



Occipitalization Of Atlas Vertebra In Dried Skull Bone: Developmental And Clinical Aspects Of A Case Report

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Abstract:

The atlas vertebra articulates with the occipital bone of skull forming the atlanto-occipital joint. Congenital fusion between various parts of atlas vertebra with the occipital bone of skull i.e. occipitalization of atlas vertebra, may reduce the diameter of foramen magnum and lead to compression of medulla oblongata, first and second cervical spinal nerve as well as other nearby structures. Various neurological as well as arthrological symptoms due to occipitalization of atlas vertebra include persistent headache, dysarthria, restricted head and neck movements or even sudden death. In the present study we reported a case of occipitalization of atlas vertebra in dried skull bone. The clinical aspects of this case report may be helpful to the neurologists, radiologists, orthopaedic surgeons, anaesthesiologists as well as physiotherapist while dealing with the cases of upper cervical spinal nerve compressive anomalies.

Keywords: Occipitalization, Atlas vertebra, Dried skull bone

Introduction:

The first cervical vertebra, atlas, articulates superiorly with the occipital bone of skull to form the atlanto-occipital joints. In this pair of synovial joints, the bones are connected by articular capsules as well as by the anterior and posterior atlanto-occipital membranes. On each side, the joint consists of two reciprocally curved articular surfaces, one over the lateral mass of atlas and the other over the occipital condyle. [1] Occipitalization of atlas vertebra or occipito cervical synostosis is the term used to denote the abnormal fusion of atlas vertebra with the base of occiput. [2] In 1844, Rokitansky described the first case of occipitalization of cervical vertebra. Earlier it was described as “pro-atlas”, because it was believed that an additional vertebra has been incorporated between the occipital bone and the atlas vertebra. [3]

The fusion between the occipital bone and the atlas vertebra may be in the form of complete or partial fusion between anterior and/or posterior arch of atlas with the margin of foramen magnum. According to various researchers, the incidence of occipitalization of atlas vertebra ranges from 0 to 4%. [4-8] In the present study, we reported a case of occipitalization of atlas vertebra in dried skull bone with its developmental and clinical aspects. The skull was obtained from the Department of Anatomy, Banas Medical College & Research Institute, Palanpur, Gujarat.

Case report:

Anterior arch of atlas vertebra: Complete and fully ossified anterior arch of the atlas vertebra was observed. Anterior arch of atlas vertebra was incompletely fused with the anterior margin of the

foramen magnum. The part of anterior arch of atlas vertebra along with the anterior tubercle was not fused with the anterior margin of the foramen magnum. On each side, the lateral aspect of anterior arch of atlas vertebra was completely fused with the anterior margin of the foramen magnum.

Lateral mass of atlas vertebra: Right and left superior articular facets of the atlas vertebra were completely fused with the corresponding occipital condyles of the skull. The transverse processes as well as the foramen transversarium on both the sides remain unfused with the skull bone. Right foramen transversarium was complete while left foramen transversarium was incomplete and larger in size than the right foramen transversarium. Right and left inferior articular facets of the atlas vertebra were clearly visible. Right inferior articular facet was oval in shape while left inferior articular facet was circular in shape.

Posterior arch of atlas vertebra: Complete and fully ossified posterior arch of the atlas vertebra was observed. Posterior arch of atlas vertebra was incompletely fused with the posterior margin of the foramen magnum. The part of posterior arch of atlas vertebra along with the posterior tubercle was not fused with the posterior margin of the foramen magnum. On each side, the lateral aspect of posterior arch of atlas vertebra was completely fused with the posterior margin of the foramen magnum.

Single fully patent hypoglossal canal was observed on each side. No other bony fusion or abnormalities were observed.

