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Short Communication

A median occipital tubercle within anterior margin of foramen magnum: a clinical correlation

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Abstract: Anatomical variations at cranio vertebral junction are of importance to clinicians and surgeons planning intervention around this area. Any osseous structure projecting within the foramen magnum may cause compression to the brain stem, resulting in neurological symptoms. The aim of this paper is to present a rare case of median occipital tubercle within the anterior margin of foramen magnum in one adult human skull among 66 skulls studied. The morphology and location of this median occipital tubercle differs from the classical description given for the median occipital condyle in the literature. Its occurrence has been discussed with available literature in light of evolutionary and developmental anatomy. An awareness of bony anomalies around the FM will be of paramount significance to neurosurgeons, radiologists and orthopaedic surgeons working in this area.
Keywords: cranio vertebral junction, foramen magnum, median occipital tubercle

INTRODUCTION:

The conjunction of occipital bone and the first cervical vertebra (atlas) is termed as cranio vertebral junction (CVJ) or cranio vertebral transition. The CVJ also includes dens of axis vertebra and foramen magnum of occipital bone. In lower vertebrates, the cranial half of 1st cervical sclerotome forms a separate bone between the atlas and occiput, the pro-atlas [1]. It may contribute to anomalous structures around the foramen magnum (FM), in humans. One such remnant and atavistic phenomenon is median occipital condyle (MOC).

Varied specialties, like neurosurgery, radiology and orthopaedics necessitate a detailed and thorough knowledge of the anatomy of the CVJ. Any prominent osseous structure at the anterior margin or around the FM may complicate the classical approach to this important region. If projecting into the FM, these varied osseous structures may decrease the potential space for the lower brain stem, resulting in neurological symptoms [2]. Moreover a thorough knowledge of the anatomical variations in the CVJ is significant for accurate orientation in the interpretation of CT and MRI scans.

In the present study, we documented a unique case of median occipital tubercle (MOT) at the anterior margin of FM and discussed its pertinent embryology.

CASE REPORT:

During the course of routine screening of bones in the osteology section of Department of Anatomy, we found a dried adult human skull with median osseous projection within the anterior margin of FM, appearing like the MOT. Retrospectively, we examined 65 other dried skull specimens from the bone bank and looked for the possibility of MOT, but none of the skulls revealed the presence of analogous structure. Hence, among 66 dried adult human skulls of unknown

age and sex examined, we came across one skull showing MOT, which accounted for 1.5%. The dimensions of the MOT were measured and the specimen was photographed. The MOT was seen as a broad conical projection with its apex pointing inferiority. It was projecting posteriorly from the anterior margin of FM in the midline. The attached surface was broad and the tubercle measured 10 mm vertically (length). The transverse dimension (breadth) and anterior-posterior dimensions (width) measured 6 mm each. This MOT did not exhibit any particular facet and was projecting within the alar part of FM (Fig.1).

