

A Morphometric Study of Superior Articular Facet of Atlas Vertebra and its Significance**Fatima Begum¹, Sadakat Ali², Harish Chaturvedi³**¹Research Scholar, Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, SGRRU²Prof & HOD, Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, SGRRU³Prof & HOD, Department of Anatomy, Pt. Jawahar Lal Nehru Govt. Medical College & Hospital, Chamba, HP

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Abstract:

Introduction: The anatomy of atlas vertebra shows extensive variability in form and size, and also undergoes many structural modifications it is located at point close to the vital centres of the medulla oblongata which can get compressed by a dislocation of the atlantoaxial joint or instability of the atlantoaxial joint. Atlas vertebra helps in complex biomechanical movements of the skull along with weight transmission of skull to spine. Recent developments in fixation technologies and minimally invasive surgical approaches have encouraged acquisition of knowledge of various dimensions of atlas vertebrae which is very important for the development of instrumentation related to atlas vertebrae.

Material & Methods: In this study, total 120 dry, adult human atlas vertebrae of unknown age and sex were examined for shape, size and number of superior articular facets on each side, in various medical colleges of North India. All dimensions were measured in bilateral manner using Digital Vernier Calliper.

Results: Different shapes of superior articular facets observed were oval-shaped, kidney-shaped, rectangular, comma-shaped, 8-shaped, irregular and two or three separate facets. Length and width of the facet were similar on two sides.

Conclusion: The observations of present study helps in improving understanding of bony dimensions of superior articular facet of atlas vertebra which could facilitate diagnosis and preoperative planning of craniovertebral joint dysfunction.

Keywords: Atlas Vertebra, Superior Articular Facet, Inferior Articular Facet, Atlantoaxial Joint, Skull.

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Introduction

The atlas holds the globe of the skull and is devoid of body and spine. It has two lateral masses linked by an anterior and posterior arch. The posterior arch of the atlas forms about 3/5 of the atlantal ring. Superior articular facets which are present on the atlas vertebrae face super medially and are well known for nodding movements and furthermore for the weight bearing of the head. These are also known for the reception of the condyles of the occipital bone to form an atlantooccipital joint (LALIT, PIPLANI, KULLAR et al., 2011).

Craniovertebral junction (CVJ) surgery includes many decompressive and stabilising operations, which includes Trans articular screw fixation of the atlas vertebra and posterior screw placement on the lateral mass of atlas vertebra. These operations usually target the atlas vertebra which is a critical component of the biomechanical complex of CVJ's

bony architecture. To treat the instability of the craniovertebral junction produced by various traumatic and non-traumatic situations, various surgical procedures such as interspinous wiring, interlaminar clamp, plate and screw fixation are now used. Trans articular and transpedicular screw fixation are also commonly employed in vertebral column stabilisation. Despite the benefits provided by the aforementioned treatments, there are risks that can develop, most notably from incorrect pedicle screw insertion, which can result in harm to critical tissues such as the cranial and spinal nerves, spinal cord, and vertebral arteries. Iatrogenic vertebral artery damage is a rare complication encountered during posterior approach craniovertebral junction procedures. [1] So, present study was undertaken to look for the variations that can occur in the atlas vertebra and to assess the

various measurements of the first cervical vertebra quantitatively.

Material & Methods

In this study, total 120 dry, adult human atlas vertebrae of unknown age and gender were examined for shape, size and number of superior articular facets on each side, in various medical colleges of North India. All dimensions were measured in bilateral manner using Digital Vernier Calliper.

Results

The mean and standard deviation of all measurements done on superior articular facet of atlas vertebrae and frequency of shape of superior articular facet are shown in Table 1 and 2.

Commonest shape of superior articular facet was oval in 31.25% of specimens and it was kidney shape in 23.33%, bilobed in 11.67%, figure of 8 shape in 7.92% of cases, rectangular shape in 7.50%, leaf shape in 7.08% , comma shape in 3.33%, trilobed 2.92% and irregular and triangular in 2.50% each. The length of superior articular facets was measured as the A-P dimension (anteroposterior) of articular surface. The width of superior articular facets was measured as the transverse dimension of articular surface.

The mean length or AP dimension of the superior articular facet on right and left side were 22.49 ±2.48 and 21.78 ±3.85 mm respectively, the width or transverse dimension of the superior articular facet on right and left side were 11.87 ±3.36 and 10.90 ±1.29 mm respectively.

