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Occurrence of the anterior tubercle in the margin of the occipital foramen

Abstract

The presence of structures that pass along the anterior margin of the occipital foramen interposed between the basilar part of the occipital and the atlas may reduce the circumference of the foramen causing compression of the spinal cord and leading to signs and symptoms of neurological deficits due to its asymmetry. The aim of this study was to determine the incidence of tuber at the occipital foramen margin. The incidence of occipital tubercle, probably formed by the apical ligament exostosis of the dens, was 0.28%. The tuber was arranged on the anterior margin of the occipital foramen and its length was about 4mm at its largest diameter. The knowledge of the presence of the occipital tubercle is of great clinical importance, as it may lead in many cases to compression of the neurovascular structures.

Keywords: occipital bone, anatomic variation, foramen magnum, skull base, atlanto-occipital joint, anterior tubercle, precondylar tubercle

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Abbreviations: FL, foramen lacerum; PB, basilar part occipital bone; CC, carotid canal; OC, occipital condyle; OF, occipital foramen; Red arrowhead, the tubercle

Introduction

The occipital foramen is an extremely important region, due to the passage of several neurovascular structures, such as accessory nerves, spinal, bulb (or medulla oblongata), and vertebral arteries.[1,2] However, the presence of a tubercle in the margin of this foramen, may cause locks and compression of these structures,[2] osteoarthritis of the atlanto-axial joint leading to basilar invagination and periodontal ligament degeneration[3,4] as well as craniocervical instability.[1] The occurrence of the anterior tubercle in the margin of the occipital foramen varies from 1.3% to 15%;[5–8] and has been attributed to the ossification of the apical ligament of the odontoid process of the axis.[9,10] The aim of this study was to determine the incidence of tuber at the occipital foramen margin.

Methods

We analyzed 350 occipital forames of human dry skulls belonging to the Studies and Research Center of Anatomy and Forensic Anthropology from the Tiradentes University (UNIT), Aracaju, Sergipe, Brazil. In all the skulls the occipital forames were preserved and were identified according to as to sex and age. The present study was approved by the Research Ethics Committee of the Federal University of Sergipe under the protocol number of 0357.0.107.000-11.

Results

A case of the tubercle was found in the anterior margin of the occipital foramen, representing an incidence of 0.28%. The tubercle had a pyramidal shape, was situated at the midpoint of the anterior margin of the foramen, with its apex facing back toward the occipital foramen (Figure 1), measuring about 4mm in the anteroposterior direction and 3mm in the transverse.

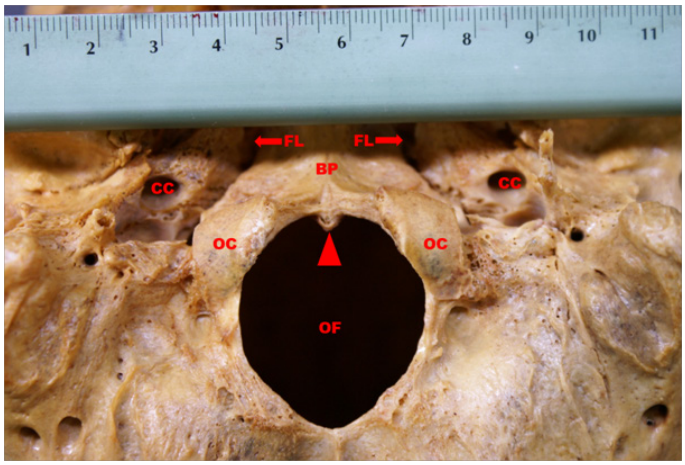

Figure 1 Photograph showing the tubercle at anterior margin of foramen magnum.

FL, foramen lacerum; PB, basilar part occipital bone; CC, carotid canal; OC, occipital condyle; OF, occipital foramen; Red arrowhead, the tubercle

Discussion

Embryologically, the occipital bone originates from the junction of the 4th and 5th somites, but in man they do not merge, that is, scletotome 4 give rise to the basilar part of the occipital and the sclerotome 5 form the apex and the apical ligament of axis dens, as well as the occipital condyles.[11]

The development of the odontoid process is complex. The dens apex develops from the proatlas, which is the cranial half of the first cervical sclerotome and the remainder of the dens of the caudal half.[12,13] The body and the neural arches of the axis develop from the second cervical sclerotome.[14,15] The proatlas also forms the anterior margin of the occipital foramen, occipital condyles, and the third condyle of the occipital bone. Therefore, odontoid dysgenesis is frequently associated with abnormalities of the basiocciput and the atlas.[16]

The apical ligament of the odontoid process extends from the uppermost point of the process to the posterior face of the anterior margin of the occipital foramen. Proposed to be vestigial, the ligament was absent in 20% of the specimens examined[7] and is not sufficiently relevant to cause changes in the physiological movements of flexion or extension.[17] The anterior atlanto-occipital membrane joins the anterior tubercle of the atlas to the basilar occiput and is continuous with the joint capsule, contributing little or nothing to the stability of the craniocervical joint.[10] Accessory vertebral elements along the anterior margin of the occipital foramen interposed between the basiocciput and the atlas may reduce the circumference of the foramen causing compression of the spinal cord, leading to signs and symptoms of neurological deficits because of asymmetry.[18] This tuber is not comparable from the phylogenetic point of view, to the medial condyle of birds and reptiles, because it does not participate as a joint surface in the cranium-vertebral joint.[6,18]

