Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

Research

An Anthropometric Study of Inferior Articular Facet of Atlas Vertebra and its Clinical Significance

Fatima Begum[1], Harmeet Kaur[2], Nidhi Sharma[3], Sadakat Ali[4]

[1]**Assistant Professor,** Department of Anatomy, Muzaffarnagar Medical College, Muzaffarnagar, Uttar Pradesh, India.

[2]**Associate Professor,** Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, SGRRU, Dehradun, Uttarakhand, India.

[3]**Assistant Professor,** Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, SGRRU, Dehradun, Uttarakhand, India.

[4]**Professor and Head,** Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, SGRRU, Dehradun, Uttarakhand, India.

Corresponding author:
Dr. Harmeet Kaur
Address:-Department of Anatomy, SGRR Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India - 248001
Email:- drharmeetkaur6@gmail.com

Cite this paper as: Begum F, Kaur H, Sharma N, Ali S. (2024) An Anthropometric Study of Inferior Articular Facet of Atlas Vertebra and its Clinical Significance. Frontiers in Health Informatics, 13 (8), 2447-2452

ABSTRACT

Introduction: Atlas vertebra helps in complex biomechanical movements of the skull along with weight transmission of skull to spine. Vital centers of the medulla oblongata can get compressed by a dislocation or instability of the atlantoaxial joint. Recent developments in fixation technologies and minimally invasive surgical approaches have encouraged to knowing of various dimensions of atlas vertebrae which is very important for the development of instrumentation related to atlas vertebrae. **Aim**: To determine mean values of the following parameters bilaterally-Length of inferior articular facet (maximum Antero-Posterior (AP) Diameter), width of inferior articular facet (maximum transverse diameter). **Materials and Methods**: This morphometric study was conducted in Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, SGRRU, Dehradun, Uttarakhand, India; In the time period from year 2020 to 2024, and included a total 120 dry, adult human atlas vertebrae of unknown age and gender which were examined for width and length of inferior articular facet on each side, in various medical colleges of North India. All dimensions were measured in bilateral manner using Digital Vernier Calliper. **Results**: The mean length or AP dimension of the inferior articular facet on right and left side were 18.39 ±2.83 and 17.91 ±2.19 mm. respectively, the width or transverse dimension of the inferior articular facet on right and left side were 15.12±1.36 and 15.04±1.41mm. respectively. **Conclusion**: The observations of present study helps in improving understanding of bony dimensions of inferior articular facet of atlas vertebra which could facilitate diagnosis and preoperative planning of atlantoaxial joint dysfunction.

Keywords: Atlantoaxial joint, Dislocation, Medulla oblongata, Morphometry

Introduction – The 1st cervical vertebra is named the atlas, because it supports the globe of the head. It differs from all the other vertebrae in having no body and this is due to the fact that the centrum of the atlas has fused with the centrum of the second cervical vertebra or axis vertebra. In addition, atlas has no spine. The atlas vertebra has laterally two bulky masses. These lateral masses connected to each other by a short anterior arch in front, and by a long curved posterior arch behind, due to these arches forms a ring of bone. The atlanto-occipital joints are responsible for about one-half of all cervical flexion and extension. [1]. The odontoid process of Axis vertebra articulates with the oval facet in the midline of the posterior surface of the anterior arch of the atlas vertebra to form the median atlanto-axial joint [2]. The median Atlanto Axial joint produces rotatory movements of head. The Inferior articulating facet articulates with the superior articulating facet of axis bone to form lateral atlanto axial joint. The variety of this lateral joint is plane variety of synovial joint. The stability of the atlanto axial joint is maintained by transverse atlantal ligament, fibrous capsule, ligamentum nuchae and alar ligament. 40° is the normal range of atlanto axial rotation.[3] There is no intervertebral disc present between Occipital bone and atlas, also between C1 and C2. The Transverse process is formed by the fusion of costal element and transverse element. The transverse process of atlas has two roots, an anterior root and posterior root. The posterior root and anterior root connect by costo transverse bar. The foramen transversarium is bound in front by the anterior root and behind by posterior root. This foramen transversarium is the characteristic feature of cervical vertebra [4]. The second part of vertebral artery passes through the foramen transversarium along with vertebral vein and sympathetic nerves. The instability of atlantooccipital junction is caused by congenital anomalies, traumatic dislocation, rheumatoid arthritis, degenerative bone disease,[5] inflammatory or infectious diseases, neoplasm and as a complication after other surgical procedures like cervical laminectomy, decompression etc. The atlantoaxial instability is caused by odontoid fracture and C1-C2 injuries. The type 2 fracture of odontoid process is the most common cause of atlantoaxial instability and it has high mortality and morbidity. Various surgical procedures like posterior atlantoaxial fusion by Gallie and Brooks wire fixation, C1-C2 lateral mass pedicle screw fixation and C1-C2 lateral mass pars interarticularis screw fixation, Atlantoaxial trans-articular screw fixation, atlanto axial translaminar fixation, Halifax clamp fixation [6]. Graft and Cable technique and wiring are done for atlanto axial instability. Inspite of benefits provided by such kind of treatments there are risks notable from incorrect screw fixation. Due to incorrect fixation procedures, results vertebral artery, spinal and cranial nerves and spinal cord are more prone to damage. [7]