Table 1: Compare the Frequency (in percentage) of Shapes of Superior Articular Facet (SAF) with other Authors; N = Number of Facet

Shape of SAF	Present study, 2023 N= 240	Lalit et al(2011) N = 60	Kintu et al (2013) N = 200	Manjunath & Ranganath, 2013 N=100	Gupta et al (2013) N=70	Girish & Shishir (2014) N = 200	Ashita et al(2016) N = 100	Parineeta Suman (2017) N = 64	Goyal N (2021) N=220
Oval	75 (31.25 %)	17 (28.33%)	76 (38%)	33 (33%)	42.8 %	53 (26.5%)	31 (31%)	26 (40.62%)	41.8%
Kidney	56 (23.33%)	12 (20%)	45 (22.5%)	10 (10%)	7.1%	19 (9.5%)	18 (18%)	17 (26.56%)	25.9%
Dumb bell	-	21 (35%)	51 (25.5%)	-		85 (42.5%)	24 (24%)	7 (10.94%)	-
Figure of eight	19 (7.92%)	10 (16.67%)	-	18 (18%)	31.4 %	20 (10%)	13 (13%)	5 (7.81%)	4.5%
Trilobed	7 (2.92%)	-	-	-	4.3%	-	-	3 (4.69%)	-
Complete separation	-	-	-	-		-	9 (9%)	2 (3.12%)	-
Triangular	6 (2.50%)	-	-	-	4.3%	23 (11.5%)	-	-	-
Elongated/ LEAF	17 (7.08%)	-	28 (14%)	-	1.4%	-	-	-	1.8%
Irregular	6 (2.50%)	-	-	39 (39%)	1.4%	-	-	4 (6.24%)	8.1%
Bilobed	28(11.67 %)	-	-	-	5.2%	-	-	-	-
Comma	8(3.33%)	-	-	-	-	-	-	-	5.4%
Rectangular	18(7.50%)	-	-	-	-	-	-	---	5.4%

Table 2: Comparison of Maximum Antero-Posterior Diameter and Maximum Transverse Diameter of Superior Articular Facet of atlas

Author	Number of Atlas	Origin	Dimension AP (Mm)		Dimension Transverse (Mm)	
			Right	Left	Right	Left
Kandziora et al (2001)	50	European	25.3± 2.22		-----	
Naderi et al (2003)	31	Turkish	19.9 ± 2.4		-----	
Cacciola et al (2004)	10	Indian	19.73		19.73	11.12
Koing et al (2005)	30	German	22.7 ± 3.0	22.8 ± 4.2	11.6 ± 2.0	11.2 ± 1.5
Sengul et al (2006)	40	Turkish	19.9 ± 3.4	18.6 ± 3.2	9.6 ± 1.9	9.8 ± 1.5
Gomez-Olivencia et al (2007)	-	Spanish	23.7 ± 1.8	23.5 ± 1.7	10.4 ± 1.2	10.5 ± 1.0
Rocha et al (2007)	20	American	23.9 ± 2.5	23.6 ± 2.5	-----	
Gosavi and Vatsalaswamy (2012)	100	Indian	21.24 ± 2.39	21.02± 2.52	10.36±1.72	10.47±1.61
Gupta et al (2013)	35	Indian	19.73		11.12	
Kaur et al (2014)	50	Indian	21.52 ± 2.36	21.51±2.07	11.21±1.47	11.32±1.53
Patel N P (2015)	50	Indian	20.73±1.68	20.86±1.97	11.34±1.82	11.32 ± 1.5
Rekha et al (2016)	100	Indian	22.33 ± 2.1	22.25 ± 2.1	8.7 ± 2.0	9.6 ± 2.3
Kyalvizhi I (2016)	50	Indian	20.56 ± 1.91	19.95±2.03	11.19±2.20	10.66±2.79
Goyal N. et al (2021)	110	Indian	21.9±2.33	22.09±2.62	11.60±1.38	11.68±1.55
Present study (2023)	120	Indian	22.49±2.48	21.78±3.85	11.87±3.36	10.90±1.29

Discussion:

The length of superior articular facets was measured as the A-P dimension of articular surface. The width of superior articular facets was measured as the transverse dimension of articular surface. The mean length of the superior articular facet on right and left side were 22.49 ±2.48 and 21.78 ±3.85 mm respectively, the width of the superior articular facet on right and left side were 11.87 ±3.36 and 10.90 ±1.29 mm respectively, while In the Ashita Kaore et al. study the anteroposterior diameter of superior articular facet of atlas was found to be 21.33mm on the right side and 21.37mm on the left side.

Göksin Sengül and Hakan Hadi Kadioglu results shows, the mean length of the superior articular facet on right and left side as 19.9 and 18.6 mm respectively, the width of the superior articular facet on right and left side as 9.6 and 9.8 mm, The dimensions have been compared with that of other workers (Table 2). While Sengul et al [1] has reported lower dimensions, findings of Konig et al [2] and Gomez Olivencia et al [3] show higher values. Our findings are comparable to that of Kaur et al [4] and Gosavi et al [5].

Commonest shape of superior articular facet in present study were oval in 31.25% of specimens while Göksin Sengül and Hakan Hadi Kadioglu, Lalit M et al. verdict turned out with Oval-shaped superior facets in 72%, 56.6% of specimens respectively [1,]. In present study concluded with kidney shape in 23.33% and they ended with 28% & 40% of specimens respectively. In the present study shows figure of 8 shaped superior articular

facets in 7.92% of specimens while study of Lalit M et al. showed in 33.3% of specimens [6].

Conclusion:

Craniovertebral junction (CVJ) surgical procedures necessitate a clear understanding of atlas quantitative anatomy. This research adds to the understanding of the anatomy of atlas vertebra and will be useful in the diagnosis of atlas fractures and congenital malformations, in the design of surgical methods also, in visualising the dimensions of the atlas Intraoperatively, and in assessing treatment outcomes.

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