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ORIGINAL ARTICLE

A STUDY ON ASSIMILATION OF THE ATLAS WITH ITS CLINICAL IMPORTANCE

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ABSTRACT: Occipitalization of the atlas, also known as assimilation of atlas, occipitocervical syntosis or atlanto-occipital fusion is defined as congenital bony fusion of the atlas vertebra to the base of the occipital bone of the skull. 100 skulls of unknown age and sex, maintained in the department of anatomy and from the I phase MBBS students of KBNIMS, Kalaburagi were examined for evidence of occipitalization of the atlas. The skulls were well-preserved and did not show any traits of craniofacial deformation. Occipitalization of atlas was found in 2 skulls (2%). The first case was partially fused to the occipital bone. The second case was showing complete assimilation of atlas. This abnormality may cause a wide range of neurological problems. Knowledge of occipitalization of the atlas may be of substantial importance to orthopedicians, neurosurgeons, physiotherapists and radiologist dealing with abnormalities of the cervical spine.
KEYWORDS: Assimliation, Occipitalization, Atlas.

INTRODUCTION: Occipitalization of the atlas is defined as congenital bony fusion of the atlas vertebra to the base of the occipital bone of the skull. It is also known as assimilation of atlas, occipitocervical syntosis or atlanto-occipital fusion. It is one of the most common osseous anomalies of the craniovertebral junction.[1] It was first described by Rokitansky in 1844 and was first demonstrated by Schuller roentgenographically in 1911. It results due to failure of segmentation and separation of the most caudal occipital sclerotome and the first cervical sclerotome during the first few weeks of fetal life. It represents the most cephalic blocked vertebra encountered in the spine. Incidence of atlanto-occipital fusion ranges from 0.14% to 0.75% of the population with both sexes being equally affected.[2] The aim of the present study was to determine the prevalence of atlanto-occipital fusion along with its brief embryological explanation and clinical implication. Knowledge of this anatomical variation is important for radiologists, neurologists and neurosurgeons.

MATERIALS AND METHODS: A total of 100 adult dried human skulls of unknown sex and age from the department of Anatomy and from the I phase MBBS students of KBNIMS, Kalaburagi, Karnataka were included in the study. The external and internal surfaces of the entire occipital bone were observed by visual inspection. Appropriate measurements were taken and the specimens were photographed.

OBSERVATIONS: Out of 100 adult human skulls studied, we observed atlanto-occipital assimilation in 2 skulls amounting to 2 %. Each skull was carefully observed for variations. Findings in the skulls with atlanto-occipital fusion were as follows,

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SKULL 1:

- Partial occipitalization of atlas was found.
- Anterior arch of atlas was partially fused with anterior margin of foramen magnum leaving a slit like gap measuring 16mm transversely between it and the basilar part of occipital bone.
- Superior articular facets of atlas were completely fused with condylar facets of occipital bone.
- Tip of the left transverse process was fused with the tympanic plate of temporal bone leaving a gap between the costotransverse bar and jugular process.
- Both the foramina transversarium were normal in dimension.
- Right posterior arch was complete and it was fused with the right part of the posterior margin of foramen magnum except for a small foramen on its superior surface close to the transverse process, most probably for the transmission of the right vertebral artery.
- Left posterior arch was incomplete. It extended 15mm from the left inferior articular facet leaving a deficit between it and the posterior arch. A small canal was observed on the superior surface of posterior arch which may have transmitted vertebral artery and the first cervical nerve.
- Dimensions of inferior articular facets were, RIAF was 19mm in length and 14mm in width, LIAF was 17mm in length and 18mm in width.
- Foramen magnum was 33mm in sagittal diameter and 30mm in tranverse diameter.
- An articular facet measuring 8mm in width and 6mm in length was found on the posterior surface of anterior arch in the midline for articulation with the odontoid process of axis vertebra was found.

SKULL 2:

- Complete occipitalization of atlas was found.
- Anterior arch of atlas was partially fused with anterior margin of foramen magnum except for a small foramen in the midline between it and the basilar part of occipital bone.
- Superior articular facets of atlas were completely fused with condylar facets of occipital bone.
- Tip of the left transverse process was fused with the tympanic plate of temporal bone on the right side leaving a gap between the costotransverse bar and jugular process.
- Posterior arch was complete and it was fused with the posterior margin of foramen magnum except for a small foramen on its superior surface close to the transverse process on both the sides, most probably for the transmission of vertebral artery and C1 nerve.
- Dimensions of inferior articular facets were, RIAF was 21mm in length and 12mm in width. It was continuous with facet on the lateral mass which measured 13mm in length and 7mm in width, LIAF was 18mm in length and 16mm in width.
- Foramen magnum was 22mm in sagittal diameter and 26mm in transverse diameter.
- No articular facet was found on the posterior surface of anterior arch in the midline for articulation with the odontoid process of axis.