Therefore, morphometric measurements and observations are necessary for neurosurgeons, orthopaedicians and radiologists.

Materials and Methods: This morphometric study was conducted in Department of Anatomy, Shri Guru Ram Rai Institute of Medical and Health Sciences, SGRRU, Dehradun, Uttarakhand, India; In the time period from year 2020 to 2023, and included a total 120 dry, adult human atlas vertebrae of unknown age and gender which were examined for width and length of inferior articular facet on each side (right & left), in various medical colleges of North India. All dimensions were measured in bilateral manner using Digital Vernier Calliper (**fig .1**).

Inclusion & Exclusion Criteria - Human dry atlas vertebrae had inferior articular facet intact in all respects included in this study and Damaged Atlas vertebrae were excluded.

Fig 1-Instument used in study

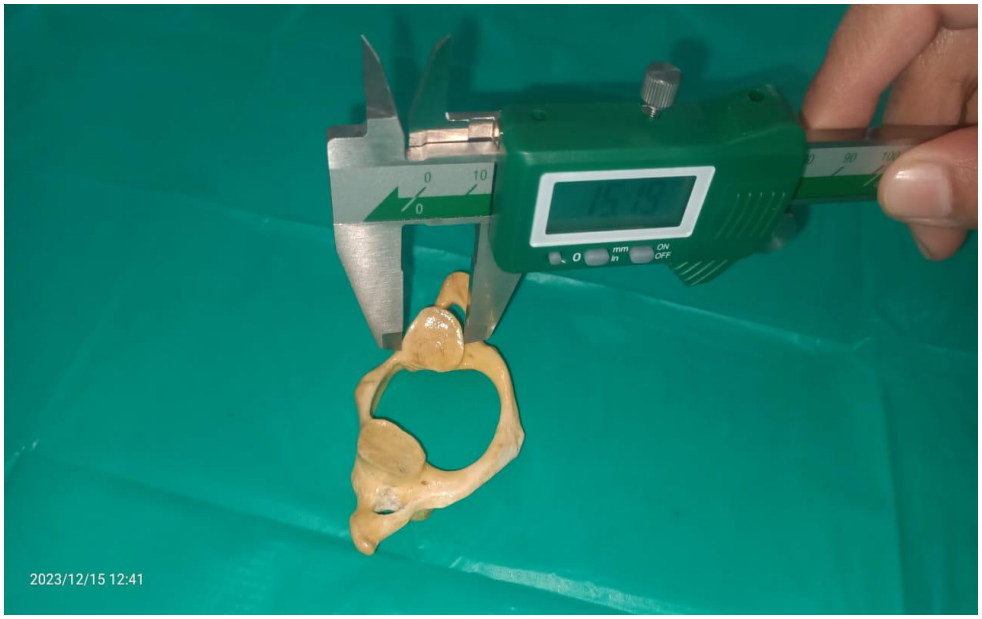

Fig 2- Examine the length of inferior articular facet with the help of bilateral manner using Digital Vernier Calliper