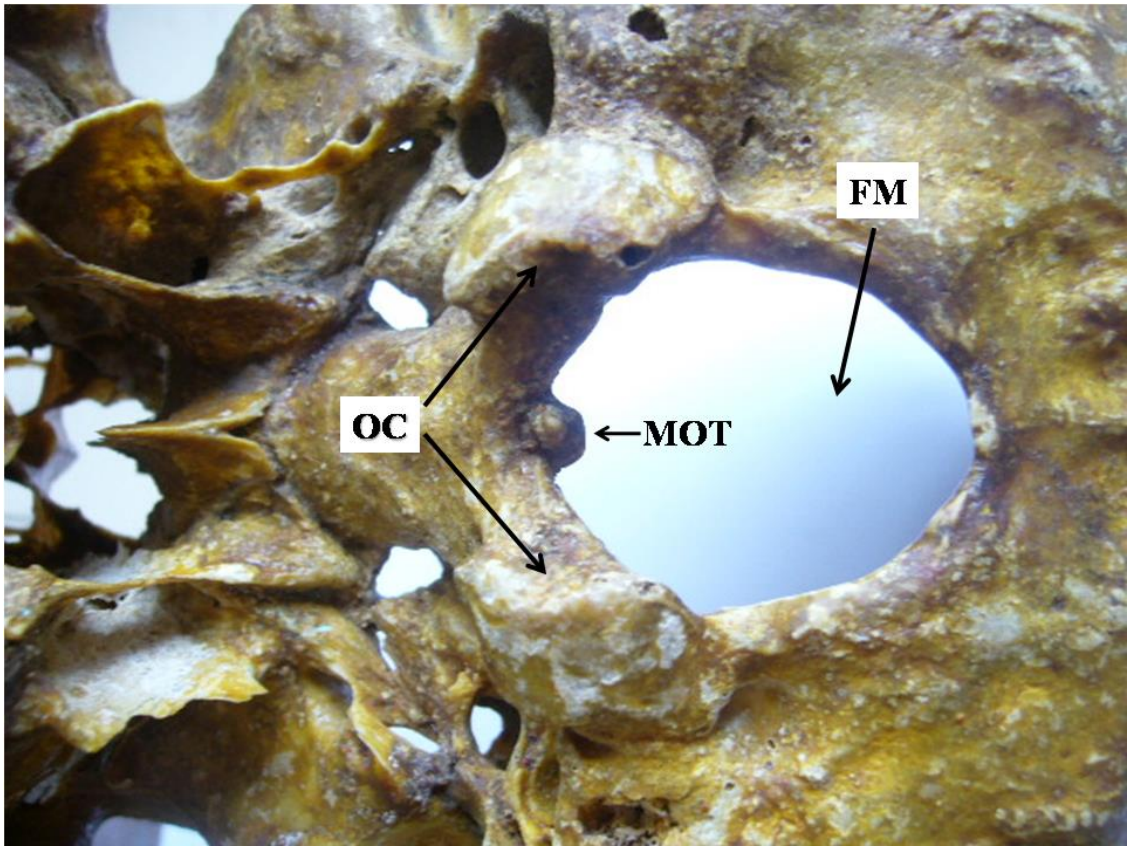

Fig 1: Basilar part of occipital bone showing median occipital tubercle (MOT), midway between the occipital condyles (OC), projecting within the foramen magnum (FM) along its anterior margin.

DISCUSSIONS:

The congenital anomalies of CVJ have been recognized for many years, but were first described by anatomists. Later, as their clinical implications became increasingly evident, they were discussed in medical literature [3].

During early development, the occipital bone is formed by the fusion of four occipital sclerotomes. The cranial half of the 1st cervical sclerotome and caudal half of 4th occipital sclerotome form the pro-atlas between the occiput and atlas. In humans, the lateral part of pro-atlas forms occipital condyle, atlas and tip of dens, whereas its body and hypochondral arch disappears completely. In some lower vertebrates, the pro-atlas persists as a separate bone. In amphibians and reptiles, it forms condyloideus impar representing the occipital vertebra, whereas in some fishes and birds, the pro-atlas forms a single occipital condyle in median location [1].

Considering the segmental complexities, involved in the phyletic and developmental establishment of the normal human cranio-vertebral articulations, the rare occurrence of anomalous fusion or separation or intercalated ossicles are not surprising [4]. One of the manifestations of variant segmentation is median occipital condyle – MOC (also referred to as condylus tertius, or third occipital condyle). A MOC can be understood as partial manifestation of occipital vertebra or precisely hypochondral bow of the Pro-atlas [5, 6]. This structure occurs as a projection attached at the anterior margin of FM, usually median in position. It either ends freely or forms articulations with the tip of odontoid process or anterior arch of atlas. The MOC can be regarded as a rare variation throughout the world [5] and its incidence varies from 0.47% to 3.3% in literature [1, 3, 6-8]. It was first described by Meckel in 1815 as a bony process in the anterior midline of FM [9].

