

Original Article

Morphometric Study of the Articular Facets of Atlas Vertebra in Bangladeshi Population

*Munni TA¹, Paul DR², Morium U³, Naznin R⁴, Sultana N⁵, Sumi MN⁶, Kabir A⁷

Abstract:

Context: The first cervical vertebra, Atlas has different features from other cervical vertebra. Cervical vertebra is an important part of bony anatomy of craniovertebral junction. The stability of atlas is provided by two symmetrical lateral masses that are united by anterior and posterior arches. These lateral masses are the most bulky and solid parts of the atlas, supportive elements composed of superior and inferior articular facets. The stability of cervical spine is violated by various traumatic and non-traumatic causes. Instability of CVJ needs surgical correction or long term immobility to attain solid fusion

Objectives: knowing of various dimensions of superior and inferior articular facets of atlas are useful in internal fixation techniques for craniovertebral junction abnormalities. The knowledge of dimensions may determine surgical strategy. The result of the study will be helpful not only for anatomists but also for orthopedicians, neurosurgeons and forensic experts.

Materials and methods: In this study total 103 dried, unbroken atlas vertebra of unknown age and sex were collected from 1st and 2nd year students of Jahurul Islam Medical College, 2023 in kishoreganj. All dimensions are measured using Digital Vernier Calipers with 0.01 resolution.

Conclusions: Information and details about in screw placement at some stage in CVG surgery procedure the dimensions of superior and inferior articular facets could be helpful.

Keywords: cervical vertebra, atlas, cranio-vertebral junction.

JSWMC 2023 [13(02)] P: 36-40

Introduction:

Injury to the upper part of vertebral column cause severe disabilities following trauma, have always been an interesting focus for anatomists¹.

The 'globe' of the head is supported by the 1st cervical vertebra that is atlas². If the atlas was morphologically similar to other vertebrae, death would be a common result of fracture. Anatomically, to protect the atlas from injury is embedded in the neck muscles and is therefore protected from injury. The atlas maintains a safety mechanism by its unique structure and anatomical location³. Superior articular facets on the atlas vertebrae directed superomedially and are admirably customary for nodding motion and also for the weight bearing of the head⁴. Inferior articular facets are flat and directed posteromedially. Atlantooccipital joint is formed by reception of the condyles that bear articular facets⁵. This study is undertaken to assess the protected site for different surgical methods in which morphometric measurements of superior and inferior articular facets are essential.

1. Dr. Tajrin Akter Munni, Associate Professor, department of Anatomy, Jahurul Islam Medical College, kishoreganj
2. Paul DR, Professor, department of Anatomy, Jahurul Islam Medical college, kishoreganj.
3. Dr. Umma Morium, Associate Professor, department of Anatomy, US-Bangla Medical College
4. Rawshon Naznin, Associate Professor, department of Anatomy, United Medical College, Dhaka
5. Dr. Naznin sultana, Assistant Professor, department of Anatomy, Shaheed Syed Nazrul Islam Medical College, Kishoreganj
6. Dr. Mahmuda Nasrin Sumi, Associate Professor, department of Physiology, Jahurul Islam Medical college, Kishoreganj.
7. Dr. Anamul Kabir, Associate Professor, department of Anatomy, Jahurul Islam Medical college, Kishoreganj.

Corresponding author: DR. Tajrin Akter Munni,
Associate Professor, department of Anatomy, Jahurul Islam Medical College, kishoreganj
Email: tajrin.munni@gmail.com

Various authors have attempted to study and throw some knowledge about the dimensions of atlas in European, Turkish, German, Spanish and American population. Cacciola et al, Gosavi and Vatsalaswamy, Gupta et al, Jasveen Kaur et al and Rekha et al are the Indian authors have

contributed to provide data about morphometric and morphologic parameters of atlas bones^{6,7}.

Thus, the assessment of these structures and the morphological relationship of the two lateral masses of the atlas is done before performing any clinical procedure in its proximity.

Materials and methods:

The present study was carried out in the Department of Anatomy, Jahurul Islam Medical College, kishoreganj. In this study 103 atlas vertebra were used for measuring the parameters by using Digital Vernier Caliper. The fractured atlas vertebra and pathologically deformed atlas vertebra were excluded from the study.

Measurements: For measuring the parameters of the bone reference points were obtained from published data



Figure 1: Depicts description of atlas measurements taken from the superior aspect.

The measurement of the length or antero-posterior dimension of superior articular facet (A). The width or transvers dimension of superior articular facet (B).



Figure 2: Depicts description of atlas measurements taken from the inferior aspect.

The measurement of the length or antero-posterior dimension of inferior articular facet(C). The width or transvers dimension of inferior articular facet (D).

Antero-posterior Diameter (length) of superior articular facet: One point was taken on the anterior limit of SAF and other point on its posterior limit then length was measured (in mm) along its principal axis directed anteromedially

Transvers diameter (width) of superior articular facet: One point was taken on the medial limit of SAF and other on its lateral limit then width was measured (in mm) perpendicular to the principal axis.

