Original Research Article

Morphometric analysis of axis vertebra on MRI

Pathan F J[1*], Rubeena Hashmi[2]

{[1]Associate Professor, Department of Anatomy} {[2]Senior Resident, Department of OBGY} MIMSR Medical College, Latur, Maharashtra.
Email: drferoz07@rediffmail.com

Abstract

Background: Features of the axis vertebra are atypical with respect to shape and its anatomical and biomechanical properties are unique. The cervical region and lumbar region are most prone for orthopedic problems **Aims and Objectives:** to study morphometric Analysis of Axis Vertebra on MRI. **Methodology:** This was a cross-sectional study carried out in the apparently normal individuals undergone MRI for neck included into the study over a six month period i.e. January 2018 to June 2018 in the six month period 50 males and 50 females were included into study. In this all of the individuals undergone MRI of neck with standard protocols. The data entered excel sheets and analyzed by un-paired t-test calculated by SPSS 19 version software. **Result:** In males the Body of Axis the mean±SD in mm - AP diameter was -13.2± 0.42; Transverse was 17.96±0.87; Ant. height was 9.64± 0.38; Post. Height was 9.06± 0.56. In Dense axis it was, AP diameter -7.61 ±0.19, Transverse- 7.60 ± 0.20; Vertical-15.79 ± 0.87; Vertebral canal–AP Was 12.40 ± 0.55, Transverse was 18.64 ± 0.77. In Females the Body of Axis the mean±SD in mm - AP diameter was -13.17± 0.59; Transverse was 18.01±0.94; Ant. height was 9.37± 0.59; Post. Height was 8.88± 0. 58. In Dense axis it was, AP diameter -7.50 ±0.29, Transverse- 7.55 ± 0.42; Vertical-15.41 ± 1.02; Vertebral canal – AP Was 11.99 ± 0.94, Transverse was 18.30 ± 1.31. In the morphometric analysis the all parameters of Body Axis like – AP diameter($t=0.29, df=98, p>0.05$), Transverse diameter($t=0.62, df=98, p>0.05$), Ant. Height ($t=0.72, df=98, p>0.05$), Post. Height($t=1.49, df=98, p>0.05$); Dense of axis-AP($t=0.19, df=98, p<0.05$), Transverse($t=0.82, df=98, p<0.05$), Vertical ($t=1.23, df=98, p>0.05$) Vertebral canal- Transverse($t=1.19, df=98, p>0.05$) were comparable with each other except Vertebral canal AP diameter where it was more among the males as compared to females ($*t=2.59, df=98, p<0.01$) **Conclusion:** Morphometric Analysis of Axis Vertebra is useful for as reference in the cervical surgeries and for the diagnosis of orthopedic problems of neck in that morphology of axis vertebra is crucial and is very useful.

Key Word: Axis Vertebra, MRI, Morphometry.

***Address for Correspondence:**
Dr. Pathan F J, Associate Professor, Department of Anatomy, MIMSR Medical College, Latur, Maharashtra.
Email: drferoz07@rediffmail.com

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INTRODUCTION

Features of the axis vertebra are atypical with respect to shape and its anatomical and biomechanical properties are unique. The cervical region and lumbar region are most prone for orthopedic problems[1]. The fractures of the dens axis is common as the third of all cervical vertebrae fractures[2,3]. However, surgeries in this region are highly risky for possible damage to aorta or other adjacent vital structures [4,6]. Thus the dimensions of instrumentations and their insertion need to respect anatomical features of the vertebra. Not only for treatment of vertebral diseases and instabilities, but also for diagnoses, the knowledge of the exact vertebral dimensions is crucial. As the ethnical variation in the vertebral dimensions has been reported, it is also necessary to distinguish the patient origin[7,9]. For this reason we have Morphometric Analysis of Axis Vertebra on MRI

METHODOLOGY

This was a cross-sectional study carried out in the apparently normal individuals undergone MRI for neck included into the study over a six month period i.e. January 2018 to June 2018 in the six month period 50 males and 50 females were included into study. In this all of the individuals undergone MRI of neck with standard protocols. In the MRI findings we have done morphometric analysis of Axis Vertebra with respect to Body Axis–AP and Transverse diameter, Ant. height ,Post. Height; Dense of axis –AP, Transverse diameter, Vertical height; Vertebral canal–AP and Transverse diameter etc. the data entered excel sheets and analyzed by un-paired t-test calculated by SPSS 19 version software.