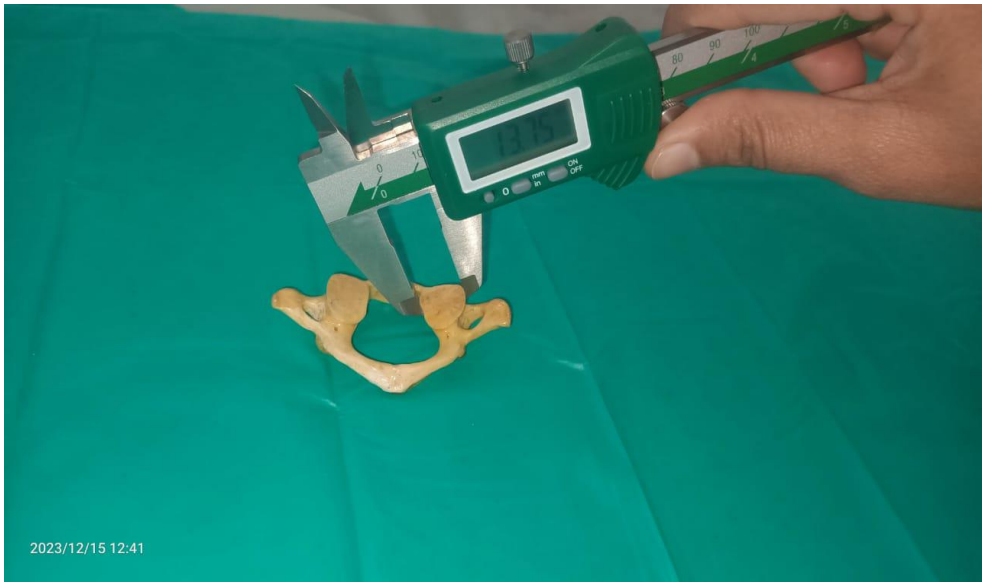

Fig 3 - Examine the width of inferior articular facet with the help of bilateral manner using Digital Vernier Calliper

Results & Discussion

The morphometric measurements like anteroposterior (Length) and transverse diameter (width) of the inferior articular facet were recorded and the mean value and standard deviation of the parameters was calculated (fig 2 & 3). The following morphometric analysis was done and recorded on Inferior articular facet.

Table 1- shows the range, mean value along with standard deviation of the morphometric parameters of the Inferior articular facet in dry adult human atlas vertebrae

Description of Parameter	Range	Mean (mm) & Standard deviation
Length of inferior articular facet (Right)	13.32 – 28.41	18.39 ±2.83
Length of inferior articular facet (Left)	13.57 – 28.11	17.91 ±2.19
Width of inferior articular facet (Right)	12.13 – 19.21	15.12 ±1.36
Width of inferior articular facet (Left)	12.25 – 19.2	15.04 ±1.41

The mean value of maximum antero- posterior diameter (Length) of the inferior articular facet on the right and left side was 18.39±2.83mm and 17.91±2.19mm respectively. The mean value of maximum transverse diameter of the right and left side of the inferior articular facet was 15.12±1.36mm and 15.04±1.41mm respectively.

Table 2- Comparison of Length (Maximum Antero-Posterior Diameter) of Inferior Articular Facet of atlas vertebrae with other authors.

AUTHOR	NUMBER OF ATLAS	ORIGIN	Anteroposterior Dimension (mm)	
			RIGHT	LEFT
Koing et al (2005)	30	German	18.5 ± 3.2	19.0 ± 2.5
Sengul et al (2006)	40	Turkish	17.1 ± 2.6	17.5 ± 2.4
Rocha et al (2007)	20	American	18.8 ± 1.7	18.7 ± 1.6
Cattrysse et al (2008)	20	Belgium	17.0 ± 1.8	16.6 ± 1.6
Gosavi and Vatsalaswamy (2012)	100	Indian	16.57 ± 1.91	16.50 ± 1.67
Patel N P (2015)	50	Indian	17.89±1.89	17.77±1.53
Rekha et al (2016)	100	Indian	17.99 ± 1.6	17.81 ± 2.3
Goyal N. et al (2021)	110	Indian	17.91±1.78	17.93±1.77
Present study (2023)	120	Indian	**18.39** ±2.83	**17.91** ±2.19

Table 3- Comparison of Width (Maximum Transverse Diameter) of Inferior Articular Facet of atlas vertebrae with other authors.

