Original Article

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Morphometric Analysis of the Human Second Cervical Vertebrae of North Indian Population

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Abstract

Introduction: The Aim of the study was to provide the morphometric measurement of the axis vertebrae in North Indian popuulation. Which could be used as clinical tool to determine the feasibility of safe translaminar screw placement. **Subjects and Methods**: 50 dry human axis vertebrae from adult North Indian population were subjected to morphometric measurement using venier caliper. The various dimensions of the axis vertebrae were observed. **Results:** There is high variability in the thickness of the C2 lamina. As compared to western population, the axis bones used in the present study had smaller profiles. **Conclusion:** The current study showed safety margin for translaminar screw insertion is low.

Keywords: Axis fixation, surgical guide, anatomy axis.

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Introduction

The unique mechanical assembly of human spine is depicted by its complex anatomical structure and function. This complex anatomical assembly protects spinal cord and nerve roots with an additional function of providing flexibility. This transmits the upper body weight to pelvis, and in due course is subjected to internal stresses and is therefore vulnerable to various congenital defects, traumatic injuries, infectious and degenerative pathologies. The cervical problem and injuries are very common in today's life style and often requires surgical intervention. However, surgeries in this region are highly risky for possible damage to aorta or other adjacent vital structures.

Among other cervical vertebrae first and second cervical vertebrae, namely the atlas and the axis, have peculiar anatomical features The second cervical vertebra (axis) features an atypical shape and both its anatomical and biomechanical properties are unique. The axis is unique in possessing a dens or odontoid process and very specialized superior articular facets. It acts as an axle for rotation of the atlas and the head around the strong dens. It is also reported that the fractures of the dens axis account for nearly the third of cervical vertebrae fractures. Like other skeletal dimensions the axis vertebrae morphology also shows variation with ethnicity and race. A good understanding of the exact dimensions and shape of axis vertebrae is crucial not only for the evaluation of treatment and instabilities, but also for diagnoses and exact vertebral dimensions.

Therefore this study was undertaken to study the morphometry of human axis vertebrae in subjects of North Indian origin.

Subjects and Methods

The study was conducted at Darbhanga Medical College and Hospital, Laheriasarai. The study was approved by institutional research committee. 50 dried human axis vertebrae of unknown sex collected from the Departments of Anatomy, Darbhanga Medical College and Hospital, Laheriasarai and were examined. All the specimens were completely dry and intact. The vertebrae with osteophytes and pathology were excluded from the study.

Various dimensions were measured with the help of Vernier Calipers and metric scale. The symmetrical structures were measured bilaterally and mean values were taken. The caliper had a depth gauge, which was used to measure the height of foramen transversarium accurately. All measurements were done by a same observer.

The observed data was subjected to statistical analysis using SPSS (Statistical Package for Social Sciences) software (Version 10.).

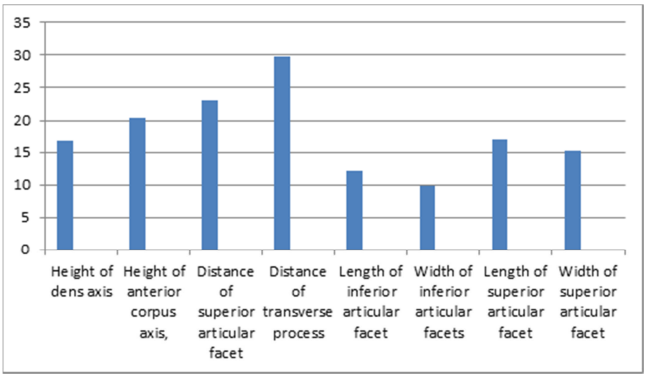
Results & Discussion

This study aims to evaluate the various dimensions of the second cervical vertebrae quantitatively and the Mean

values, S.D. and Range is shown in the [Table 1 & Figure 1].

Table 1: shows the Mean Values, S.D. and Range of the various dimensions of axis vertebrae.

	Mean	S.D.	Maximum	Minimum
Width of dens axis	9.2	7.54	10.37	7.7
Height of dens axis	16.7	1.66	19.98	13.89
Height of anterior corpus axis,	20.4	1.46	19.3	18.33
Distance of superior articular facet	23.15	2.08	29.27	19.61
Distance of transverse process	29.83	3.75	36.82	21.2
Length of inferior articular facet	12.22	1.66	17.09	8.25
Width of inferior articular facets	9.75	1.38	11.55	6.73
Length of superior articular facet	17	1.45	20.29	13.8
Width of superior articular facet	15.2	1.31	17.9	12.95



Metrical details of the axis vertebra are important for several surgical procedures. Various studies have given a similar and comparable data with respect to axis vertebrae with a few studies having higher values for the same. The variations seen in the different parameters are perhaps due to the difference in the ethnicities to which these vertebrae belonged in various studies.

Posterior transarticular fixation at the level of Superior Articular Facet of axis and Inferior Articular Facet of atlas provides rigidity as well as preserves motion between atlanto-occipital joint. This procedure is advantageous in situations such as significant disruption of C1 posterior arch, canal comprise, posterior subluxation and congenital anomalies. For the locations of points of screw insertion on the Superior Articular Facet the knowledge of its dimensions is necessary.

The superior articular facets of the axis vertebra differ from the facets of all other cervical vertebrae in two important ways, which make this region especially prone to vertebral artery injury during screw fixation. First, these facets in the axis are present in the proximity of the body when compared with vertebrae where they are located close to the lamina. Second, the foramen transversarium of the axis is partially or completely present on the inferior surface of the superior articular facet, while in other cervical vertebrae this foramen is very closely related to the transverse process (Cacciola et al., 2004).

This study in addition to determining safe sites for different surgical procedures such as interlaminar clamp, interspinous wiring, plate and screw fixations to correct the instability of the atlantoaxial complex or occipito-cervical junction and trans-articular and transpedicular screws fixation in stabilizing the cervical column, caused by numerous traumatic and non-traumatic conditions as incorrect insertion of pedicle screws can cause damage to adjacent vital structures such as spinal cord, nerve roots, cranial nerves and vertebral arteries. A further studies may be conducted to analyse and differentiate the gender difference if any, and this may be of value for forensic experts.

Conclusion

This study in addition to determining safe sites for different surgical procedures such as interlaminar clamp, interspinous wiring, plate and screw fixations to correct the instability of the atlantoaxial complex or occipito-cervical junction and trans-articular and transpedicular screws fixation in stabilizing the cervical column, caused by numerous traumatic and non-traumatic conditions as incorrect insertion of pedicle screws can cause damage to adjacent vital structures such as spinal cord, nerve roots, cranial nerves and vertebral arteries. Significance of the work lies in the fact that transverse diameter of atlas, height of dens of axis as well as antero-posterior diameter, if they are greater the gender may be categorized as male whereas if these diameters are smaller the sex may be female.

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