Antero-posterior Diameter (length) of inferior articular facet: One point was taken on the anterior limit of IAF and other on its posterior limit then length was measured (in mm) along its principal axis directed anteromedially

Transvers diameter (width) of inferior articular facet: One point was taken on the medial limit of IAF and other on its lateral limit then width was measured (in mm) perpendicular to the principal axis.

All parameters were measured by using digital Vernier calipers in millimeters. The mean, median, range and standard deviation obtained were tabulated and presented for all the paramaters.

Results

The parameters mentioned were analyzed and shown in Table 1:

Table 1: showing parameters that were analyzed.

Parameter		Mean (mm) SD	Range(mm)
Length of Superior articular facet	RT	20.25± 2.22	14.5-25
	LT	20.79±1.88	14-24.9
Width of superior articular facet	RT	11.43±1.87	7.8-22
	LT	11.44±1.84	6-17
Length of inferior articular facet	RT	16.99±2.24	12.4-22
	LT	16.45±2.27	12.43-21.5
Width of inferior articular facet	RT	14.34±2.14	10.45-18
	LT	14.07 ±1.96	10.47-17.6

In the 103 atlas vertebra, anteroposterior and transvers diameter were studied for superior and inferior articular facets. The mean for anteroposterior diameter, transvers diameter were calculated. The percentage was calculated for each parameter and the results were compared with the findings of other workers.

According to the present study, the mean value of length of superior articular facets were measured as 20.25 mm and 20.79 mm on right and left side respectively. The highest and lowest values of superior articular facet observed as 25 mm and 14.5 mm for right side and 24.9 mm and 14 mm for left side respectively. The mean value were 11.43 mm and 11.44 mm for transvers diameter of right and left superior articular facet respectively. The highest and lowest values of superior articular facet observed as 22 mm and 7.8 mm for right side and 17 mm and 6 mm for left side respectively.

The mean value of length of right and left inferior articular facet were calculated as 16.99 mm and 16.45 mm respectively. The highest and lowest values of inferior articular facet were observed as 22mm and 12.4 mm for right side and 24.15 mm and 12.43 mm for left side respectively. The mean value of transvers diameter of right and left inferior articular facets were observed as 14.34 mm and 14.07 mm respectively. The highest and lowest values of inferior articular facet were 26.2 mm and 10.45 mm for right side and 17.6 mm and 10.47 mm for left side respectively.

Discussion

The atlas hold up the skull and privileged positioned in atlantoaxial complex. Instrumentation for stabilizing unstable spine is gradually increasing with newer surgical methods. That is why a detail anatomical knowledge regarding bones are becoming more essential now a days. Comparison of certain atlas parameters in before studies to the present study are noted in the Tables given below. It is clear that there is some difference in such values for various parameters. Due to racial difference this variation is perhaps to which the atlases belonged. Textbooks of anatomy describe racial

differences in bones, particularly the skull. it is therefore, not illogical to say that the differences noted above are due to racial differences in the atlas.

In the present study the length of superior articular facet of atlas was 20.25 mm on right side and 20.79 mm on left side. No statistically significant difference was found in length of superior articular facet of left and right side. The dimensions have been compared with that of other workers (Table 2). While Sengulet al⁸ has reported lower dimensions, findings of Konig et al⁹ and Gomez Olivencia et al¹⁰ show higher values. Our findings are comparable to that of Kaur et al¹¹ and Gosavi et al¹². Wood-jones F¹³ observed that dimensions of Europeans are larger in comparison to other races. in the present study most of the parameters observed on Indian subjects are shorter than that of European studies. These differences in the findings can be attributed to racial variations.

Table 2: Comparison of length of superior articular facets of atlas.

Author	Origin	Dimensions(mm)	
		Right	Left
Gupta et al	Indian	21.5	21.8
		22.7±3.0	22.8±4.2
Konig et al	German	22.7±3.0	22.8±4.2
Sengul et al	Turkish	19.9±3.4	18.6±3.2
Gomez olivencia et al	Spanish	23.7±1.8	23.5±1.7
Kaur et al	Indian	21.52	21.51
Gosavi et al	Indian	21.24	21.02
Present study	Bangladesh	20.25	20.79

In our study the transvers diameter of superior articular facet of atlas was 11.43 mm on the right side and 11.44 mm on the left side. No statistically significant difference was found in the dimensions of two sides. The findings are similar to most of previous studies (Table 3). The observations made by Sengual et al⁸ and Gomez-Olivencia et al.¹⁰ are lower than our study. Transarticular screw fixation has become one of the primary treatment options for cervical spine instability. The knowledge of the dimensions of superior articular facet can help in the safe planning of these screw placements.

Table 3: Comparison of transvers diameter of superior articular facets of atlas.