Discussion:

Occipitalization of atlas vertebra occurs due to defective development between the occipital bone and the atlas vertebra during the early embryonic period. [9] During sixth month of intrauterine life, two ossification centres appear for the anterior part of atlas. These centres unite anteriorly within few month of their appearance. Two ossification centres for the posterior part of atlas appears posterior to the each lateral mass and transverse process. These centres unite in the midline during fifth year of life. Midline defect in the atlas vertebra can appear due to failure of midline fusion of ossification centres. [10] Occipital bone anterior to the foramen magnum develops from the basioccipital portion, posterior to

the foramen magnum develops from supraoccipital portion and lateral to the foramen magnum develops from exoccipital portion of the chondrocranium. [11] Cranial half of the first cervical sclerotome unites with the caudal half of the last occipital sclerotome to form the base of the skull. The caudal half of the first cervical sclerotome combines with the cranial half of second cervical sclerotome to form first cervical vertebra as well as odontoid process. [12] Occipito cervical synostosis results due to failure of differentiation between last occipital and first cervical sclerotome. [13]

Walia S et al found three bony skulls having occipitalization of atlas vertebra. In the first case, they found completely fused atlas vertebra with the occipital bone at the base of the skull, except at the transverse processes on both sides. The anterior arch of atlas vertebra was fused with the basilar part of the occipital bone leaving a gap in the synostosed part. In the second case, they found completely fused atlas vertebra with the occipital bone at the base of the skull, except the right transverse process. Anterior and the posterior arches were completely fused with the occipital bone but there was small non synostosed part between anterior arch and basilar part of occipital bone. The whole of the posterior arch was fused with the posterior margin of foramen magnum. In the third case, they found partial and asymmetrical occipitalization of atlas vertebra. Midline defect was present in the posterior arch of atlas vertebra. They stated that the restricted movements or even absence of movements at the atlanto-occipital joint might be the first sign to appear in case of the occipitalization of cervical vertebra. [14] Hussain Saheb et al reported a case of complete fusion of atlas vertebra with the occipital bone of skull involving lateral mass including transverse process, anterior arch as well as posterior arch of atlas. [15] Nayak et al reported a case of occipitalization of atlas. They found completely fused superior facets over the lateral mass with the corresponding occipital condyles. Anterior arch of atlas was incompletely fused with the basilar part of skull. Posterior arch of atlas was incomplete and was in the form of two small projections from the two lateral masses. [16] Barma SD et al reported a case of fusion of atlanto-occipital joint. They found complete fusion of occipital condyles with the atlas anteriorly. [17] Jayanthi et al reported two cases of occipitalization of atlas vertebra with bifid spine of

atlas. In the first case, there was unilateral complete fusion of transverse process of atlas with occipital bone of skull and incomplete fusion of the anterior arch of atlas with the basilar part of skull. In the second case, the anterior arch of the atlas was fused with the occipital bone of the skull. [18] Soni S et al reported a case of complete fusion of atlas with occipital bone out of total 50 skulls studied. [19]

Occipitalization of atlas vertebra can be associated with other bony malformations like Klippel-Feil syndrome, Arnold Chiari malformation, Spina bifida, cervical stenosis. [12] Persons having occipitalization of atlas vertebra may have low hairline, abnormal short neck, restricted neck movements, torticollis, other fused vertebra or other congenital abnormalities. [20] Abnormally immobile atlantoaxial joint may lead to compensatory hyper mobile atlantoaxial joint due to overstretching of alar

ligaments and apical ligament of dens. [21] Occipitalization of atlas vertebra may reduce the diameter of foramen magnum which can act as trigger for the onset of various neurological symptoms like headache, paraesthesia, numbness, seizures, vertigo, dizziness, syncope etc. [22] The knowledge of fusion of atlas vertebra with the skull bone may be important to the neurologists, radiologists, orthopaedic surgeons, anaesthesiologists as well physiotherapist while dealing with the various diagnostic, therapeutic as well as operative procedures in the upper cervical region. In patients with the upper cervical neurological compressive anomalies, the clinical investigative workout should be done in the directions of possibilities of bony fusion anomalies like occipitalization of atlas vertebra.

