Scope
Volume 14 Number 03 September 2024

A Case Series on Variations in Superior Articulating Facets of Atlas and its Clinical Significance

Khrieketouzo Chielie[1], Leon Ranjoline Guria[2*], Thoudam Bedita Devi[2]
[1]Associate Professor, Shija Academy of Health Sciences, Imphal, Manipur
[2]Assistant Professor, Shija Academy of Health Sciences, Imphal, Manipur

Corresponding Author: **Leon Ranjoline Guria**

Abstract

Introduction: The atlanto-occipital joint strains predominantly induce a tension-like headache which is caused as a result of a prolonged and an inappropriate posture which results from a poor ergonomic adaptation. Superior articulating facets on atlas are usually concave, with concavity in both longitudinal and transverse directions. However, variations have been reported in shape of its superior articulating surfaces. The anatomy of the atlas is essential to understand the basis for Craniovertebral junction anomalies and their surgical correction. **Material and Methods**: This study was conducted at the Department of Anatomy of Shija Academy of Health Sciences, Imphal, Manipur. During routine undergraduate studies, variant superior articulating surfaces of atlas were observed in 10 bones. **Result**: Out of the 10 cases, three cases were observed to have comma shaped articulating surfaces,dumb bell shaped was observed in one vertebrae and complete separation of articulating surfaces was seen in fourvertebrae along with two vertebrae showing irregular superior articulating facets. **Conclusion**: In recent years, considerable innovations in the internal fixation techniques have created a need for more detailed quantitative description of the anatomy of this bone. Thus, the anatomy of the cervical vertebrae or the spine is of great clinical importance to surgeons, as a surgical procedure may be done through the anterior or posterior cervical spine, with gratifying results

Keywords: Atlanto-occipital, posture, headache, case series.

Introduction

The atlas, the first cervical vertebra is unique in that it fails to incorporate a centrum, whose expected position is occupied by the dens.[1]As a result, there is no intervertebral disc between CI and CII. When viewed from above, the atlas is ring shaped and composed of two lateral massesinterconnected by an anterior archand a posterior arch.Each lateral mass articulates above with an occipital condyleof the skull and below

with the superior articular process of vertebra CII (the axis). The superior articular surfacesare bean shaped and concave, whereas the inferior articular surfacesare almost circular and flat.[2]

Superior surface of posterior arch bears a wide groove for vertebral artery and venous plexus immediately behind. Superior border gives attachment to posterior atlanto occipital membrane and inferior border to the ligamentumflava. Posterior tubercle is a rudimentary spinous process roughened for attachment of ligamentum nuchae.[3]

Literature review reveals multiple studies reporting the anatomical variations in the morphology and morphometry of atlas.[4]Superior articulating facets on atlas are usually concave, with concavity in both longitudinal and transverse directions. The facets form an atlanto-occipital joint with occipital condyles and this joint is responsible for nodding movements and also for the weight- bearing of the head. The most common side effect of atlanto-occipital joint strains is a tension-like headache, which is brought on by an extended period of improper posture as a result of inadequate ergonomic adaptation.[5]

It has been postulated that antero-posterior axial changes are important for assessing the surgical applications.[6]Fitz-Ritson reported a high correspondence of upper cervical joint fixations in patients suffering from cervicogenic vertigo.[7]Injuries of the upper cervical spine which cause severe disabilities following trauma, have always been an interesting focus for anatomists.[8]

It has been observed that osteophytes may appear on the atlas characteristically in the region of the superior articular facets causing vertebrobasilar ischaemia due to the compression of the vertebral arteries.[9]

As stated in literature, variations have been reported in the superior articulating facets of atlas, however, this case series describes ten cases of variations of morphology of superior articulating facets adds to it keeping in mind that recent developments in fixation technologies and minimally invasive surgical approaches have encouraged further studies of the region.[10]

Material and Methods

This study was conducted at the Department of Anatomy of Shija Academy of Health Sciences, Imphal, Manipur. During routine undergraduate studies, variant superior articulating surfaces of atlas were observed in 10 bones. The bones were of unknown age and sex. Damaged and pathologically abnormal bones were excludedfrom the study. Morphological parameters like shapes, constrictions and partial or complete separations of facets were noted. The study did not require approval from research and ethical committees as it was a case series.

Study design:

This was a descriptive case study.

Inclusion criteria

The bones involving the superior articular surfaces of the atlas were included.

Exclusion criteria

The damaged and pathologically abnormal bones were excluded from the study.

Statistical analysis

Considering this is a case series no statistical analysis was required for obtaining the results.

Results

Following patterns were observed which are shown in Table 1

Table 1- Patterns of variation in superior articular facets

Population	Shape Of the Articulating Facet	Number of vertebrae	Number of vertebrae with Unilateral variation	Number of vertebrae with Bilateral variation
Northeast India	Comma shaped	3	3	-
	Dumbbell shaped	1	1	
	Complete separation on both sides	4	1	3
	Irregular shaped	2	-	2

In the present case series, three cases (30%) were observed to have comma shaped articulating surfaces as shown in Fig 1. All three variations were unilateral.Ten percent cases (one vertebrae) showed dumbbell shaped facets which was aunilateral variation as shown in Fig 2.Complete separation of articulating surfaces was seen in four vertebrae (40%) cases, one case had unilateral finding and threeshowed bilateral variation as shown in Fig 3. Also, 20% vertebrae showed irregular superior articulating facets, both of which were bilaterally present as shown in Fig 4.

