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Morphological Study of Superior Articular Facet of Atlas

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Abstract

Aim: The variations of superior articular facets of the Atlas vertebra has been less described in most of the anatomy textbooks though it is significant clinically. Different authors have described the superior articular facets based on constrictions, grooves and shapes. Present study deals with the division of the facet, constrictions, grooves, division, shapes and depth, its frequency and possible explanation. *Materials and Methods:* 100 superior articular facets of 50 dried, adult atlas vertebrae were collected from the bone library, Department of Anatomy, Subbaiah Institute of Medical Sciences, Shimoga. *Results:* Constrictions on medial margin were more frequent, 54% bilaterally followed by constrictions on both the margins about 46% on right side and 44% on left side. Grooves were observed about 46% on right and 44% on left side on the superior articular facets. According to constriction and groove, the facets were divided into complete, incomplete and non division. Non divisions were frequently seen, 54% on right and 56% on left side and complete divisions were less frequent, 8% on right and 2% on left side. Shapes of the facets were also defined according to its division. Kidney- shaped facets (54% bilaterally) were commonly observed followed by dumb-bell shape with left side predominance (36%). Depth of the facets was studied where concave was more common. *Conclusion:* The knowledge of variations of superior articular facets of Atlas is of importance to anatomists, anthropologists and clinicians since asymmetry may lead to restricted movements of atlanto-occipital joint and incomplete decompression of neuro-vascular structures.

Keywords: Cervical Vertebrae; Atlas; Superior Articular Facets; Constrictions; Grooves.

Introduction

The first cervical vertebra, Atlas (C1) has different anatomical features from the other cervical vertebrae. C1 vertebra is an important part of bony anatomy of Cranio-vertebral Junction (CVJ). The stability of the atlas is provided by two symmetrical lateral masses that are united by anterior and posterior arches. These lateral masses are thick, supportive elements composed of both superior and inferior articular facets [1,2]. Superior Articular Facets (SAF) are present superomedially on atlas vertebra occupying most of the upper surface of the lateral mass and lie obliquely, their anterior ends being always nearer to the midline than the posterior ends. Facets are usually concave, with concavity in both longitudinal and transverse directions. The facets with occipital condyles form atlanto-occipital joint which is responsible for nodding movements and also for the weight-bearing of the head [3].

The description of the superior articular facets of the atlas vertebra as found in most of the text-books of anatomy makes no mention of its variations. The different shapes of the facets have been variously described as concave, deeply concave, oval, elongated, kidney-shaped by Schaeffer (1942), Brash (1951), Hamilton et al. (1958), Johnston, Davies & Davies (1958), Breathnach (1958), Woodburne (1961) and Sahana (1962). Some of these authors have also mentioned constrictions or notches on the inner or outer border, or both borders of the facets tending to subdivide them. Bryce (1915), Huber (1936), and Wood Jones (1950) have described the presence of a groove dividing the facet [3].

Any strain on atlanto-occipital joint predominantly induces a tension-like headache which is caused as a result of a prolonged and an inappropriate posture which results from a poor ergonomic adaptation.

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Hypermobility of atlanto-occipital joints due to cervical spine malformations and craniovertebral junction abnormalities may give rise to neurological and vascular symptoms. Alterations in the morphology and morphometry of superior articular facet will alter the ergonomics of the joint, leading to restricted movements. The stability of the cervical spine is violated by various traumatic and non-traumatic causes. Instability of CVJ needs surgical correction or long term immobility to attain a solid fusion.

Literature has revealed marked variations in the shape, symmetry, partial or complete separations of the facets and constrictions of SAF of the atlas. The non-metrical/morphological changes which occur in the superior facets of atlas may be a concordant factor for restriction of a cranio-vertebral motion [3, 4, 5, 6, and 7]. So, the present study was undertaken to study the morphologies of the superior articular facets.

Materials & Methods

Fifty dried, adult atlas vertebrae collected from the bone library, Department of Anatomy, Subbaiah Institute of Medical Sciences. Broken and distorted bones were excluded. Morphology of 100 superior articular facets was studied for the division, constrictions, grooves, shapes and depth and its frequency and possible explanation. The study was compared with similar other previous studies.