References:

1. Newell RLM. The Back, in Standring S. Gray's Anatomy - The anatomical basis of clinical practice, 40th ed., Churchill Livingstone, Elsevier, 2008:733
2. Ranade AV, Rai R, Prabhu LV, Kumaran M, Pai MM. Atlas assimilation: a case report. Neuroanatomy.2007; 6:32-33.
3. Guebert GM, Yochum TR, Rowe LJ. Congenital anomalies and normal skeleton variants. Essentials of skeletal radiology, Baltimore, MD: Williams and Wilkins; 1987. p. 197-386
4. Ciolkowski MK, Krajewski P, Cizek B. A case of atlas assimilation: description of bony and soft structures. Surg Radiol Anat., 2014; 36(8): 833-836.
5. Kassim NM, Latiff AA, Das S, Ghafar NA, Suhaimi FH, Othman F et al. Atlanto-occipital fusion: an osteological study with clinical implications. Bratisl Lek Listy., 2010; 111(10): 562-565
6. Sharma M, Singh B, Abhaya A, Kumar H. Occipitalization of atlas with other associated anomalies of skull. Eur J Anat., 2008; 12(3): 159-167.
7. Rajani SJ, Suttarwala I M, Rajani JK. An unusual case of unilateral atlanto-occipital assimilation with skull asymmetry – case report. National J Med Res., 2012; 2(2): 238-240.
8. Jadhav S, Ambali MP, Patil RJ, Doshi MA, Roy PP. Assimilation of atlas in Indian dry skulls. JKIMSU, 2012; 1(1): 102-106.
9. Grilliot JR, Oswal CA. Assimilation of the atlas and occiput: a case report. J Can Chiropr Assoc 1988 Dec; 32(4):195-198.
10. Macalister A. Notes on the development and variations of the atlas. J Anat Physiol 1893 Jul; 27(Pt 4):519-554
11. Shapiro R, Robinson F. Embryogenesis of the human occipital bone. Am J Roentgenol 1976 May;126(5):1063-1068
12. Saini V, Singh R, Bandopadhyay M, Tripathi SK, Shamal SN. Occipitalization of atlas: its occurrence and embryological basis. IJAV. 2008;2:85-88
13. Motabagani MA, Surendra M. Total occipitalisation of the atlas. Anat Sci Int 2006 Sep;81(3):173-180
14. Walia S , Modi BS, Puri N, Patnaik VVG. Occipitalization of Atlas. Int J Anat Res 2014;2(4):781-784
15. Hussain Saheb S, Mavishetter GF, Thomas ST, Prasanna LC, Murlidhar P. Occipitalization of

- Atlas: A case report. J Biomed Sci and Res., 2010; 2(2):73-75
16. Nayak S, Vollala VR, Raghunathan D. Total fusion of atlas with occipital bone: a case report. Neuroanatomy 2008; 4:39-40
17. Barma SD, Rabha G, Talukdar K. Occipitalization of atlas- a case report. NJCA, 2016; 5(2):107-109
18. Jayanthi V, Kulkarni R, Kulkarni RN. Atlanto-occipital fusion:report of two cases. J Anat Soc India 2003;52(1):71-73
19. Soni S, Nazeer M, Rattaiah K, Pavana Kumari KV, Ranzeetha D, Haseena S et al. Atlanto-occipital Fusion: Embryological Basis and Clinical Implication. Sch. J. App. Med. Sci., 2015; 3(3A):1089-1091
20. Mckechnie B. Occipitalization of atlas. Dynamic Chiropractic. 1994;2(7)
21. Ryniewicz AM, Skrzat J, Ryniewicz A, Ryniewicz W, Walocha J. Geometry of the articular facets of the lateral atlanto-axial joints in the case of occipitalization. Folia Morphol. 2010 Aug;69(3):147-53
22. Jadhav S, Ambali M, Patil R, Doshi M, Roy P. Assimilation of atlas in Indian dry skulls. JKIMSU.2012;1:102-106

