

Original Research Article

Morphological Study of Hypoglossal Canal and Its Anatomical Variation

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ABSTRACT

Background: The hypoglossal canal transmits the nerve that supplies the motor innervations to the tongue. Studies on morphometry of hypoglossal canal and its variation has been a field of considerable interest to research workers especially because of their racial and regional importance.

Material &Methods: In the present study, 100 adult dry human crania of known sex were studied for hypoglossal canal and its variants. The skulls were observed for any damage of post cranial fossa and those in good condition were selected. Sliding Vernier caliper was used for morphometric analysis.

Results: The anteroposterior diameter and transverse breadth of hypoglossal canal was more in male than in females. In both sexes, length was more on left side than right side, while breadth was more on right side in females. Unilateral double hypoglossal canal was noted in 25% dry skulls whereas bilateral double hypoglossal canal in 3% dry skulls.

Conclusion: Detailed morphometric analysis of hypoglossal canal will help in planning of surgical intervention of skull base in safer and easier ways.

Keywords: Hypoglossal canal, variants, double hypoglossal canal, dry skulls.

INTRODUCTION

The vertebral skull is the most modified part of the axial skeleton. It's a skeletal complex adapted to protect the brain, special senses and cranial nerves. A study of skull and its foramina provides information about the evolutionary history of man. Hypoglossal canal size has previously been used to date the origin of human like speech capabilities to at least 4,00,000 years ago to assign modern vocal abilities. [1]

The hypoglossal canal is a permanent element of human skull. [2] The hypoglossal canal is situated above the occipital condyle at its junction of anterior one third and posterior two third and lies a little above and anterolateral to foramina magnum [3] (Fig.1). It is also known as anterior condylar canal. It transmits hypoglossal nerve, meningeal branch of ascending pharyngeal artery and an emissary vein from the basilar plexus internally and to the internal jugular vein externally. [3] The venous plexus is a dominant component of this canal. [2] Sometimes it is divided by a spicule of bone leading to variant as double hypoglossal canal. [4] A

few cranial variants have been a subject of study by many pioneering workers. Many such variants have been observed on a racial basis also by Berry and Berry. [5] This was of considerable ethnic but lesser forensic interest. Berry made a special study of non metric variants including double hypoglossal canal. [5]

The present study was undertaken to know the exact range of measurements, size and incidence of symmetry, variations as well as sexual dimorphism of the hypoglossal canal in human skull.

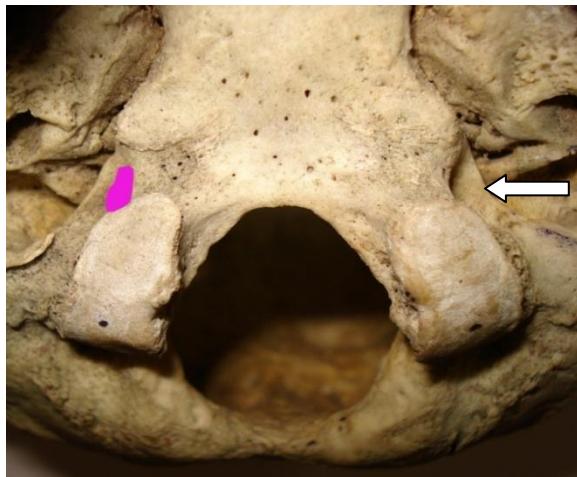


Figure 1- Photograph showing position of hypoglossal canal in the base of skull as shown by arrow.

MATERIAL AND METHODS

Hundred dry adult human crania of known sex were analyzed (seventy was of male skulls and thirty was of females) from the department of Anatomy, KIMS, Karad.

The skulls were observed for any damage of posterior cranial fossa and those in good condition were selected. For morphometric analysis, we used sliding Vernier caliper (of 30 cms length; 0.01 cm accuracy) to measure the anteroposterior diameter and transverse breadth of exocranial opening hypoglossal canal (Fig.2). The readings were analyzed statistically for mean and standard deviation. Presence or absence of any bony septum, double



Figure 2- Black arrow shows anteroposterior diameter and transverse breadth of hypoglossal canal.

hypoglossal canal was observed. The data obtained were used for statistical analysis by student's t test. The level of significance was $p < 0.05$.

OBSERVATIONS AND RESULTS

The mean anteroposterior (AP) diameter in male on right side was 0.61 cms and on left side was 0.64 cms at P value of 0.018. In females, on right side it was 0.57 cms and on left 0.62 cms at P value of 0.018. Total AP diameter in males was 0.63 cms while in females it was 0.59 cms at P value of 0.015. (Table no.1) All the parameters related to AP diameter were statistically significant.

Table no.1 showing parameters related to A-P diameter of hypoglossal canal.

	Male		Female		Total	
	Right	Left	Right	Left	Male	Female
Mean (cm)	0.61	0.64	0.57	0.62	0.63	0.59
Std. Deviation	0.08	0.09	0.07	0.09	0.09	0.09
't' value	2.37		2.08		2.45	
P value	0.018		0.018		0.015	

Mean transverse breadth in males was 0.52cms on both sides, while in females it was 0.52 cms on right side and 0.49 cms on left side. Total breadth in males was 0.53 cms and in females was 0.51cms (Table no.2). The parameter related to transverse breadth was statistically not significant.

Table no.2 showing parameters related to transverse breadth of hypoglossal canal.

