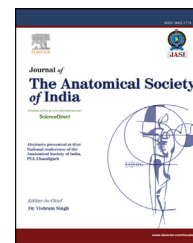


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Original Article

Bridging pattern of hypoglossal canal – Reclassified

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ABSTRACT

Introduction: The hypoglossal canal is a constant feature of the human skull and presents variations in its morphology. These variations include duplication and bridging of the canal. There have been number of studies earlier which merely defined presence and absence of the bridging of the canal however none gave a detailed classification. Hence the aim of present study was to provide a detailed classification of the bridging pattern based on the observations on a large number of sample size.

Methods: The 625 skulls were procured from Department of Anatomy of GSVM Medical College, Kanpur, Santosh Medical College, Ghaziabad and School of Medical Sciences and Research, Greater Noida. The hypoglossal canal of each skull was examined and the bridging pattern was observed and classified. The skulls with no bridging were classified as Type 1; incomplete bridging was classified as Type 2; complete endocranial bridging as Type 3; exocranial bridging as Type 4 and complete bridging throughout the canal as Type 5. These categories were further subdivided according to unilateral or bilateral bridging of the canal.

Results: The results obtained show that the hypoglossal canal is the constant feature of occipital bone of the skull and invariably presents with morphological variations. Type 1 category was seen in 84% of skulls, Type 2 was observed in 4.32% with left side dominance. Type 3a category was seen in 7.68% and Type 3b in 4.16%. There was no skull with Type 4 and Type 5 category.

Discussion: The bridging pattern of hypoglossal canal is governed by molecular, environmental and racial factors. The detailed classification of bridging pattern is of great significance to the anthropologists, forensic experts, radiologists and neurosurgeons.

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1. Introduction

The study of morphological variations of cranial traits especially that of cranial foramina of human skull has been a field of considerable interest to researchers because of their anthropological and clinical significance.

The hypoglossal canal in the occipital bone is situated above the occipital condyles at the junction of its anterior one-third and posterior two thirds and is a constant feature of human skull.¹ It transmits (a) hypoglossal nerve which is the only motor supply to the muscles of tongue (b) ascending pharyngeal artery which supplies the cranial dura, (c) meningeal branch of hypoglossal nerve which provides sensory innervations to the duramater of the posterior cranial fossa and (d) the venous plexus which connects the inferior petrosal sinus, anterior condylar vein and paravertebral venous plexus.² The venous plexus is considered to be of great significance because it is the major source of venous drainage through the postsellar cranial cavity.^{3,4}

Lesions involving the hypoglossal canal are rare and usually benign. They include hypoglossal nerve schwannomas, posterior fossa meningiomas, and jugulo-tympanic paragangliomas.⁵ The decision to intervene surgically for these conditions is based not only on factors including tumour type, size, patient age, symptoms, etc but also on the detailed anatomical information of this foramen since the cranial foramina show considerable racial and regional variations. In the modern era of advanced technology and development where even skull surgeries are considered a mere brush of knife, small anatomical and anthropological detail available to surgeons can be of great clinical and surgical significance. Hence the aim of the present study is to identify the morphological variations of hypoglossal canal in a North Indian Population and propose a classification depending on the bridging pattern. In literature only one study done in Anatolian population attempts to describe the bridging of hypoglossal canal as per detailed method.⁶ There has been no Indian study conforming to this pattern of classification for hypoglossal canal bridging. The present study is a descriptive analysis of hypoglossal canal bridging, describing not only the dichotomous pattern but also providing a detailed method of classification of bridging pattern of the canal.

2. Materials & methods

The present study was conducted on 625 dried skulls obtained from Department of Anatomy of GSVM Medical College Kanpur, Santosh Medical College Ghaziabad, School of Medical Sciences and Research Greater Noida. The skulls were observed for any damage to posterior cranial fossa and those in good condition were selected for further evaluation. In the present study a modified classification based on the dichotomous and detailed method of classification suggested by Berry and Berry⁷ and Hauser & de Stefano⁸ respectively is suggested. The hypoglossal canal bridging was observed and classified as per the below mentioned classification.

3. Results

The results obtained show Type 1 category in 84% of skulls i.e. 527 skulls had no evidence of hypoglossal canal bridging whether incomplete in form of spines or spurs or complete. The incomplete bridging i.e. Type 2 was seen in 4.32% (27 skulls) with preponderance of incompleteness on to the left side (2.72%) (Fig. 1). There was no skull with Type 2b variety. The Type 3a category (Fig. 2) which manifests as unilateral bifurcation of canal seen from the endocranial aspect was seen in total of 7.68% of skulls and in this category also the dominant side for bridging was left side of skulls (4.16%). Type 3b (Fig. 3) i.e. bilateral bridging was observed in 3.68%. There was no skull with exocranial bridging (Type 4) or complete bridging throughout the hypoglossal canal (Type 5).

4. Discussion

The bridging and duplication pattern of hypoglossal canal is one of the hyperostotic non-metric cranial variant which has been of clinical interest to many early researchers. Wood Jones was the first to propose that the differing incidences of these variants may occur in different races and hence might be useful in anthropological studies.⁹ His study also suggested that the variations can be unilateral or bilateral within a specific population. Various factors have been suggested as potential cause for bridging in a given set of population, viz: (1) The hypoglossal canal develops by the fusion of occipital sclerotomes and the process of occipital chondrification at stage 17 while the development of the hypoglossal nerve occurs at stage 12. Embryologically, the nerve originates from several segments forming rootlets. These nerve rootlets enter into the hypoglossal foramen when they get enveloped in a fibrous sheath to form two or more nerve bundles explaining the division of canal into two or more compartments¹⁰ (2) excessive ossification of connective tissues, during development¹¹ (3) Most of the skull bones are derived from neural crest mesenchyme and any defect in molecular regulation of these cells through HOX genes via fibroblastic growth factors (FGFs) may be the causative factor of duplication and multiplication of the canal,^{12,13} thus taking into account all the three factors (vide supra) the detailed classification of the bridging pattern of the canal provides a potential insight in

Classification type	Description
Type 1	No evidence of bridging on both the sides
Type 2	Incomplete bridging (spines & osseous spurs)
a	Unilaterally
b	Bilaterally
Type 3	Complete endocranial bridging with duplication of canal
a	Unilaterally
b	Bilaterally
Type 4	Complete exocranial bridging
Type 5	Complete bridging of canal along whole extent

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