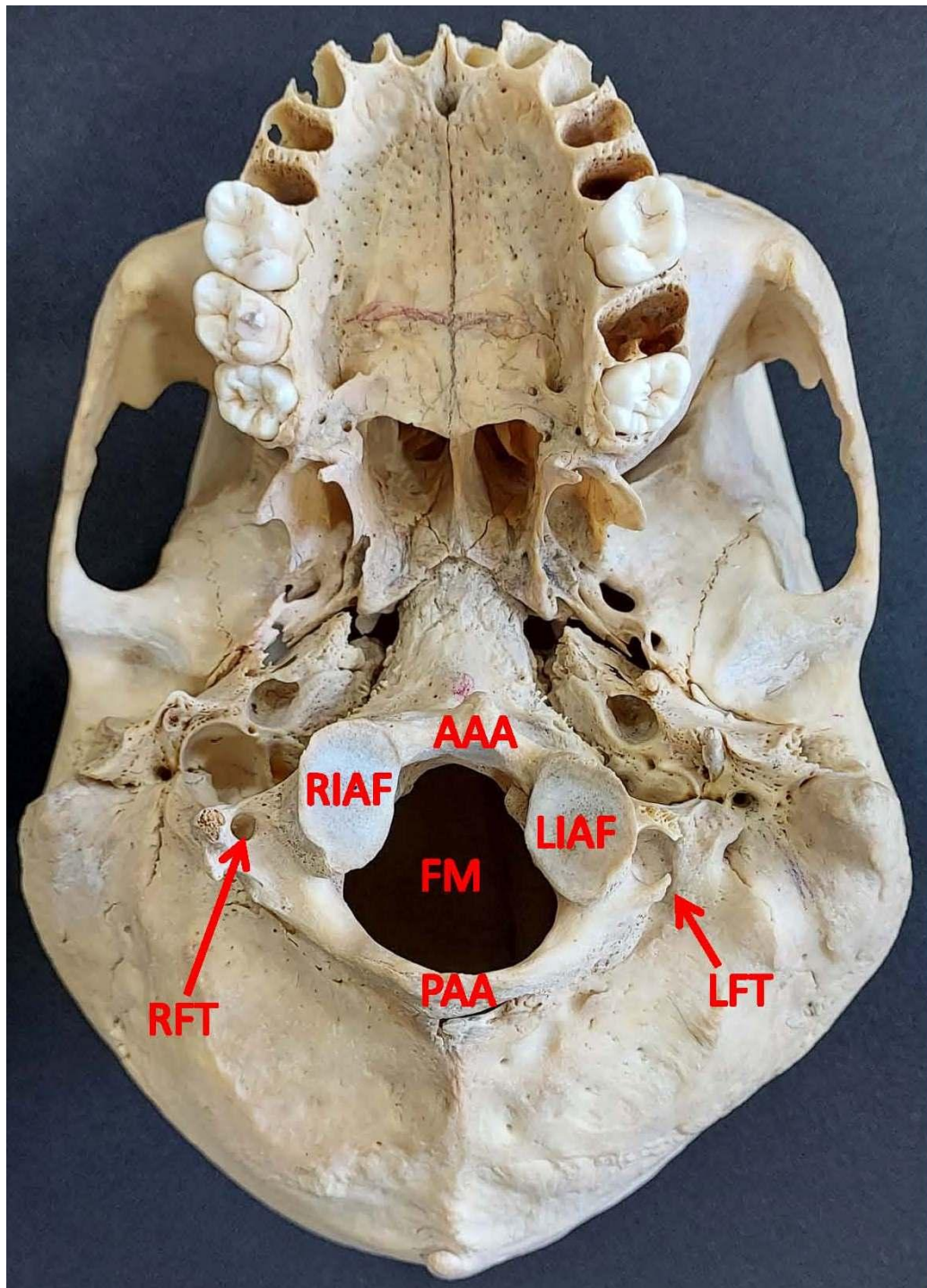


Fig 1: Inferior view of skull showing the occipitalization of atlas vertebra. AAA: Anterior Arch of Atals, PAA: Posterior Arch of Atlas, RIAF: Right Inferior Articular Facet of Atlas vertebra, LIAF: Left Inferior Articular Facet of Atlas vertebra, RFT: Right Foramen Transverserium of Atlas vertebra, LFT: Left Foramen Transverserium of Atlas vertebra, FM: Foramen Magnum

