International Journal of Anatomy and Research,
Int J Anat Res 2017, Vol 5(2.2):3829-32. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2017.194

Original Research Article

MORPHOMETRIC STUDY OF THE ARTICULAR FACETS OF ATLAS VERTEBRA IN NORTH INDIAN POPULATION

Kayalvizhi I, Bansal S, Dhidharia K, Narayan RK, Kumar P *.

Department of Anatomy, Pt. B. D. Sharma, PGIMS, Rohtak, Haryana, India.

ABSTRACT

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. 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.

Materialsand Methods: For the study of various metric parameters, 50 atlas vertebrae were used. Maximum anteroposterior (AP) and transverse (T) diameter of SAF and IAF were measured and the data were analyzed.

Discussion: SAF-AP: The average anteroposterior diameter of SAF on both the sides of atlas was maximum in European, American, Spanish and German population where as in Indian and Turkish population the values were less. SAF-T: The average transverse diameter of SAF was more or less similar in Indian, German, Turkish and Spanish population. IAF: IAF had maximum AP &T diameter in American and German population. The values of IAF in Spanish population correlated with the values in Indian population. The values were found more or less similar in all the Indian studies.

Results and Conclusion: The mean values obtained for all the parameters were more or less symmetrical. In the present study, the AP diameters of SAFs were less as compared to the western population. The values of AP & T diameter of IAF was also found less in Indian population. The knowledge of the dimensions of the SAF (AP - 20.25mm; T-10.93mm) and IAF (AP- 16.95mm; T- 14.95 mm) help in safe planning of the screw placement during CVJ surgery.

KEY WORDS: Cervical vertebrae, Atlas, Cranio-vertebral junction, Superior articular facets, Inferior articular facets.

Address for Correspondence: Dr Piyush Kumar, Department Of Anatomy, Pt. B. D. Sharma, PGIMS, Rohtak, Haryana, India. **E-Mail:** piyushkarnonline@gmail.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2017.194

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 20 Mar 2017
Peer Review: 21 Mar 2017
Revised: None

Accepted: 25 Apr 2017
Published (O): 31 May 2017
Published (P): 31 May 2017

INTRODUCTION

The first cervical vertebra, Atlas (C1) has different anatomical features from the other cervical vertebrae. The atlas holds the globe of the skull and is devoid of body and spine and is composed of an anterior arch and posterior arch with laterally projecting transverse processes which resemble an irregular ring: [1,2]. Due to this ring structure when fracture occurs there is disruption of the ring which results in segments that needs surgical repair.

C1 vertebra is an important part of bony anatomy of Cranio-vertebral Junction (CVJ). It has articular relationship with occiput and C2. CVJ surgery is an important part of spinal surgery, which requires knowledge regarding the

neuromuscular and musculoskeletal anatomy of this region [3].

The stability of the atlas is provided by two symmetrical lateral masses that are united by anterior and posterior arches. The posterior arch of the atlas forms about 3/5th of the atlantal ring. These lateral masses are thick, supportive elements composed of both superior and inferior articular facets. SAFs which are present on the atlas vertebrae face superomedially and are well known for nodding movements and for bearing the weight of the head. Inferior articular facets are flat and facing posteromedially [1,2,4].

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. Therefore reduction and rebuilding of the stability of this complex is important. A short segment posterior fixation technique is often adopted to preserve the motion of the CVJ.

This study is undertaken to assess the safe site for different surgical methods for which morphometric measurements of SAFs and IAFs are necessary. No such work has been done on this bone in North Indian Haryanvi population.

Various authors have attempted to study and throw some knowledge about the morphologic and morphometric details of atlas in European, Turkish, German, Spanish and American population. [4-9] Indian authors who have contributed to provide data for morphologic and morphometric parameters of atlas bone are Cacciola et al, Gosavi and Vatsalaswamy, Gupta et al, Jasveen Kaur et al and Rekha et al. [13-15].

MATERIALS AND METHODS

The present study was conducted in the Department of Anatomy, Pt. B.D Sharma Post Graduate Institute of Medical Sciences, Rohtak, India.

For the study of various metric parameters, 50 atlas vertebrae were used. These bones were retrieved from the Department of Anatomy, Pt. B.D Sharma PGIMS, Rohtak. Digital Vernier Calliper was used for measuring the parameters. The fractured atlas vertebrae and pathologically deformed atlas vertebrae were excluded from the study.

Measurements: For measuring the parameters of the bone reference points were obtained from published data of Naderi et al. [3]

Maximum Antero-posterior Diameter (length) of superior articular facet: Two points were taken, one on the anterior limit of SAF and other on its posterior limit then length was measured (in mm) along its principal axis directed anteromedially.

Maximum Transverse Diameter (width) of superior articular facet: Two points were taken, one on the medial limit of SAF and other on its lateral limit then width was measured (in mm) perpendicular to the principal axis.