	Male		Female		Total	
	Right	Left	Right	Left	Male	Female
Mean (cm)	0.52	0.52	0.52	0.49	0.53	0.51
Std. Deviation	0.11	0.12	0.12	0.11	0.11	0.11
't' value	0.11		0.82		0.82	
P value	0.91		0.41		0.41	

Regarding cranial variant related to bony spicule, 25 skulls showed unilateral bony spicules. On the right side, it was in 11 skulls and on the left side, in 14 skulls (Fig.3)

Bilateral complete bony septum was observed in 3 dry skulls (Fig.4). All the dry

skulls with bilateral complete bony septum were male skulls. Unilateral double hypoglossal canal was found in 25% of dry skulls. Bilateral double hypoglossal canal was found in 3% of dry skulls in our study (Table no.3).



Figure 3- Photograph of unilateral double hypoglossal canal.

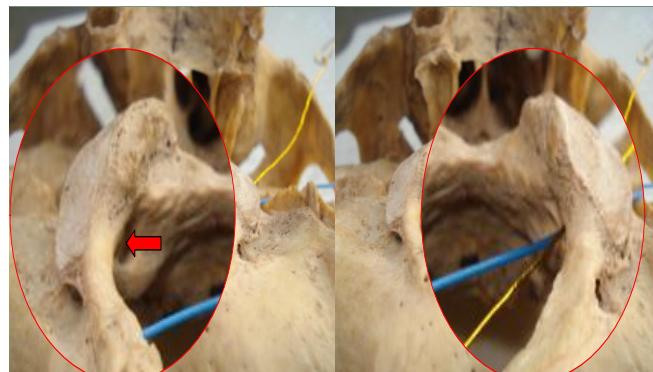


Figure 4- Photograph showing bilateral double hypoglossal canal.

Table no.3 Double hypoglossal canal.

Unilateral (25)Double hypoglossal canal	
Right (11)	Left (14)
Male = 8	Male = 11
Female = 3	Female = 3
Bilateral (3) Double hypoglossal canal	
Male =3	Female =0

DISCUSSION

The dimensions of the foramina and the variations are clinically significant in view of the delicate neurovascular structures that transverse them. The hypoglossal canal may be divided by a bony spicule. This

division of the hypoglossal canal by bony spicule separates the meningeal branch of ascending pharyngeal artery from hypoglossal nerve. Berry and Berry [5] studied the hypoglossal canal in different population of the world and found that the frequency of such separation was noted in 7-27.4%.

In the present study, unilateral double hypoglossal canal was noted in 25% of dry skulls (11 on right side with 14 on left side) and bilateral double hypoglossal canal in 3% of dry skulls. So the incidence of

double hypoglossal canal in our study was 28%. Zaidi SHH et al [4] showed 12.5% incidence of double hypoglossal canal. The double hypoglossal canal was found in 43% specimens of human skulls as per Wysocki J et al. [2] Double hypoglossal canal was observed in 97 skulls out of 492 dry skulls studied according to age and sex as per De Francisco M et al. [6] Muthukumar N et al [7] found that hypoglossal canal was divided into two by a bony septum in 30% of the dry skulls studied.

The hypoglossal canal may be divided by a bony spicule. Berge JK and Bergman RA [8] found a division of canal on the endocranial side unilaterally on the right in 8% skulls, on left side in 20% skulls and

bilaterally in 4% skulls. Berge JK et al [8] found that that AP diameter and transverse breadth (D X B) of hypoglossal canal was 0.55x0.42 cms (Table no.4). Berlin A et al [9] found that the morphometry of hypoglossal canal was as 0.9x0.5 cms. Sharma N [10] found that D X B on right side was 0.53x0.43 cms and on left side was 0.54x0.43 cms.

In the present study, we studied D X B on the right and left side of skull according to sex difference as male and female. The D X B on right side in male was 0.61x0.52 cms and in female was 0.57 X 0.52cms, while on left side in male it was 0.64x0.52 cms and in female 0.61x0.49 cms (Table No.4).

Table no.4-Comparison of AP Diameter x Transverse Breadth of exocranial opening of hypoglossal canal with other studies (cm).

	Right		Left	
	Male	Female	Male	Female
Berge JK et al [8]	0.55 X 0.42			
Berlin A et al [9]	0.90 X 0.50			
Sharma N [10]	0.53 X 0.43		0.54 X 0.43	
Present study	0.61 X 0.52	0.57 X 0.52	0.64 X 0.52	0.61 X 0.49

It is important that skull volume is significantly related to area of the jugular foramina and hypoglossal canal, indicating that these are the two most important venous foramina of the human skull. [2]

CONCLUSION

The study of hypoglossal canal and its variation is important to anatomist, anthropologists, forensic experts and clinicians. The AP diameter and Transverse breath of the hypoglossal canal was more in males than females. The AP diameter of hypoglossal canal was more on left side than right in both sexes, while the transverse breadth was more on right side in females. Unilateral double hypoglossal canal was noted in 25% of dry skulls and bilateral double hypoglossal canal in 3% dry skulls.

The knowledge of dimensions of hypoglossal canal is essential for radiologist and neurosurgeons for the surgeries of

posterior cranial fossa for tumors like schwannoma of hypoglossal nerve and sleep apnea treatment. The introduction of microsurgery necessitated improved understanding of microsurgical anatomy of hypoglossal canal for better patient's outcome. Hence, detailed morphometric study will be helpful for planning of surgical intervention involving the skull base easier and safer ways.

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