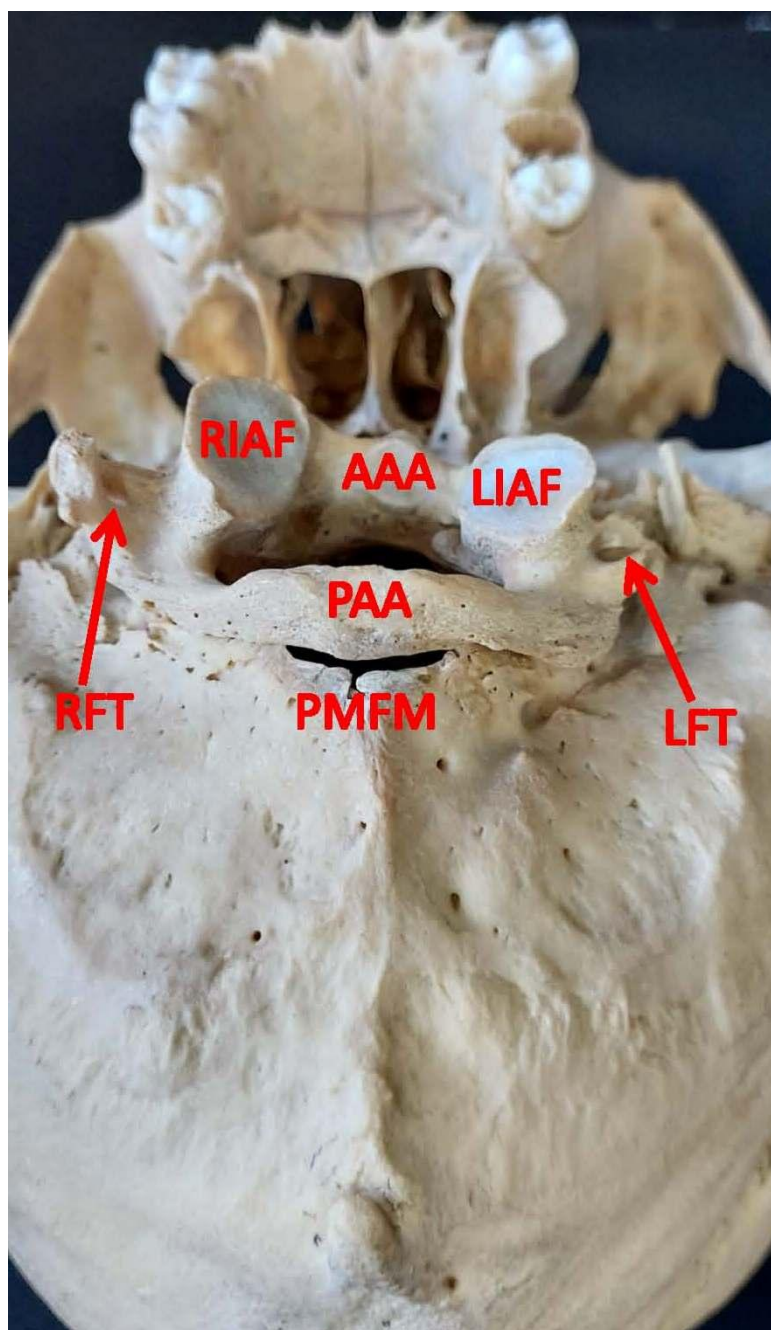


Fig 2: Posterior view of skull showing the occipitalization of atlas vertebra. PMFM: Posterior Margin of Foramen Magnum