Maximum Antero-posterior Diameter (length) of inferior articular facet: Two points were taken, one on the anterior limit of IAF and other on its posterior limit then length was measured (in mm) along its principal axis directed anteromedially.

Maximum Transverse Diameter (width) of inferior articular facet: Two points were taken, one on the medial limit of IAF and other on its lateral limit then width was measured (in mm) perpendicular to the principal axis.

All the measurements were subjected to statistical analysis. The mean, median, range and standard deviation obtained were tabulated and presented for all the parameters.

RESULTS

The parameters mentioned (vide supra) were analyzed and are shown in **Table I**:

Table 1: Showing the Parameters that were analyzed.

Parameter	St. deviation	Mean	Median	Min	Max	Paired t test value
Length of the SAF(L)	2.03	19.95	19.39	16.81	22.39	0.29
Length of the SAF(R)	1.91	20.56	20.88	16.9	22.71	
Width of the SAF(L)	2.79	10.66	10.27	7.84	16.18	0.17
Width of the SAF(R)	2.2	11.19	11.81	8.09	14.35	
Length of the IAF(L)	1.81	16.95	17.09	14.5	18.95	0.5
Length of the IAF(R)	1.18	16.95	16.53	15.68	18.91	
Width of the IAF(L)	3.83	14.73	15.1	6.83	19.26	0.15
Width of the IAF(R)	3.33	13.64	14.37	6.83	17.05	

Paired T-test was carried out for comparison of readings from right and left sides. When these parameters were subjected to paired t- test the difference was found to be statistically insignificant.

DISCUSSION

Few authors (Kandizora et al, Naderi et al, Cacciola et al and Gupta et al) have reported the results without considering the side (right / left) of facet. Their data was also considered for comparison in our study.

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

Author	Origin	Dimension	
		Right	Left
Kandziora et al (2001) [5]	European	25.3 ± 2.22	
Naderi et al (2003) [3]	Turkish	19.9 ± 2.4	
Koing et al (2005) [7]	German	22.7 ± 3.0	22.8 ± 4.2
Sengul et al (2006) [6]	Turkish	19.9 ± 3.4	18.6 ± 3.2
Gomez-Olivencia et al (2007) [11]	Spanish	23.7 ± 1.8	23.5 ± 1.7
Rocha et al (2007) [9]	American	23.9 ± 2.5	23.6 ± 2.5
Cacciola et al (2004) [13]	Indian	19.73	
Gosavi and Vatsalaswamy (2012) [11]	Indian	21.24 ± 2.39	21.02 ± 2.52
Gupta et al (2013) [10]	Indian	19.73	
Kaur et al (2014) [4]	Indian	21.52 ± 2.36	21.51 ± 2.07
Rekha et al (2016) [12]	Indian	22.33 ± 2.1	22.25 ± 2.1
Present Study	Indian	20.56 ± 1.91	19.95 ± 2.03

SAF-AP: The average anteroposterior diameter of SAF on both the sides of atlas was maximum in European, American, Spanish and German population where as in Indian and Turkish population the values were less than the above mentioned population.

Table 3: Comparison of Maximum Transverse Diameter of Superior Articular Facet of atlas.

Author	Origin	Dimension(mm)	
		Right	Left
Koing et al (2005) [7]	German	11.6 ± 2.0	11.2 ± 1.5
Sengul et al (2006) [6]	Turkish	9.6 ± 1.9	9.8 ± 1.5
Gomez-Olivencia et al (2007) [8]	Spanish	10.4 ± 1.2	10.5 ± 1.0
Cacciola et al (2004) [13]	Indian	11.12	
Gosavi and Vatsalaswamy (2012) [11]	Indian	10.36 ± 1.72	10.47 ± 1.61
Gupta et al(2013) [10]	Indian	11.12	
Kaur et al(2014) [4]	Indian	11.21 ± 1.47	11.32 ± 1.53
Rekha et al(2016) [12]	Indian	8.7 ± 2.0	9.6 ± 2.3
Present Study	Indian	11.19 ± 2.20	10.66 ± 2.79

SAF-T: The average transverse diameter of SAF was more or less similar in Indian, German, Turkish and Spanish population.

IAF: IAF had maximum AP & T 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 found more or less similar in all the Indian studies.

In general the variation in SAF & 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 Turkish population were found more or less similar.

Table 4: Comparison of Maximum Antero-Posterior Diameter of Inferior Articular Facet of atlas.