Author	Origin	Dimensions(mm)	
		Right	Left
Gupta et al	Indian	11.8	11.5
Konig et al	German	11.6±2.0	11.2±1.5
Sengul et al	Turkish	9.6±1.9	9.8±1.5
Gomez olivencia et al	Spanish	10.4±1.2	10.5±1.0
Kaur et al	Indian	11.21±1.47	11.32±1.53
Gosavi et al	Indian	10.36	10.47
Present study	Bangladesh	11.43	11.44

IAF had most of the length and transvers diameter in American and German population. The values of IAF in Spanish population correlated with the values in Indian population. European data for IAF was not available. The values were more or less similar in all Indian studies. In general the variation in SAF and IAF parameters for western population may be due to their heavy built and bigger stature which needs statistical verification. The parameter values of our present study when compared with Indian population were found more or less similar

Table 4: Comparison of length of inferior articular facets of atlas.

Author	Origin	Dimensions(mm)	
		Right	Left
Gupta et al	Indian	15.76	15.76
Konig et al	German	18.5±3.2	19.0±2.5
Sengul et al	Turkish	17.1±2.6	17.5±2.4
Gomez olivencia et al	Spanish	16.3±1.3	16.2±1.2
Kaur et al	Indian	17.54±1.5	17.7±1.6
Gosavi et al	Indian	16.57±1.91	16.50±1.67
Present study	Bangladesh	11.43	11.44

Table 5: Comparison of transvers diameter of inferior articular facets of atlas.

Author	Origin	Dimensions(mm)	
		Right	Left
Gupta et al	Indian	15.22	15.22
Konig et al	German	15.9±1.9	16.2±1.0
Sengul et al	Turkish	14.6±2.5	14.6±2.5
Gomez olivencia et al	Spanish	15.5±1.0	15.8±1.2
Kaur et al	Indian	14.99±1.65	14.94±1.51
Gosavi et al	Indian	14.01±1.93	14.42±1.67
Present study	Bangladesh	11.43	11.44

Conclusion

The difference of results between this study and other international studies could be due to racial differences. The particular study of dimensions of superior and inferior articular facets are helpful for instrumental fixation surgeries for the CVJ. The understanding of the dimensions of atlas can help in safe planning of these surgeries. This study will be useful for the anatomists, forensic experts, physical anthropologist, radiologists, neurosurgeons and orthopedic surgeons

References:

1. Bohlman HH. Acute fractures and dislocations of the cervical spine. J Bone and Joint Surgery 1979; 61-A(8): 1119-1141.
2. William M, Newell RLM, Collin P. The back: cervical vertebrae. In: Standring S, Ellis H, Haely JC, Johnson D, Williams A, Gray's Anatomy. 39th edition. Edinburg, London: Elsevier Churchill Livingstone; 2005: 742-746.
3. Landells CD, Peteghem KV. Fractures of the atlas: classification, treatment and morbidity. Spine 1988; 13(5): 450-452.
4. Bryce TH. Osteology the skeleton – Vertebral column. In: Schaffer EA, Symington J, Bryce TH, Editors. Quains elements of anatomy. 11th edition. London: Longmans Green and Co; 1915; 5-34.
5. Grant JCB. Cervical vertebrae. In: An atlas of anatomy by regions. 2nd edition.

- Baltimore, USA: The Williams and Wilkins Company; 1948: 268-274.
6. Cacciola F, Phalke U, Goel A. Vertebral artery in relationship to C1 –C2 vertebra: An anatomic study. *Neurology India*. 2004;52(2):178–84.
 7. Cattrysse E, Provyn S, Gagey O, Kool P, Clarys JP, Roy PV. In vitro three dimensional morphometry of the lateral atlantoaxial articular surfaces. *Spine*. 2008;33(14):1503-8.
 8. Sengul G, Kadioglu HH. Morphometric anatomy of the atlas and axis vertebrae. *Turk Neurosurg*. 2006; 16(2):69-76.
 9. Konig SA, Goldammer A, Vitzthum HE. Anatomical data on the craniocervical junction and their correlation with degenerative changes in 30 cadaveric specimens. *J Neurosurg Spine*. 2005;3:379-85
 10. Gomez-Olivencia A, Carretero JM, Arsuaga JL, Rodriguez-Garcia L, Garcia-Gonzalez R, Martinez I. Metric and morphological study of the upper cervical spine from Sima de los Huesos site (Sierra de Atapuerca, Burgos, Spain). *J Hum Evol*. 2007;53:6- 25.
 11. Kaur Jasveen, Grewal Harsimran, Singh Poonam, Kumar Ajay. Morphometric study of the articular facets of atlas and axis vertebrae. *Unique Journal of Medical and Dental Sciences*. 2014;02(02):83- 89.
 12. Shilpa N Gosavi, Vatsalaswamy P. Morphometric Study of the Atlas Vertebra using Manual Method. *Malaysian Orthopaedic Journal*. 2012;6(3):18-20. [15].
Wood-Jones F. The cervical vertebrae of the Australian native. *J. Anat*. 1938;72(3):411-5.