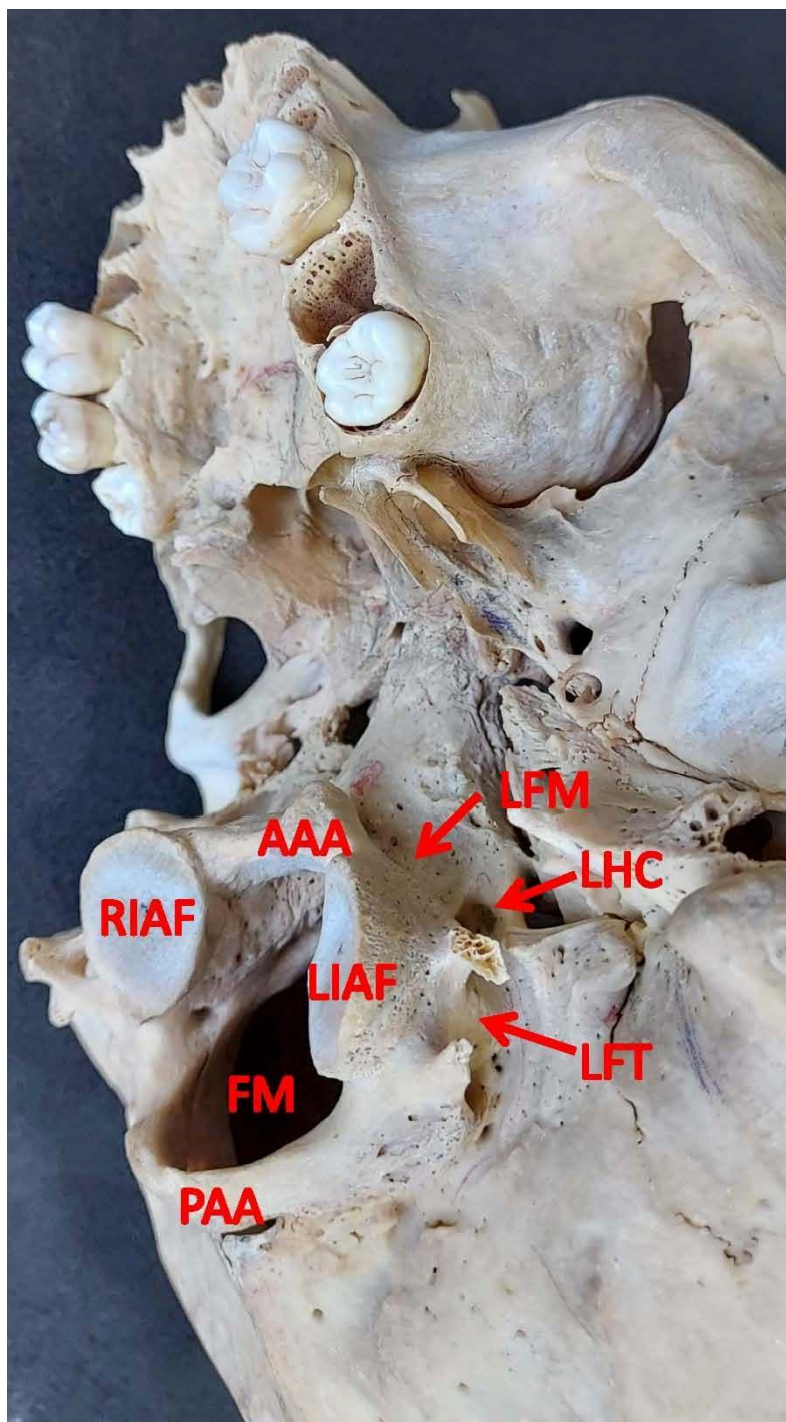


Fig 3: Left lateral view of skull showing the occipitalization of atlas vertebra. LFM: Left Fused Mass, LHC: Left Hypoglossal Canal