RESULT

Table 1: Morphometric analysis of Axis Vertebra in the male patients

	Body Axis				Dense axis			Vertebral canal	
	Type of diameter in mm				Type of diameter in mm			Type of diameter in mm	
	AP	Transverse	Ant. height	Post. Height	AP	Transverse	Vertical	AP	Transverse
Mean	13.2	17.96	9.64	9.06	7.61	7.60	15.79	12.40	18.64
SD	0.42	0.87	0.38	0.56	0.19	0.20	0.87	0.55	0.77
Max	14.2	19.6	10.2	9.8	7.9	8	17.2	13.2	20.2
Min	12.3	16.5	8.5	7.9	7.1	7.3	14.1	10.5	17.6

In males the Body of Axis the mean±SD in mm - AP diameter was -13.2± 0.42; Transverse was 17.96±0.87; Ant. height was 9.64± 0.38; Post. Height was 9.06± 0.56. In Dense axis it was, AP diameter -7.61 ±0.19, Transverse- 7.60 ± 0.20; Vertical-15.79 ± 0.87; Vertebral canal–AP Was 12.40 ± 0.55, Transverse was 18.64 ± 0.77

Table 2: Morphometric analysis of Axis Vertebra in the female patients

	Body Axis				Dense of axis			Vertebral canal	
	Type of diameter in mm				Type of diameter in mm			Type of diameter in mm	
	AP	Transverse	Ant. height	Post. Height	AP	Transverse	Vertical	AP	Transverse
Mean	13.17	18.01	9.37	8.88	7.50	7.55	15.41	11.99	18.30
SD	0.59	0.94	0.59	0.58	0.29	0.42	1.02	0.94	1.31
Max	14.1	19.3	10	9.6	8.4	9.1	17.4	14.6	20
Min	11.6	16.1	7.4	7.8	7.1	7.1	13.8	9.7	13.7

In Females the Body of Axis the mean±SD in mm - AP diameter was -13.17± 0.59; Transverse was 18.01±0.94; Ant. height was 9.37± 0.59; Post. Height was 8.88± 0.58. In Dense axis it was, AP diameter -7.50 ±0.29, Transverse- 7.55 ± 0.42; Vertical-15.41 ± 1.02; Vertebral canal – AP Was 11.99 ± 0.94, Transverse was 18.30 ± 1.31.

Table 3: Comparison of the morphometric parameters in Males and Females

	Body Axis				Dense of axis			Vertebral canal	
	Type of diameter in mm				Type of diameter in mm			Type of diameter in mm	
	AP	**Transverse**	**Ant. height**	**Post. Height**	**AP**	**Transverse**	**Vertical**	**AP**	**Transverse**
Male (n=50)	**13.2±0.42**	**17.63±0.87**	**9.63±0.38**	**9.05±0.56**	**7.61±0.19**	**7.59±0.20**	**15.79±0 .87**	**12.39±0. 55**	**18.64±0.77**
Female (n=50)	**13.17±0.59**	**18.01±0.94**	**9.37±0.59**	**8.88±0.58**	**7.50±0.29**	**7.55±0.42**	**15.41±1 .02**	**11.99±0. 94**	**18.30±1.31**
p-value (unpaired t-test)	**t=0.29,df= 98,p>0.05**	**t=0.62,df= 98,p>0.05**	**t=0.72,df= 98,p>0.05**	**t=1.49,df= 98,p>0.05**	**t=0.19,df= 98,p<0.05**	**t=0.82,df= 98,p<0.05**	**t=1.23, df=98,p >0.05**	***t=2.59,d f=98,p<0. 01**	**t=1.19,df=98,p>0. 05**