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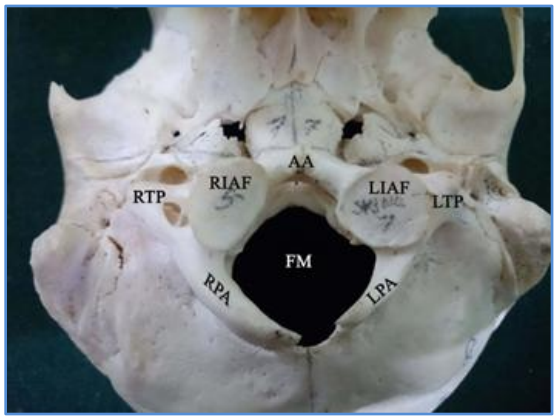

Fig. 1: Skull showing partial occipitalization of atlas

AA: anterior arch of atlas, RIAF: Right inferior articular facet, LIAF: Left inferior articular facet, RTP: Right transverse process, LTP: Left transverse process, RPA: Right posterior arch, LPA: Left posterior arch & FM: Foramen Magnum.

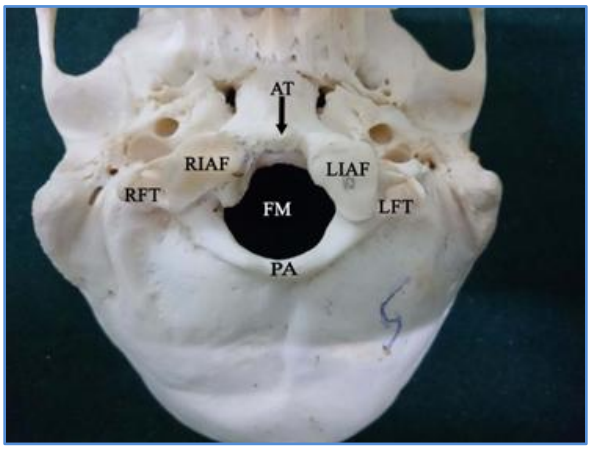

Fig. 2: Skull showing complete occipitalization of atlas

AT: anterior tubercle of atlas, RIAF: Right inferior articular facet, LIAF: Left inferior articular facet, RTP: Right transverse process, LTP: Left transverse process, PA: Posterior arch of atlas & FM: Foramen Magnum.

DISCUSSION: Occipitalization of atlas results due of failure of segmentation and separation of the most caudal occipital sclerotome and the first cervical sclerotome during the first few weeks of fetal life.[2] It is commonly associated with concomitant neurovascular and skeletal anomalies at the craniovertebral junction, which may produce a variety of symptoms[3].The patients with craniovertebral joint anomalies exhibit the first neurological signs and symptoms usually no sooner than the second decade.[4]

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Absolute immobility of an occipitalized atlantooccipital joint results in compensatory hypermobility between the atlas and axis. Approximately 50% of patients with atlanto-occipital fusion develop atlanto-axial instability.[5]

Neurological symptoms associated with occipitalization of the atlas are attributed to the ligamentous laxity of the transverse ligament about the odontoid process caused by repeated flexion and extension of the neck leading to the compression of the spinal cord or actual indentation of the medulla oblongata.[6] The patient will be probably asymptomatic if the odontoid process is located below the level of foramen magnum. This relationship is best assessed through the use of McRaes & Barnon (1953) line which is drawn across the foramen magnum. Normally the odontoid process should not project above this line.[7]

Patients with occipitalization of the atlas may have the following physical features: low hairline, torticollis, restricted neck movements and / or abnormal short neck. In neurological examination of the atlanto occipital fusion patient may reveal the following clinical findings: headache, neck pain, numbness and pain in the limbs, weakness, abnormal head posture, posteriorly located dull aching headache. Cranial nerve findings associated with occipitalization of the atlas include tinnitus, visual disturbances and lower cranial nerve palsies leading to dysphagia and dysarthria. The neurological Symptoms and signs of atlanto-occipital fusion cannot be distinguished from those of the Arnold Chiari malformation as the pathophysiology of both is essentially the same.[7]

Spinal cord compression always occurs when the sagittal spinal canal diameter behind the odontoid process is less than or equal to 14 mm. Cord compression is possible when the sagittal canal diameter is between 15 and 17 mm and almost never occurs at a distance of 18 mm or more.[8]

Gholve et al studied 30 cases of occipitalization of atlas in children with mean age of 6.5yrs and classified it morphologically into 4 zones, zone 1 with fused anterior arch, zone 2 with fused lateral masses, zone 3 with a fused posterior arch and zone 4 withcombination of fused zones. They also found 57% of patients had an associated atlantoaxial instability, 26% had an associated C_2-C_3fusion, 37% had spinal canal encroachment and the highest prevalence of which was found in zone 2 patients.[9] Lopez et al reported that three patients with atlanto-occipital fusion have had cervical pain and two patients had tonic or clonic convulsions.[10] Iwata et al reported a case of atlanto-occipital fusion with unusual neurological symptoms.[11] Sabuncuoglu H et al. reported a case of hypoplasia of the posterior arch of the C_1. They said that upper cervical anomalies can be misinterpreted as fractures, luxation, osteolysis or instability.[12]

CONCLUSION: Occipitalization of atlas is the most common anomaly of the craniocervical junction which can remain asymptomatic for first 2 decades of life. Detection and treatment of this deformity are essential as this deformity often causes cervical spine instability. Special imaging such as CT scan, 3-dimensional CT scan or MRI should be obtained before surgery.

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