Figure 1 showing Right sided Comma shaped facet

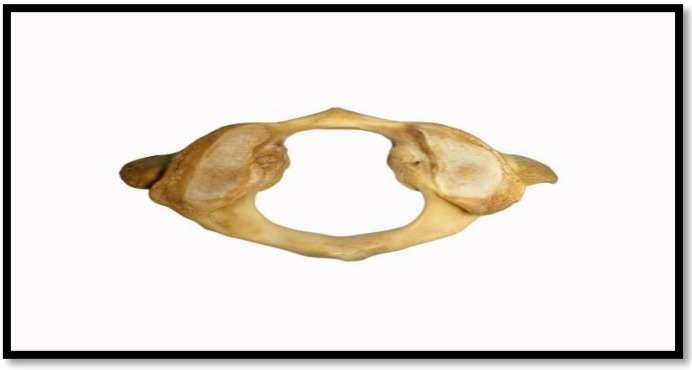


Figure 2 showing Left sided Dumbbell shaped superior articulating surface.

Figure 3 showing Complete separation of superior articulating facets Bilaterally

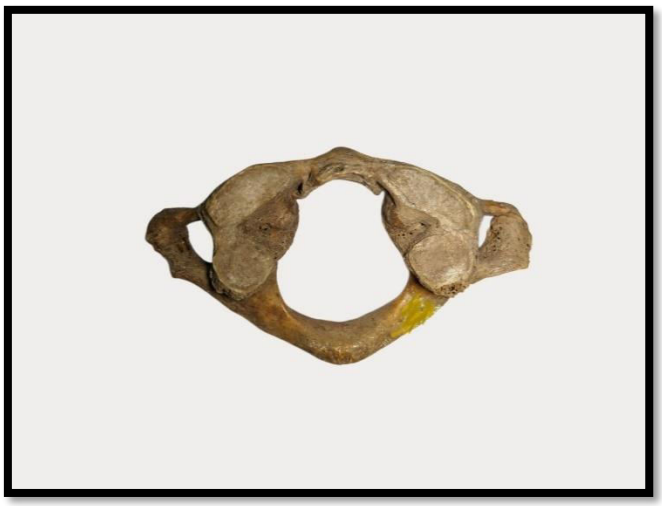
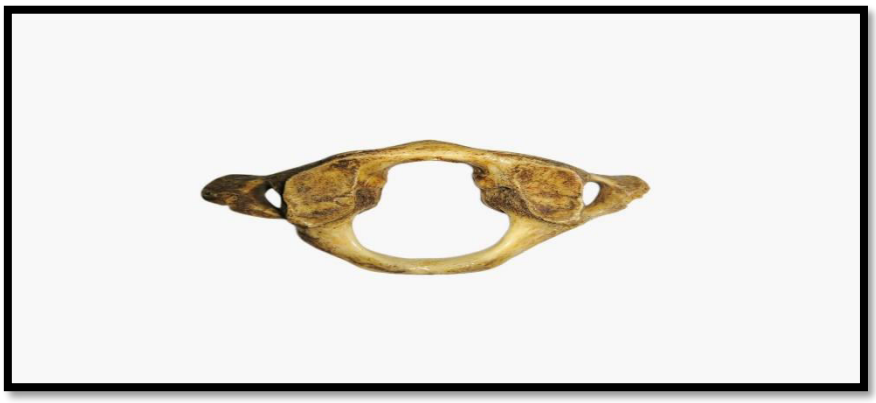


Figure 4 Showing irregular superior articulating surfaces Bilaterally



Discussion

The atlanto-occipital joint is the one which involves an approximate reciprocal configuration of occipital condyles with superior articular facets of atlas. The superior articular facets which assume a horizontal orientation during development, which will assume a concave appearance by 6 years of development, will establish stabilization process of the joint.[11]

The atlas vertebra develops from the caudal half of occipital somite 4 and the cranial half of cervical somite 1. It ossifiesfrom three centers – two appear in the lateral masses at the7thweek and they gradually extend into the posterior archwhere they unite between the 3rd and 4th years, usuallydirectly but occasionally through a separate center. Aseparate centre appears for the anterior arch at about theend of first year. This unites with the lateral masses betweensixth and eighth year, the lines of union extending acrossanterior parts of the superior articular facets.[12]

The posterior part of the superior articular facet is developed by the posterior arch. This different embryological development of the two parts of the superior articular facets explains their partial or complete dissociation.[13]

Partial or complete partition of the facet is an important finding, that could be interpreted as a derived characteristic for human species, which could indicate the functional modification of the joint, due to acquisition of erect posture and bipedalism.[14]

The variations in the pattern of superior articulating facet of atlas have been reported in literature.