In the morphometric analysis the all parameters of Body Axis like – AP diameter(t=0.29,df=98,p>0.05), Transverse iameter(t=0.62,df=98,p>0.05), Ant. Height (t=0.72,df=98,p>0.05) , Post. Height(t=1.49,df=98,p>0.05) ; Dense of axis-AP(t=0.19,df=98,p<0.05),Transverse(t=0.82,df=98,p<0.05),Vertical(t=1.23,df=98,p>0.05)VertebralcanalTransverse(t=1.19,df=98,p>0.05) were comparable with each other except Vertebral canal AP diameter where it was more among the males as compared to females (*t=2.59,df=98,p<0.01)

DISCUSSION

Axis vertebra has various distinct anatomical features like dens or odontoid process, two lateral masses with obliquely oriented articulating facets, transverse processes with foramina transversarium d spinous process. It is related to various vital□and a usually bi structures like the cervico-medullary junction, cranial nerves, cervical spinal nerve roots and vertebral arteries. Various pathological processes like congenital skeletal dysplasias, trauma, infection, neoplasm etc. affect the axis vertebra[9-15]The morphological characteristics of axis vertebra are crucial in managing various pathologies of the craniovertebral junction[16].Various anatomical features of axis vertebra make it unique and hence variations in morphological parameters assume importance. Varied surgical procedures are performed to address the pathologies of the craniovertebral junction such as interlaminal clamping, interspinous xation etc. wiring, plate and screw In our study we have seen that In males the Body of Axis the mean±SD in mm - AP diameter was -13.2± 0.42; Transverse was 17.96±0.87; Ant. height was 9.64± 0.38; Post. Height was 9.06± 0.56. and in In Females the Body of Axis the mean±SD in mm-AP diameter was -13.17± 0.59; Transverse was 18.01±0.94; Ant. height was 9.37± 0.59; Post. Height was 8.88± 0.58. In the study by Sneha et al found the mean height of body of axis vertebra was 16.33+1.76mm, being 16.93+1.63 mm in males and 15.8+1.7mm in females. Singla et al. found that the mean anterior height of body of axis was 19.67 mm[17]. Lang[18] measured the same parameter with its value 22.1mm and Lu et al.,[19] found this parameter as 20.4 mm. In our study, the mean height of body of axis vertebra was16.33+1.76 mm, which is less than that found in previous studies In males Dense axis it was, AP diameter -7.61 ±0.19, Transverse- 7.60 ± 0.20; Vertical-15.79 ± 0.87; Vertebral canal – AP Was 12.40 ± 0.55, Transverse was 18.64 ± 0.77 In females Dense axis it was, AP diameter -7.50 ±0.29, Transverse- 7.55 ± 0.42; Vertical-15.41 ± 1.02; Vertebral canal – AP Was 11.99 ± 0.94, Transverse was 18.30 ± 1.31. In study by Sneha [20] et al found the mean AP and transverse diameter of dens was 10.82 +0.99 mm and 9.8 +1.25 mm respectively, being 11.1+0.81 mm and 10.15 +1.41 mm in males and 10.58 +1.07 mm and 9.50 +1.02 mm in females respectively. The number of subjects who had the minimum transverse diameter less than 9 mm were 35 % [10 males (21.7%), 25 females cantly more in females (p=0.01). The number of (46.2 %)] being significant subjects having minimum transverse diameter less than 7.4 mm were 2 % [0 males, 2 females (3.7 %)].In the morphometric analysis the all parameters of BodyAxislikediameter(t=0.29,df=98,p>0.05),Transversediameter(t=0.62,df=98,p>0.05),Ant.Height(t=0.72,df=98,p>0.05),Post.Height(t=1.49,df=98,p>0.05);DenseofaxisAP(t=0.19,df=98,p<0.05),ransverse(t=0.82,df=98,p<0.05),Verticalt=1.23,df=98,p>0.05) Vertebral canal-Transverse(t=1.19,df=98,p>0.05) were comparable with each other except Vertebral canal AP diameter where it was more among the males as compared to females (*t=2.59,df=98,p<0.01) Except Vertebral canal-Transverse all other parameters in males and Females in our study were comparable this could be due to the geographic variation in the individuals.