Results

In 50 atlas vertebrae, the morphology of 100 superior articular facets was studied which includes the shape, the presence of a constriction and groove with a tendency to separate completely or incompletely. Based on these observations, the percentage was calculated for each parameter as shown in the tables and figures. We observed constrictions on medial margin, 54% bilaterally and both the margins, 46% on right side and 44% on left side. Constrictions only on lateral margin were not observed. Margins were absent in 2% on the left side (Table 1). Grooves were present, 46% on right side and 44% on left side of the superior articular facets (Table 2). According to constriction and groove, Superior Articular Facets were divided into complete division, incomplete division and non division. Non divisions were frequently seen, 54% on right side and 56% on left side. Incomplete divisions were next commonly seen, 38% on right side, 42% on left side. Complete divisions were less frequently observed, 8% on right side, 2% on left side. Shapes were defined according to division of Superior Articular Facets. In incomplete division, facets were of two types, Figure of 8 and dumb-bell shaped. In non division, kidney, oval shaped facets were observed. In incomplete divisions, dumb-bell shape was more frequent and common on the left side (36%). In non division, kidney-shaped facets were found with the incidence of 54% bilaterally (Table 3) . In the study of depth of the Facets, concave (96% bilaterally) and flat (4% bilaterally) were observed where the facets were more frequently concave (Table 2). Photographs of the different shapes, constrictions are shown in Fig. 1-5.

Table 1: Constrictions at the superior articular facets of atlas

Side	Both margins	Medial margin	Lateral margin	Absent	Total
Right	23	27	0	0	50
Left	22	27	0	1	50

Table 2: Grooves and depth at the superior articular facets of atlas

Side	Groove		Depth		Total
	Present	Absent	Flat	Concave	
Right	23	27	2	48	50
Left	22	28	2	48	50

Table 3: Divisions and various shapes of superior articular facets of atlas

Side	Complete Division	Incomplete division			Non division			
		Total	'8' shaped	Dumb-bell shaped	Total	Oval	Kidney shaped	Irregular
Right	4	19	2	17	27	0	27	0
Left	1	21	3	18	28	1	27	0

Fig. 1: Complete division showing figure of 8 shaped facets bilaterally

Fig. 2: Complete division on the right side and shallow groove on the left side of superior articular facet

Fig. 3: Dumb-bell shaped facet on the left side

Fig. 4: Non-division showing kidney shaped facet on the right side and concave superior articular facet on the left side

Fig. 5: Bilateral construction on the right and oval shaped facet on the left

Table 4: Comparison of presence of constriction and groove

Study/ Year	No. of Atlas	Constrictions (%)								Grooves (%)	
		Right				Left				Present	Absent
		Medial	Lateral	Bilateral	Absent	Medial	Lateral	Bilateral	Absent		
Shamer Singh [3], 1965	200	4	2.5	67	26.5	3	7	69	21	74	26
Lalit M et.al [5], 2011	30	13.3	6.66	46.6	33.3	10	10	56.6	23.3	56.66	43.33
Londhe Shashikala R et.al [8], 2016	50	28	2	28	42	16	4	34	46	30	70
Present study, 2018	50	54	0	46	0	54	0	44	2	22	28

Table 5: Comparison of shapes of superior articular facets

Study/ Year	No. of Atlas	Shape of superior articular facet (%)									
		Oval		Kidney shaped		Dumbbell shaped		Figure of 8		irregular	
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Shamer Singh [3], 1965	200	26.5	21	6.5	10	67	69	-	-	-	-
Lalit M et.al [5], 2011	30	33.3	23.3	20	20	36.6	33.3	10	23.3	-	-
Londhe Shashikala R et.al [8], 2016	50	34	36	30	20	16	20	6	6	8	8
Present study, 2018	50	0	2	54	54	34	36	4	6	-	-

Discussion

Constrictions and Grooves: The presence of constrictions and grooves of superior articular facet of Atlas in the present study was compared with similar previous studies. Bilateral constrictions on both sides were common in studies done by Shamer Singh and Lalith M et.al [3,5]. In another study done by Shashika Londhe et.al, absence of constrictions was more commonly observed [8]. In present study, constrictions on medial margins were more common bilaterally.

Shamer Singh and Lalit M et al. reported high incidence of presence of grooves. The present study was similar with the observations done by Shashika Londhe et.al where absence of grooves was more common. The results are shown in Table 1, 2 & 4.

The Superior articular facets of Atlas facing superomedially receives the occipital condyles to form the atlantooccipital joint [1]. An atlanto occipital transarticular approach is done for anterior extradural lesions of the cranio vertebral junction [10]. An abnormal hypertrophy of the articular facets is one of the causes for the narrowing of the vertebral canal and consequent neurological deficits [11].