Several authors described the manifestation of an occipital vertebra radiologically [8, 10]. Later,

authors have reported clinical cases of progressive myelopathy, transverse ligament laxity, atlanto-axial instability and even quadriplegia associated with MOC [2, 11, 12]. The mechanical compromise, either from direct neural compression and /or from a secondary vascular impairment (arterial or venous), leads to the signs and symptoms of cervico medullary compression [13]. A MOC may limit rotation of the head by the restraining action of the joint capsule and other ligamentous structures, especially the cruciate ligament, anterior and posterior longitudinal ligaments, and tectorial memberane [1]. Further the compromised movement at Atlanto-occipital joint may lead to hyper mobility at Atlanto-axial joint causing Atlanto-axial instability. Kotil et. al., reported a rare case of a 40 year old woman presenting myelopathy related to condylus occipitalis located in the anterior FM region [2]. A three dimensional understandings of its anatomy is crucial for correlating with various myelopathies.

In the present study we observed a MOT in an adult human skull among 66 skulls studied, which accounted for 1.5%. This MOT is not comparable to the classical presentations of MOC described in literature as it is situated along the anterior margin, projecting within the FM. There is hardly any literature about the MOT of similar morphology which projects into the FM [14]. The location of such MOT might narrow the FM and could cause compression to the spinal medulla and, perhaps, is more liable to injure the pyramidal fibres in extreme flexion of the head [15]. Its close relation to vascular and nervous elements of CVJ may produce a variety of signs and symptoms [15]. Patients may exhibit myelopathy, presenting with different degrees of weakness in the extremities; and motor myelopathy may include quadriparesis attributed to repetitive trauma to the pyramidal tracts and chronic compression of neural structures at the cervico medullary junction [8, 10]. Vascular symptoms include syncope, vertigo, altered level of consciousness and transient visual field loss due to excessive stretching or angulation of vertebral or anterior spinal arteries [1, 8, 10, 13].

According to Muthukumar *et al.;* a FM index of more than 1.2 will require much more extensive bony resection than otherwise. In the present study we observed a FM index of 1.25. Further, he emphasized that a similar sized lesion located anterior to the brainstem will require more extensive bone removal in a person with an ovoid FM than in a person with circular FM. Thus, in a patient with a round FM, without significant protrusion of the occipital condyles into the FM, less bony resection will be required than in a patient with an ovoid foramen magnum, medially protruberant and sagitally inclined occipital condyles, even though both patients harbour similar lesions [16].

Other associated anomalies of CVJ in relation to basiocciput are precondylar tubercles, assimilation of atlas, basilar processes, labia foraminis magni anteriora, Torus occipitalis and Os odontoideum [15]. There is an increased prevalence of Os odontoideum with occurrence of MOC. An Os odontoideum may cause displacement of dens rostrally, instability of atlanto-axial joint and compression at cervico-medullary junction [17]. Its symptoms can range from vague discomfort to quadriparesis and may even cause sudden death. Van Gilder and Menezes (1983) reported post-traumatic posterior invagination of an unfused odontoid process in two patients, resulting in ventral cervico medullary compromise [18].

Hence the physician should be familiar with these congenital anomalies for appropriate diagnosis and treatment as the patient may present with abnormal signs and symptoms. Moreover, a thorough understanding of anomalous structures around the FM is essential to neurosurgeons for performing safest exposure during trans-articular screw implementation and lateral approaches to the FM [19, 20].

CONCLUSION:

An accurate knowledge of bony anomalies around the FM will be useful to neurosurgeons, radiologists and orthopaedic surgeons working in this area. A MOT, as documented in the present study, could be the main bony prominence obstructing the anterolateral approach during surgeries and if symptomatic, may pose difficulty to the physician in correct diagnosis.

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