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A Study of Variations at the Base of the Skull in South Indian Population

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Abstract: ***The base of the skull is formed from highly irregular bones that develop in cartilages in a very complicated way. It supports the brain which is highly evolved in humans. It also forms a connecting link for other organs such as respiratory organs, gustatory organs etc. The cartilage centres appear in the base of skull during the second month in three areas [1]. Fifty skulls were studied. In the present study tubercle on the anterior margin of the foramen magnum was found in 2 skull, tubercle on the posterior margin of the foramen magnum was found in 1 skull, articular facet on the posterior margin of the foramen magnum was found in 2 skulls, Occipitilization of the atlas was found in 1 skull and elongated styloid (more than 45 mm) [2] process was found in 2 skulls. One has to be familiar with the anatomical features at the foramen magnum, in order to prevent damage to the neurovasular structures at the formamen magnum. Symptomatic abnormal elongation of styloid process is treated by surgical excision through intra oral or extra oral approaches. Further regional studies are required to know the causes for the abnormal elongation of styloid process, which may help us for better management of symptomatic cases.***

Keywords: Cartilage centres, Foramen magnum, Occipitilization, Skull, Tubercle.

1. Introduction

The base of the skull is formed from highly irregular bones that develop in cartilages in a very complicated way. It supports the brain which is highly evolved in Humans. The cartilage centres appear in the base of skull during the second month in three areas [1].

1. Around the cephalic part of the notochord
2. Around the hypophysis cerebri.
3. Between the optic and nasal capsules.

The synchronization between the developing areas is very important as minor mistakes in synchronization pattern causes malformations. All the malformations or variations are clinically important as important structures are related to the base of the brain and can affect the normality of the individual. In some malformations life threatening situations are encountered. So the clinicians are supposed to have knowledge of variations that are present in the base of the skull. As the study is also important in identification it is applicable in the field of forensic science. The study is also useful in the field of physical Anthropology as regional variations and racial differentiation can be found.

2. Materials and Methods

Fifty skulls were studied in the Department of Anatomy. Twenty five were taken from DM-Wayanad Institute Of Medical Science, Wayanad and other twenty five skulls were studied at K.S.Hegde Medical Academy, Mangalore.

3. Result

Variation	Frequency	Percentage
Tubercle On The Anterior Margin Of The Foramen Magnum	2	2
Tubercle On The Posterior Margin Of The Foramen Magnum	1	1
Articular Facet On The Posterior Margin Of The Foramen Magnum	2	2
Occipitilization Of The Atlas Vertebrae	1	1
Elongated Of The Styloid Process	2	2

In the present study tubercle on the anterior margin of the foramen magnum was found in 2 skulls, tubercle on the posterior margin of the foramen magnum was found in 1 skull, articular facet on the posterior margin of the foramen magnum was found in 2 skulls, Occipitilization of the atlas was found in 1 skull and elongated styloid (more than 45 mm) [2] process was found in 2 skulls.

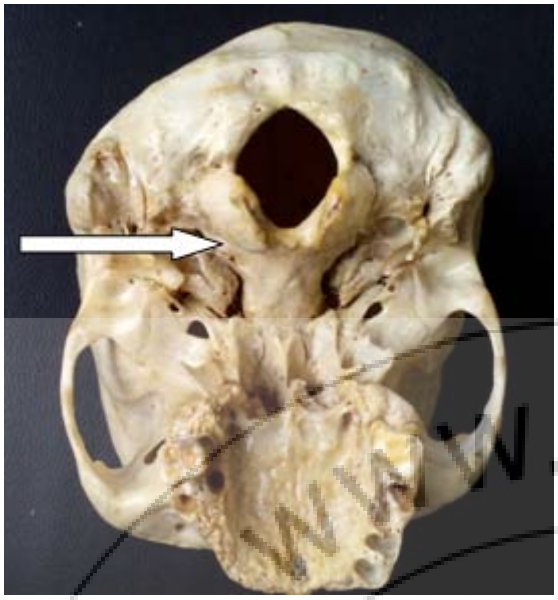

Figure 1: Arrow showing a bony tubercle at the anterior margin of the foramen magnum

Figure 2: Arrow showing a bony tubercle at the posterior margin of the foramen magnum.

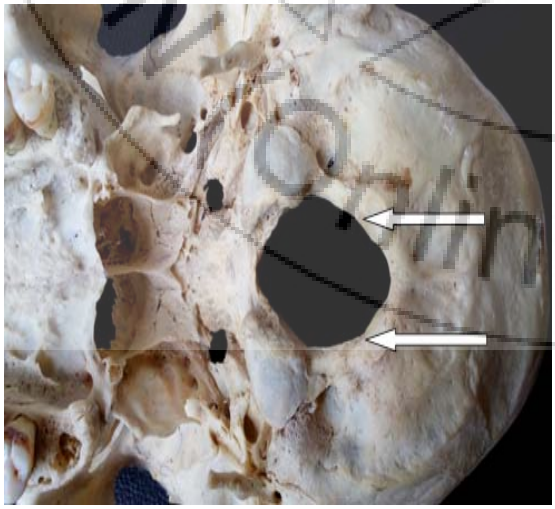

Figure 3: Arrow showing the facets at the posterior margin of the foramen magnum.

Figure 4: Figure showing elongated styloid process.

Figure 5: Figure Showing Occipitilization of the Vertebrae.

4. Discussion

Tubercles and facets around the foramen magnum have always fascinated the anatomical world. The cephalic part of the notochord extends up to the dorsum sellae of sphenoid bone. This part of the notochord is surrounded by the paracordal cartilage which subsequently unites to form basal plate. This is continuous behind with four precervical or occipital sclerotomes . This fuses with one another to form the basiocciput. The rudimentary transverse processes unite and constitute the ex-occiput, which persists as jugular processes. The lamina of the sclerotome meet behind the foramen magnum and continue further upwards as a supra occiput which develop as squamous part of the occipital bone.

