of East Indian population showed some differences, which implies accompanying variations in the course of associated emissary veins. It unilateral in more than 90% of individuals. Its variations should not be misinterpreted as abnormal. A knowledge of the anatomical relationships and variations of these veins is necessary for radiological diagnosis during surgical or endovascular treatment of skull-base diseases. An understanding of the possible variations including the potential absence of the canal would invariably help the surgeon plan and execute precise operative procedure involving base of the skull. Surgical approaches near the foramen magnum and the craniocervical junction like the far lateral approach involving extensive dissection of structures related to the posterior condylar canal and particularly the posterior condylar canal requires considerations for the possible variations of the neurovascular structures, especially during the treatment of dural arteriovenous fistula.

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