AUTHOR	NUMBER OF ATLAS	ORIGIN	Transverse Dimension (mm)	
			RIGHT	LEFT
Koing et al (2005)	30	German	15.9± 1.9	16.2±1.0
Sengul et al (2006)	40	Turkish	14.6±2.5	14.6±2.5
Rocha et al (2007)	20	American	16.6±2.0	16.4±2.0
Cattrysse et al (2008)	20	Belgium	16.9 ±1.6	17.2 ± 2.0
Gosavi and Vatsalaswamy (2012)	100	Indian	14.01±1.93	14.42±1.67
Patel N P (2015)	50	Indian	14.97±1.89	15±2.03
Rekha et al (2016)	100	Indian	14.84±1.3	14.49±1.8
Goyal N. et al (2021)	110	Indian	15.18±1.45	15.07±1.48
Present study (2023)	120	Indian	**15.12** ±1.36	**15.04** ±1.41

The length of the inferior articular facet on right and left side as 17.1 and 17.5 mm, the width of the inferior articular facet as 8.8 mm and 8.5mm. (SENGÜL and KADIOGLU, 2006).
While In Rekha et al. study the anteroposterior diameter of inferior articular facet of atlas was found to be 17.99 mm on the right side and 17.81 mm on the left side.Göksin Sengül results were, the mean length of the inferior articular facet on right and left side as 17.1 mm and 17.5 mm respectively, the width of the inferior articular facet on right and left side as 14.6 and 14.6 mm, The dimensions have been compared with that of other workers. While Sengul et al has reported lower dimensions, findings of Rocha et al and Koing et al show higher values. Our findings are comparable to that of Gosavi et al, Rekha et al, Goyal N et al and Patel NP.

Conclusion: The observations of present study helps in improving understanding of bony dimensions of inferior articular facet of atlas vertebrae which could facilitate diagnosis and preoperative planning of atlantoaxial joint dysfunction. This study may be helpful in improving the understanding and to decide safe location for different surgical methods and to facilitate preoperative planning and to avoid injury to vertebral artery and 1st cervical nerve. Morphometric measurements and observations are necessary for neurosurgeons, orthopaedicians and radiologists.

REFERENCES –

1. Schafer RC, Faye LJ. Motion Palpation and Chiropractic Technic.2nd ed. Huntington Beach, CA: Motion Palpation Institute; 1990.p. 426.
2. McGregor, A., Decker, G., Du Plessis, D. and Du Plessis, D. (1986). Lee McGregor's synopsis of surgical anatomy. 12th ed. Bristol: Wright.pp553.
3. Standring, S. and Gray, H. (2008). Gray's anatomy. 41st ed. [Edinburgh]: Churchill Livingstone/Elsevier. pp.720- 748.
4. Moore, K., Dalley, A. and Agur, A. (2006). Clinically oriented anatomy. 5th ed. Philadelphia: Lippincott Williams & Wilkins.pp482.
5. Awadalla, AM. andFetouh, FA. (2009). Morphometric analysis of the vertebral artery groove of the first cervical vertebra (atlas). Pan Arab Journal of Neurosurgery, 13(1), p.66-71.
6. Kim, D., Smith, V., Vaccaro, A., Dickman, C., Cho, D., Lee, S. and Kim, I. (2013). Surgical anatomy & techniques to the spine. 2nd ed. Elsevier Health Sciences. pp. 92-110 .
7. Lalit, M., Piplani, S., Arora, AK.,Kullar, JS. and Sharma, T. (2014). Incidence of atlas bridges and tunnels–their phylogeny, ontogeny and clinical implications. Revista Argentina de AnatomíaClínica, 6(1), pp.26-34.
8. 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.
9. Sengul, G. and Lu, HHK. (2006). Morphometric Anatomy of the Atlas and Axis Vertebrae. Turkish Neurosurgery, 16(2), p.69-76
10. Rocha R, Safavi-Abbasi S, Reis C, Theodore N, Bambakidis N, de Oliveira E, et al. Working area, safety zones, and angles of approach for posterior C-1 lateral mass screw placement: A quantitative anatomical and morphometric evaluation. J Neurosurg Spine 2007;6:247-54.
11. Cattrysse E, Provyn S, Gagey O, Kool P, Clarys JP, Van Roy P. In vitro three dimensional morphometry of the lateral atlantoaxial articular surfaces. Spine (Phila Pa 1976) 2008;33:1503-8.
12. Gosavi, SN., and Vatsalaswamy, P. (2012). Morphometric Study of the Atlas Vertebra using Manual Method. Malaysian Orthopaedic Journal, 6(3), p.18–20.
13. Rekha, BS. And Neginhal, DD. (2016). Variations in foramen transversarium of atlas vertebra: An osteological study in South Indians. Int J Res Health Sci, 2(1), pp.224-228.
14. Goyal N, Jain A: Variation of the superior articular facet of atlas and their significance. J Anat Soc India. 2021, 70:151-5.