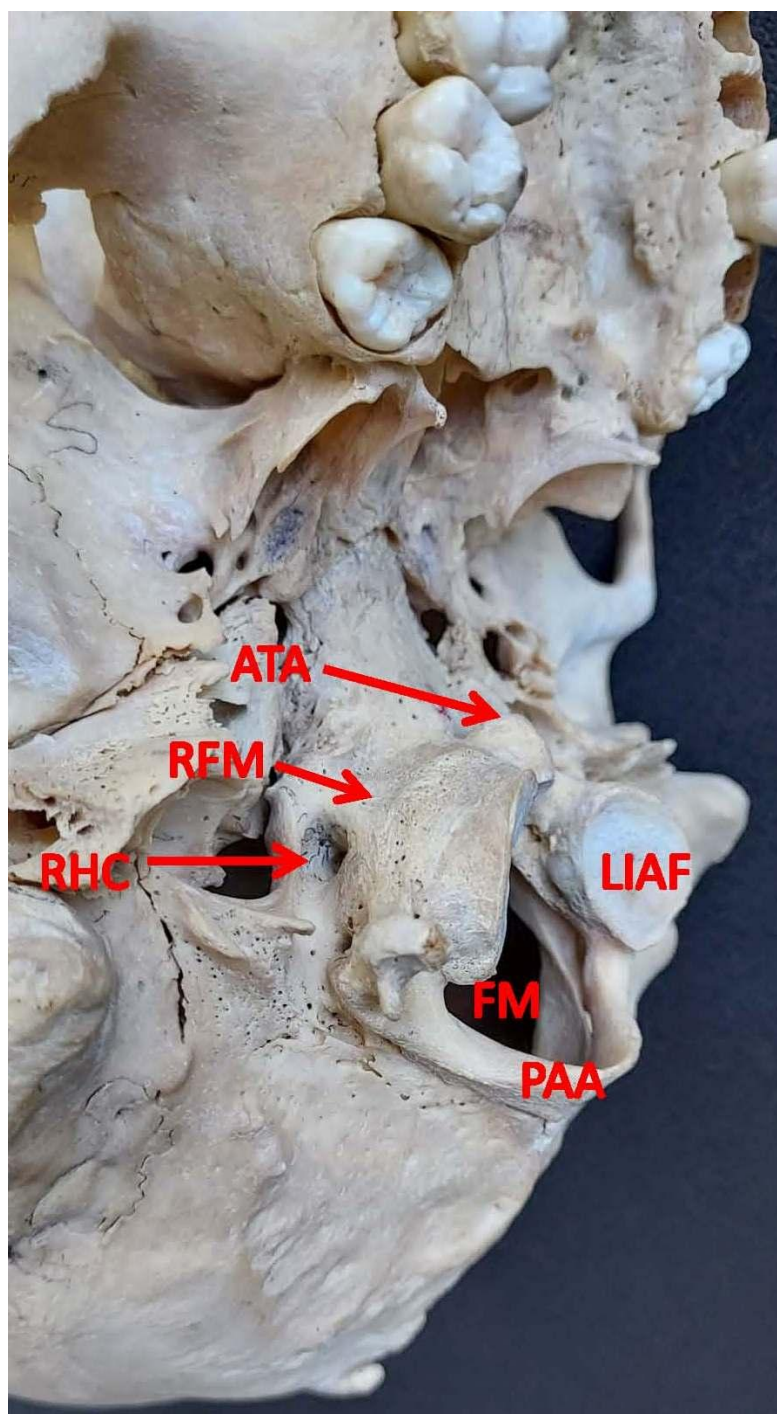


Fig 4: Right lateral view of skull showing the occipitalization of atlas vertebra. RFM: Right Fused Mass, RHC: Right Hypoglossal Canal, ATA: Anterior Tubercle of Atlas vertebra