CONCLUSION

Morphometric Analysis of Axis Vertebra is useful for as reference in the cervical surgeries and for the diagnosis of orthopedic problems of neck in that morphology of axis vertebra is crucial and is very useful

REFERENCES

1. Mayer F, Börm W, Hom« C (2008) Degenerative cervical spinal stenosis. Dtsch Arztebl Int 105: 366-372.
2. Clark CR, White AA (1985) Fractures of the dens: A multicentre study. J Bone Joint Surg Am 56: 1340-1348.
3. Ochoa G (2005) Surgical management of odontoid fractures. Injury 36: 54-64.
4. Madawi AA, Case ATH, Solanki GA, Tuite G, Veres R, et al. (1997) Radiological and anatomical evaluation of the atlantoaxial transarticular screw fixation technique. J Neurosurg 86: 961-68.
5. Wrigth NM, Lauryssen C (1998) Vertebral artery injury in C1-2 tran sarticular screw fixation Results of a survey of the AANS/CNS section on disorders of the spine and peripheral nerves. J Neurosurg 88: 634-640.
6. Gupta S, Goel A (2000) Quantitative anatomy of the lateral masses of the atlas and axis vertebrae. Neurol India 48: 120-125.
7. Tan SH, Teo EC, Chua HC (2004) Quantitative three-dimensional anatomy of cervical, thoracic and lumbar vertebrae of Chinese Singaporeans. Eur Spine J 13: 137-146.
8. Yusof MI, Ming LK, Abdullah MS (2007) Computed tomographic measurement of cervical pedicles for transpedicular fixation in a Malay population. J Orthop Surg 15: 187-190.
9. Chen C, Ruan D, Wu C, Wu W, Sun P, et al. (2013) CT morphometric analysis to determine the anatomical basis for the use of transpedicular screws during reconstruction and fixation of anterior cervical vertebrae. PLoS ONE 8: e81159
10. Smoker WR. Craniovertebral junction: normal anatomy, craniometry, and congenital anomalies. Radiographics. 1994 Mar;14(2):255-77.
11. Offiah & Day, E Of & Day, E. Insights Imaging (2017) 8: 29. doi:10.1007/s13244-016-0530-5
12. Elena Serchi, Saul F. Morales-Valero, Jeremy Fogelson. (2014) Pathology of the Craniovertebral Junction. Contemporary Neurosurgery 36:19, 1-7
13. Jain N, Verma R, Garga UC, Baruah BP, Jain SK, Bhaskar SN. CT and MR imaging of odontoid abnormalities: Apictorial review. Indian J Radiol Imaging 2016;26:108-19
14. Dhadve RU, Garge SS, Vyas PD, et al. Multidetector Computed Tomography and Magnetic Resonance Imaging Evaluation of Craniovertebral junction Abnormalities. North American Journal of Medical Sciences. 2015; 7(8):362-367.
15. Doherty BJ, Heggeness MH. Quantitative anatomy of second cervical vertebra. Spine. 1995; 20(5):513–17.
16. Doherty BJ, Heggeness MH. Quantitative anatomy of second cervical vertebra. Spine. 1995; 20(5):513–17
17. Singla M, Goel P, Ansari MS, Ravi KS, Khare S. Morphometric Analysis of Axis and Its cance -An Anatomical Study of Indian Human Axis Vertebrae.

Journal of Clinical Signi Clinical and Diagnostic Research: JCDR. 2015; 9(5):AC04-AC09.
18. Lang J. Skull Base and Related Structures. 1st ed. Stuttgart: Schattauer; 1995. p. 292.
19. Lu J, Ebraheim NA, Yang H, et al. Anatomic considerations of anterior transarticular xation for atlantoaxial instability. Spine. 1998; 23(11):1229–35.
20. Sneha Rohit Pai et al. Morphometric Analysis Of The Axis Vertebra In Indian Population: Manoeuvring Through The Craniovertebral Junction. International Journal of Scientific Research JULY-2017; 6 (7) : 580-583.

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