Author	Origin	Dimension	
		Right	Left
Koing et al (2005) [7]	German	18.5 ± 3.2	19.0 ± 2.5
Sengul et al (2006) [6]	Turkish	17.1 ± 2.6	17.5 ± 2.4
Gomez-Olivencia et al (2007) [8]	Spanish	16.3 ± 1.3	16.2 ± 1.2
Rocha et al (2007) [9]	American	18.8 ± 1.7	18.7 ± 1.6
Cattrysse et al (2008) [15]	Belgium	17.0 ± 1.8	16.6 ± 1.6
Cacciola et al (2004) [13]	Indian	15.76	
Gosavi and Vatsalaswamy (2012) [11]	Indian	16.57 ± 1.91	16.50 ± 1.67
Gupta et al(2013) [10]	Indian	15.76	
Kaur et al(2014) [4]	Indian	17.54 ± 1.5	17.7 ± 1.6
Rekha et al (2016) [12]	Indian	17.99 ± 1.6	17.81 ± 2.3
Present Study (2016)	Indian	16.95 ± 1.18	16.95 ± 1.81

Table 5: Comparison of Maximum Transverse Diameter of Inferior Articular Facet of atlas.

Author	Origin	Dimension	
		Right	Left
Koing et al (2005) [7]	German	15.9 ± 1.9	16.2 ± 1.0
Sengul et al (2006) [6]	Turkish	14.6 ± 2.5	14.6 ± 2.5
Gomez-Olivencia et al (2007) [8]	Spanish	15.5 ± 1.0	15.8 ± 1.2
Rocha et al (2007) [9]	American	16.6 ± 2.0	16.4 ± 2.0
Cattrysse et al(2008) [15]	Belgium	16.9 ± 1.6	17.2 ± 2.0
Cacciola et al (2004) [13]	Indian	15.22	
Gosavi and Vatsalaswamy (2012) [11]	Indian	14.01 ± 1.93	14.42 ± 1.67
Gupta et al (2013) [10]	Indian	15.22	
Kaur et al(2014) [4]	Indian	14.99 ± 1.65	14.94 ± 1.51
Rekha et al (2016) [12]	Indian	14.84 ± 1.3	14.49 ± 1.8
Present Study (2016)	Indian	13.64 ± 3.32	14.72 ± 3.83

CONCLUSION

In the present study, the AP diameters of SAFs were less as compared to the western population. The values of AP & T diameter of IAF was also found less in Indian population. The knowledge of the dimensions of the SAF (AP-20.25mm, T-10.93mm) and IAF (AP- 16.95mm, T- 14.95 mm) help in safe planning of the screw placement during CVJ surgery.

Conflicts of Interests: None

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]. Naderi S, Cakmakc H, Acar F, Arman C, Metrol T, Arda MN. Anatomical and computed tomographic analysis of C1 vertebra. Clin Neurol Neurosurg. 2003;105:245-8.
[4]. Kaur J, Grewal H, Singh P, Kumar A. Morphometric study of the articular facets of atlas and axis vertebrae. UJMDS. 2014;02(02):83-9.
[5]. Kandziora F, Schulze-Stahl N, Khodadadyan-Klostermann C, Schroder R, Mittlmeier T. Screw placement in transoral atlantoaxial plate systems: an anatomical study. J Neurosurg (Spine). 2001July;95:80-7.
[6]. Senegul G, Kodiglu HH. Morphometric anatomy of atlas and axis vertebra. Turkish Neurosurgery. 2006;16(2):69–76.
[7]. 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 Nov;3:379-85.
[8]. 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.
[9]. 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 C1 lateral mass screw placement: a quantitative anatomical and morphometric evaluation. J Neurosurg Spine. 2007;6(3):247-54.
[10]. Gupta S, Goel A. Quantitative anatomy of the lateral masses of the atlas and axis vertebrae. Neurol India. 2000;48:120-5.
[11]. Gosavi SN and Vatsalaswamy P. Morphometric Study of the Atlas Vertebra using Manual Method. Malays Orthop J. 2012;(6)3-18-20.
[12]. Rekha BS, Divya Shanthi D'Sa. Morphometric Anatomy of the atlas(C1) Vertebra among Karnataka population in India. Int J Anat Res. 2016;4(1):1981-4.
[13]. Cacciola F, Phalke U, Goel A. Vertebral artery in relationship to C1 –C2 vertebra: An anatomic study.Neurology India. 2004;52(2):178–84.
[14]. Lalit M., Piplani S, Kullar JS, Arora AK, Mannan R. The Morphological Analysis of the Superior Articular Facet of the adult Human Atlas vertebra. Journal of Clinical and Diagnostic Research. 2011; 5(2):274-7.
[15]. 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.

How to cite this article:

Kayalvizhi I, Bansal S, Dhidharia K, Narayan RK, Kumar P. MORPHOMETRIC STUDY OF THE ARTICULAR FACETS OF ATLAS VERTEBRA IN NORTH INDIAN POPULATION. Int J Anat Res 2017;5(2.2):3829-3832. **DOI:** 10.16965/ijar.2017.194