In the mean time the costal elements of the upper 3 or 4 cervical vertebrae are connected to each other in front of the corresponding centrum by bands of mesanchymal condensation which persists as the hypochondral bow. The centrum of atlas is detached from the anterior arch and fuses with centrum of axis, which persists as the odontoid process

of the axis, which articulates around the foramen magnum by the means of apical ligament [1].

The occipital bone is perforated by the foramen magnum with the squamous part behind the foramen, the condylar parts lateral and the basilar part in front. A transient mesenchymal hypochondrial bridge of the occipital vertebra along the anterior margin of foramen magnum between the occipital condyles was observed in human embryos of 12.5-21.0mm crown rump length which was completely absent by the 80mm crown rump length. Failure of complete disappearance of the hypochondrial bridge during development may manifest as osseous formation in this craniocervical transition region [3]. The assimilation of various vertebrae into the occipital segments of the skull is responsible for the variable morphology of the craniovertebral region among vertebrates. A partial liberation of one of the vertebral elements which normally enter into the composition of the basiocciput results in an 'occipital vertebra' [4]. Besides being of anthropological and ethnological interest, these variants may be important in a clinical context. Accessory vertebral elements along the anterior margin of foramen magnum interposed between the basiocciput and atlas may reduce the circumference of the foramen or cause asymmetry. [5,6]. Enlarged median or paramedian bony masses ventral to the foramen may form a pseudojoint with the apical segment of the odontoid process or anterior arch of the atlas, thereby affecting the kinetic anatomy and integrity of the atlantooccipital articulation [7]. Romanes (1964) commented that the small bony tubercle on the anterior margin of the foramen magnum indicates the position of the apical ligament of the dens. Romanes (1964) and Basmajian (1972) described the presence of a third occipital condyle that projects from the anterior border of the foramen magnum to articulate with the dens of the axis [8,9]. The basilar process of occipital bone is formed by fusion of the first three primitive vertebrae (or occipitoblasts), the most caudal of which is so-called occipital vertebra or pro-atlas [10]. The failure of distal occipitoblasts to fuse with others gives rise to abnormal bone formations on the external surface of skull around foramen magnum, phenomenon called as “manifestation of occipital vertebra” [10]. Tubercles are formed by exostoses. Albrecht designates – all elements of cranio-vertebral articulation including intraligamentous ossification as “pro-atlas” vertebra. The apical ligament of dens, which forms part of this pro-atlas region, occasionally contains rudiments of notochord within it [11]. An anomaly at the foramen magnum has been attributed to occipitalization of the atlas or assimilation of the atlas to the occipital bone. Assimilation seemed to be bony continuity between the anterior arch of atlas and the anterior lip of the foramen magnum [12].

Sometimes posterior atlanto occipital membrane may be ossified, under such conditions the tubercles may be found. Even sometimes bony canals which surround the 3rd part of vertebral artery have been documented [13].

The styloid process, which arises embryonically from the Reichert cartilage of the second branchial arch, is a long and thin outgrowth at the base of the temporal bone, immediately in front of the stylomastoid foramen. It serves as a point of attachment for the stylomandibular and stylohyoid ligament as well as the styloglossus, stylohyoid, and stylopharyngeus muscles. Elongation of it is a poorly understood process. Commonly admitted theories about the actual cause of the elongation of the styloid process are defined as congenital elongation of the styloid process, calcification of the stylohyoid ligament by an unknown process, and growth of osseous tissue where the stylohyoid ligament inserts [14,15].

Congenital elongation is explained by Lengele B. et al is a mechanical stress stretching the second branchial arch during the fetal development probably induce a variable involvement of the different parts of Reichert’s cartilage in the morphogenesis of the styloid process [16].

Elongated styloid process is characterised by the following symptoms: pharyngeal pain localised in the tonsillar fossa, radiating to the oesophagus, to the hyoid bone, painful head rotation and lingual movements. The pain is exacerbated by swallowing and chewing. Other symptoms include foreign body sensation [17] and voice change lasting for only a few minutes. A variety of additional symptoms have been reported such as clicking jaw [18], unilateral pain, pain radiating to the neck, to the tongue, chest or temporomandibular joint (TMJ) and facial paraesthesia, hypersalivation, sometimes visual problems, dysphagia and pharyngeal spasm.

The internal jugular vein and the accessory, hypoglossal, vagus, and glossopharyngeal nerves are located medial to the styloid process. The glossopharyngeal nerve emerges from the anterior part of the jugular foramen, medial to the styloid process, where it then curves around the posterior border at the level of the origin of the stylohyoid muscle [19]. This anatomic relationship is important as a cause of glossopharyngeal neuralgia in reported cases with an elongated and or fractured styloid process as the etiologic cause [20].

The pain aggravates typically on rotation of the head and also by swallowing and chewing. Relief by injection of Xylocaine over the tonsillar fossa is also a simple bed side procedure. Medical treatment includes analgesics, anticonvulsants, and antidepressants. Surgical excision can be done by intra oral or extra oral approaches [21].

5. Conclusion

In conclusion it may be stated that one has to be familiar with the anatomical features at the foramen magnum, in order to prevent damage to the neurovasular structures at the formamen magnum. Future scope lies in the field of orthopaedics and neurology as such anomalies may cause compression of the neural structures and also is important in pain management. Symptomatic abnormal elongation of styloid process is treated by surgical excision through intra oral or extra oral approaches. Further regional studies are required to know the causes for the abnormal elongation of styloid process, which may help us for better management of symptomatic cases.

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