Few studies have reported the frequency of tubercles in the occipital foramen. In our study we found a frequency of 0.28%, differently from the several authors, in which they found a frequency varying from[1,3] to 15%,[2,5,6,8] even studying similar numbers of skulls. The anteroposterior length and transverse width of the anterior tubercle were 4 and 3mm respectively. This is also consistent with that found by Lakhtakia et al.[5] and Prakash et al.[18] where the length ranged from 4 to 5mm and the transverse width of 3mm.[5,18] For Tubbs et al.[7] and Ahmed et al.[2] the length of the anteroposterior tubercle and transverse width were more than double, while for Patil et al.[1] these dimensions were approximately half of that found in our study. It is therefore important to know not only its occurrence but also its dimensions, since tubercles later directed to the occipital foramen are, perhaps, capable of damaging the pyramidal fibres in extreme flexion of the head.[5]

Conclusion

The anterior tubercle in the margin of the occipital foramen is clinically important in most situations, and may lead to extensive neurovascular damage, or even lead to an important clinical picture in the case of traumatic lesions, especially when associated with other manifestations of the pro atlas. In addition, the knowledge about variations in the region of the occipital foramen will be useful for the various professionals working in this area, especially for physicians who routinely visualize images or manage clinical problems of the craniocervical junction which may lead to the compression of the neural structures.

Acknowledgments

None.

Conflicts of interest

The authors declare there is no conflict of interest.

References

1. Patil GV, Shishirkumar. Bony tubercle on the anterior border of foramen magnum - a case study. *International Journal of Science and Research*. 2014;3(8):57–58.
2. Ahmed K, Fatima T, Priyanka M, et al. A study on tubercles at the anterior margin of the foramen magnum. *J of Evolution of Med and Dent Sci*. 2015;4(1):54–58.
3. Goel A, Shah A, Gupta SR. Craniovertebral instability due to degenerative osteoarthritis of the atlantoaxial joints: analysis of the management of 108 cases. *J Neurosurg Spine*. 2010;12(6):592–601.
4. Pang D, Thompson DN. Embryology and bony malformations of the craniovertebral junction. *Childs Nerv Syst*. 2011;27(4):523–564.
5. Lakhtakia PK, Premsagar IC, Bisaria KK, et al. A tubercle at the anterior margin of the foramen magnum. *J Anat*. 1991;177:209–210.
6. Vazquez JF, Verona JA, Balbas JA, et al. Tubercle at the foramen magnum. *Skull Base Surg*. 1996;6(3):169–170.
7. Tubbs RS, Grabb P, Spooner A, et al. The apical ligament: anatomy and functional significance. *J Neurosurg*. 2000;92(2 Suppl):197–200.
8. Shaikh VG, Kulkarni PR. A Morphological study of shapes, overlapping of occipital condyles and the anterior tubercle of foramen magnum in human skull with comparison in adolescent, adult and foetal age and in males and females. *International Journal of Advanced Research*. 2015;3(4):920–927.
9. Bergman RA, Afifi AK, Miyauchi R. Anomalies of occipital bone at foramen magnum (Occipital Condyles).
10. Lopez AJ, Scheer JK, Leibl KE, et al. Anatomy and biomechanics of the craniovertebral junction. *Neurosurg Focus*. 2015;38(4):E2.
11. Tubbs R, Oakes J. *The Chiari Malformations*. New York: Springer-Verlag; 2013.
12. Stevens JM, Chong WK, Barber C, et al. A new appraisal of abnormalities of the odontoid process associated with atlanto-axial subluxation and neurological disability. *Brain*. 1994;117(Pt 1):133–148.
13. List CF. Neurologic syndromes accompanying developmental anomalies of occipital bone, atlas and axis. *Arch NeurPsych*. 1941;45(4):577–616.
14. Wollin DG. The osodontoideum. Separate odontoid process. *J Bone Joint Surg Am*. 1963;45:1459–1471.
15. Rao PV, Mbajiorgu EF, Levy LF. Bony anomalies of the craniocervical junction. *Cent Afr J Med*. 2002;48(1-2):17–23.
16. Jain N, Verma R, Garga UC, et al. CT and MR imaging of odontoid abnormalities: A pictorial review. *Indian J Radiol Imaging*. 2016;26(1):108–119.
17. Jea A, Tatsui C, Farhat H, et al. Vertically unstable type III odontoid fractures: case report. *Neurosurgery*. 2006;58(4):E797.
18. Prakash BS, Padma Latha K, Jagdish LM, et al. Tubercle at the anterior margin of foramen magnum. *IJAV*. 2011;4:118–119.