The grooves present in the superior articular facets may give rise to pressure facets which are smooth circular impressions present on the medial sides of the articular surfaces. These pressure facets exert a greater pressure at these sites during movement at the atlanto-occipital joints [3].

Shapes: Based on the constrictions and grooves, the superior articular facets were divided into complete, incomplete and non-division. Under incomplete and nondivision various shapes of the facets were defined and compared with previous studies as shown in table 3 & 5. A study done by Gupta and Goel defined only two shapes, oval (74%) and kidney shaped (24%) [9]. The depth of the facets was also studied and based on the observation, flat and concave types were defined wherein the concave facets were more common.

The incidence of the division of the superior articular facets is of anthropological interest [12]. Phylogenetically, a single superior articular facet is the primitive pattern in primates. The functional modifications due to the acquisition of erect posture and bipedalism resulted in bipartition of the superior articular facet of the atlas during human evolution [13].

Osteophytes may appear on the atlas characteristically in the region of the superior articular facets and lead to Vertebrobasilar ischaemia due to the compression of the vertebral arteries [14].

Conclusion

The knowledge of superior articular facets of Atlas and its variations regarding the constrictions, groove and shapes is of importance not only to anatomists and anthropologists but also to clinicians. Since a little is mentioned about it in literature, this study will be of importance in consideration with the diagnosis and treatment of various clinical conditions like restricted movements at the atlantooccipital joint, compressive lesions like congential osseous craniovertebral junction malformations and also in atlanto occipital transarticular approach done for anterior extradural lesions of the cranio vertebral junction.

References

1. Baron EM, Tunstall R. The Back. In: Standring S (41st ed). Gary's Anatomy: The Anatomical Basis of Clinical Practice. 41st edition. Churchill Livingstone Elsevier. 2016;710-49.
2. Agur AMR, Dalley AF. Grant's Atlas of Anatomy.12th Edition. Lippincott Williams & Wilkins (eds).2009; 295-300.
3. Shamer Singh. Variations of the superior articular facets of atlas vertebrae. Journal of Anatomy. 1965; 99:565-71.
4. Schaeffer J.P. Morris's Human Anatomy, A complete systematic. Treatise. 1942; 10th ed: 85.
5. Lalit M, Piplani S, Kullur JS, Arora AK, Mannan R. The morphological analysis of superior articular facets of adult human atlas vertebra. Journal of Clinical and Diagnostic Research. 2011;5(2):274-77.
6. Paraskevas G, Papaziogas B, Tzaveas A, Natis K, Spanidou S, Kitsoulis P. Morphological parameters of the superior articular facets of atlas and potential clinical significance. Surg. Radiol. Anat. 2008; 30: 611-17.
7. Scheuer l, Black S. Developmental Juvenile Osteology, Elsevier, Amsterdam, 2000.p.199.
8. Londhe Shashikala R., Panjakash Samreen. Study of Superior Articular Facets in Human Atlas Vertebrae. National Journal of Medical Sciences 2016 Jan-June; 1(5):27-30.
9. Gupta S, Goel A. Quantitative anatomy of the lateral masses of the atlas and axis vertebrae. Neural India 2000;48:120-25.

10. Kawashima M, Tanriover N, Rhoton AL, Ulm AJ, Matsushima T. Extreme lateral variants of the atlanto occipital transarticular approach to anterior extradural lesions of the cranio vertebral junction – Anatomic reports. Neurosurgery 2003;53(3):662-75.
11. Gupta M, Bharihoke V, Bhargava SK, Agarwal N. Size of the vertebral canal – A correlative study of measurements in radiographs and dried bones. J Anat Soc India 1998; 47:1-6.
12. Maheshwari J. Spinal Injuries. In: Essential orthopaedics. 3rd edition. New Delhi. Mehta publishers; 2002.pp. 143-152.
13. Frank Billmann, Jean Marie Le Minor, Matthias Stianwachs. Bipartition of the superior articular facet of the first cervical vertebra (atlas or C1): a human variant probably specific among primates. Annals of Anatomy Anatomischer Anzieger official organ of the Anatomische Gesellschaft 2007;189(1):79-85.
14. Nathan H. Osteophytes of the vertebral column- An anatomical study of their development according to age, race and sex with considerations as to their etiology and significance. J Bone and Joint Surg 1962; 44-A(2):243-68.