Manifestation of occipital vertebra: a new variant

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Abstract
Introduction
Abnormalities of the cranio-vertebral junction associated with occipital bone are of great interest not only to anatomists but also to clinicians, because many of these malformations can produce neurological symptoms. Cranio-vertebral joints include atlanto-occipital joints and atlanto-axial joints. Atlanto-occipital joint is formed by the superior articular facet of lateral mass of atlas and condyle of occipital bone. This study reports a case of a new variant of a manifestation of occipital vertebra.

Case report
During the examination of skulls in the osteology lab of the Department of anatomy, CSM Medical University, a skull was detected having exostosis on the basilar part of occipital bone at the anterior margin of foramen magnum. The length and width of the exostosis was 1.4 cm and 6 mm, respectively. The facet has also been observed on the manifestation. This clearly indicates that dens must be articulating on this facet.

Discussion
As this bony elevation is present in the median plane superomedial to two occipital condyles, therefore, it may be called as third/median occipital condyle on the basis of its location.

Conclusion
The third occipital condyle may cause discomfort and neck pain during biomechanical movements of the neck. This information may be of immense use to physicians, orthopaedic surgeons and neurosurgeons.

Introduction
Considering the segmental complexities involved in the phyletic and developmental establishment of the normal human cranio-vertebral articulations, the occasional occurrence of anomalous separations, fusions and intercalated ossicles should not be surprising. One of these manifestations of variant segmentation is the manifestation of the occipital condyle (basilar tubercle). This structure occurs as a projection on basion (anterior central point between both occipital condyles) of the foramen magnum. In more developed cases there is actually an articular facet that receives the tip of the odontoid process forming a true diarthrosis. The mammalian apical odontoid element is the phylogenetic equivalent of the pro-atlas of reptiles. In most members of this vertebrate class pro-atlas fuses to the occiput of the skull, whereas in mammals it becomes fused to the atlantal contribution of the odontoid.

Cranio-vertebral articulations generate cranio-vertebral joints. Cranio-vertebral joints include atlanto-occipital joint and atlanto-axial joint. Atlanto-occipital joint is formed by the superior articular facet of lateral mass of the atlas and condyle of the occipital bone. The anterior atlanto-occipital membrane connects the superior surface of the anterior arch of the atlas to the anterior margin of the foramen magnum. On each side, it blends with the capsule of the atlanto-occipital joint. The atlanto-axial joint is created by the articular facets of atlas and axis vertebra.

The atlanto-occipital joint may be altered by variations in the development of manifestation of median occipital condyle. One such variant of manifestation of occipital condyle as bony tubercles consisting of two elevations (bony spurs) associated with articulating facets near the anterior margin on the basilar part of the foramen magnum at the external surface situated between the two occipital condyles was encountered by the author. Such bony spurs have also been reported inside the obturator foramen.

The variant under this study is new and not reported so far. Therefore this anomaly may seek the attention of not only anatomists for new findings but also clinicians for neck pathology and other related complications, imagery interpreters, anthropologists, forensic experts and anatomists. This is the rationale of the report.

Case report
During the analysis of skulls in the osteology lab of the CSM Medical University, a skull, out of 66 skulls, was observed having a bony tubercle on the anterior margin of the foramen magnum on the basilar part of the occipital bone on the external surface of the male skull (Figure 1).

Its curved length, width and height range were 14 mm, 6 mm and 2–3 mm, respectively. There were two bony spurs and facet on this accessory bone facing the foramen magnum. There was no other abnormality in the skull.

Discussion
The basilar portion of the occipital bone is formed by fusion of the first
Case report

three primitive vertebrae or occipitoblast. The most caudal of these primitive vertebrae is known as the occipital vertebra or pro-atlas. The failure of distal occipitoblast to fuse with other primitive vertebra may give rise to abnormal bone formation on the external surface of skull around the foramen magnum. This phenomenon is known as manifestation of the occipital vertebra.

This separate bony element may partly be attributed to development of the occipital vertebra and partly due to secondary ossification of the ligaments.

Normally, occipital sclerotome and first cervical sclerotome are incorporated into the occipit. If these sclerotomes are incompletely incorporated then remnants of an occipital vertebra may develop. These remnants can result in a variety of structures like hypochondral arch or third occipital condyle.

A hypochondral arch is a prominent ridge coursing along the anterior margin of the foramen magnum. The failure of complete disappearance of the hypochondral bridge during development may manifest as osseous formation in the cranio-cervical transition region. The accessory bone formed might be a manifestation persistent of the hypochondral bridge. If the ridge is incomplete, the term, third occipital condyle is used to describe the elevation along the anterior margin of the foramen magnum. The third occipital condyle can form a pseudoarthrosis with the odontoid process or anterior arch of the atlas.

Manifestation of the occipital vertebra is regressive in contradiction to progressive change represented by the assimilation of atlas to the base of the skull. An anomaly at the foramen magnum may be attributed to the occipitisation of atlas or assimilation of atlas vertebra to the occipital bone. Assimilation is of bony continuity between the anterior arch of the atlas and anterior lip of the foramen magnum. Thus the exostosis observed in this case might be a persistent hypochondral arch or manifestation of the occipital vertebra. Moreover, other causes of this additional bony growth may be due to excessive stretching of the anterior atlanto-occipital membrane (which may be caused by more stretching/extension of the neck as in basketball, volleyball players or tree climbers), the periosteum is lifted up exposing the osteogenic layer. The osteocytes lay down the bone forming exostosis. Or it might be caused by partial ossification of the anterior atlanto-occipital membrane. The cause of development of this bony tubercle may provide the scope/arrangement to anthropologists and forensic experts for identification of volley ball/ basketball players and tree climbers.

Normal junction of the occipital vertebra and atlas provide a healthy function to biomechanical movements of the neck and smooth neurological functions of upper limb pathology. But this additional bony growth may create clinical complications such as bony spurs present on the manifestation of the occipital bone at the anterior part of the foramen magnum may create trauma in the structures present in close proximity of these elevations during neck movements. This may create not only neck pain but also pathology of the upper limbs. The neurovascular bundle present in close proximity of these bony spurs is at risk of getting damaged to further aggravate the clinical complications.

Not only this, the bony projection may create difficulty during surgical interventions while accessing the foramen magnum.

Conclusion

This defect may cause neck pain during neck movements besides misinterpretation of radiographs. Thus knowledge of this bony tubercle may...
be of paramount importance to anatomists, orthopaedic surgeons, neurosurgeons, anthropologists, forensic experts and radiologists.

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References