Author	**Number of Atlas**	**Shape**	**Right Superior Articulating Facet**	**Left Superior Articulating Facet**	**Total**
Singh[5]	200	Oval	53	42	95
		Reniform	13	20	33
		Dumbbell	134	138	272
		F8			
Gupta and Goyal[15]	50	Oval			74
		Reniform			24
Lalit M[16]	30	Oval	10	7	17
		Reniform	6	6	12
		Dumb bell	11	10	21
		F8	3	7	10
Patil GV[9]	100	Oval	29	24	63
		Reniform	7	12	19
		Dumb bell	44	41	85
		F8	10	10	20
		Triangular	10	13	23

Congenital variations in the cervical spine, such as clefts, can be easily misidentified as fractures, subluxations, or instances of osteolysis, necessitating a comprehensive evaluation.[17]

Pediatric populations warrant special consideration, particularly given that children under the age of 3 are at heightened risk for cervical injuries. Furthermore, the potential for misdiagnosis of congenital anomalies is significant in children younger than 8 years, a period during which complete ossification processes may not have fully occurred.[18]

Superior and inferior articular processes form a solid articular pillar that transmits some weight from one vertebra to the next lower vertebra.[19]The knowledge of the quantitative anatomy of the atlas will prove useful to the surgeons who perform operative procedures in this region and will thus help in avoiding vascular complications.[20]

Conclusion- In recent years, considerable innovations in the internal fixation techniques have created a need for a more detailed quantitative description of the anatomy of this bone. Thus, the anatomy of the cervical vertebrae or the spine is of great clinical importance to surgeons, as a surgical procedure may be done through the anterior or posterior cervical spine, with gratifying results.

Bibliography

1. Standring S. Back.Gray's Anatomy. 41st ed. London: Churchill Livingstone Elsevier;2016.p. 710-73.
2. Drake RL, Vogl AW and Mitchell AWM. Back. Gray's Anatomy for students. 4th ed. Canada: Churchill Livingstone Elsevier;2020.p. 51-122.
3. Muralimohan S, Pande A, Vasudevan MC, Ramamurthi R. Suboccipital segment of the vertebral artery: a cadaveric study. Neurol India. 2009;57(4):447-52.
4. Ebraheim NA, Xu R, Knight T, Yeasting RA. Morphometric evaluation of lower cervical pedicle and its projection. Spine. 1997;22(1):1-5.
5. Singh S. Variations of the superior articular facets of atlas vertebrae. J of Anat. 1965; 99: 565-71.
6. Motagi MV, Ranganath V. Morphometric analysis of superior articular facets of atlas vertebra and its clinical applications in ergonomics of atlanto-occipital joints. JCDR. 2013;7(12):2674-6.
7. Fitz-Ritson D. Assessment of cervicogenic vertigo. J Manipulative PhysiolTher 1991;14:193-8.
8. HH B. Acute fractures and dislocations of the cervical spine. J Bone Joint Surg. 1979;61:1119-42.
9. Girish V, Shishirkumar D. Superior Articular Facets of Atlas Vertebra-Amorphological Study. IJSR. 2014;3(7):364-5.
10. Goyal N, Jain A. Variation of the superior articular facet of atlas and their significance. J of the AnatSoc of Ind. 2021;70(3):151-5.
11. Cunningham C, Scheuer L, Black S. Dev juvosteo. Academic press; 2016 Jul 26.
12. Standring S. Neck. Gray's Anatomy. 40th ed. London: Churchill Livingstone Elsevier; 2008. p. 460, 763-73.

13. Paraskevas G, Papaziogas B, Tzaveas A, Natsis K, Spanidou S, Kitsoulis P. Morphological parameters of the superior articular facets of the atlas and potential clinical significance. Surg&radiol anat. 2008;30:611-7.
14. Billmann F, Le Minor JM, Steinwachs M. Bipartition of the superior articular facets of the first cervical vertebra (atlas or C1): a human variant probably specific among primates. Ann of Ana-AnatomischerAnzeiger. 2007;189(1):79-85.
15. Gupta S, Goel A. Quantitative anatomy of the lateral masses of the atlas and axis vertebrae. Neurol Ind. 2000;48(2):120-1.
16. Lalit M, Piplani S, Kullar JS, Arora AK, Mannan R. The morphological analysis of the superior articular facet of the adult human atlas vertebra. JCDR. 2011;5(2):274-7.
17. Ulusoy OL, Sasani H, Mutlu A, Darıcı E, Şirvancı M. A case of combined congenital anterior and posterior arch anomaly of C1 vertebra. Marmara Med Jour. 2017;30(1):40-3.
18. Harrop JS, Jeyamohan S, Sharan A, Ratliff J, Flanders A, Maltenfort M et.al. Acute cervical fracture or congenital spinal deformity?. The J of Spin Cord Med. 2008;31(1):83-7.
19. Inderbir Singh. Cervical vertebrae. In: Textbook of human Osteology. 2nd edition. New Delhi: Medical Publishers LTD; 2002: 98-103.
20. Lamberty BG, Živanović S. The retro-articular vertebral artery ring of the atlas and its significance. Cells Tiss Org. 1973;85(1):113-22.