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Original Research Article

A morphomertic study of dry human typical thoracic vertebral body in coastal region, Andhra Pradesh

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ABSTRACT

Background: The frequent surgical interventions of the thoracic spine are more common due to a wide array of traumatic, degenerative, and neoplastic diseases. For successful surgical management of these conditions, detailed anatomical knowledge of the thoracic vertebrae is required. Previous studies in the past about morphometry of thoracic vertebrae mainly focused on pedicle diameters and their angulations. The vertebral body was not studied particularly in the coastal region, Andhra Pradesh which is the reason the present study has given importance to the morphometry of the vertebral body. Aim was to measure the various parameters of the vertebral body in typical thoracic vertebrae.
Methods: 82 dry human typical thoracic vertebrae from the department of anatomy, Andhra Medical College, Visakhapatnam were studied for the various morphometric parameters.
Results: The antero posterior distance of the vertebral body in typical thoracic vertebrae ranged from 14.5-27.5 mm with a mean of 21.77 mm. The vertebral body superior transverse diameter ranged from 18.1-38.7 mm with a mean of 28.22 mm. The vertebral body inferior transverse diameter ranged from 22.6-41.2 mm with a mean of 31.3 mm. The anterior height of the body ranged from 10.2-24.1 mm with a mean of 18.17 mm. The right and left lateral height of the body ranged from 9.0-24.7 mm with a mean of 18.4 mm.
Conclusions: The results provide information for more accurate modelling and design of vertebral body implants and instrumentations for the Indian population.

Keywords: Anteroposterior distance, Inferior transverse diameter, Superior transverse diameter, Vertebral body

INTRODUCTION

The adult vertebral column (also called the spine or spinal column) usually consists of 33 vertebral segments-7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal. The functions of the column are to support the trunk, to protect the spinal cord and nerves, and to provide attachments for muscles. It is also an important site of haematopoiesis throughout life.[1] The vertebral bodies and the intervertebral discs form an important column in transmission of weight of the body. In the upper thoracic region, due to the anterior curvature, the main part of the compressive force is transmitted through the anterior column formed vertebral body and intervertebral disc, with resulting increased stress.[2]

All vertebrae begin ossification in the embryonic period of development around 8 weeks of gestation. They ossify from three primary ossification centers: one in the endochondral centrum (which will develop into the vertebral body) and one in each neural process (which will develop into the pedicles). This begins at the thoracolumbar junction and proceeds in the cranial and caudal directions. The neural processes fuse with the

centrum in between three and six years of age. During puberty, five secondary ossification centers develop at the tip of the spinous process and both transverse processes and on the superior and inferior surfaces of the vertebral body. The ossification centers on the vertebral body are responsible for the superior-inferior growth of the vertebrae. Ossification completes around the age of 25.[3]

The previously done morphometric studies have helped in the design of a vast array of implants and surgical approaches. Vertebral morphometry is a quantitative method used to identify osteoporotic vertebral fractures and relies on the measurement of distinct vertebral dimensions, calculating relative changes.[4]

In the present study we are measuring the anteroposterior distance, superior and inferior transverse diameter, anterior height, right and left lateral height using digital vernier callipers. Any alterations in the morphometry of the body of the vertebrae can cause spinal cord compression leading to mild/severe symptoms in the patient. In general, information regarding the precise dimensions of the typical thoracic vertebrae is essential for spinal surgery and instrumentation.[5] In surgical procedures, a combination of both biologic (bone graft) and prosthetic materials are used.[6] Comprehensive assessments of the morphometric features of the vertebrae components are required to guide all of these procedures, including the very delicate ones as they will enhance preclinical evaluation of spinal implants and serve as a necessary step to ensure their reliability and safety before implantation.[7]

Hence a knowledge about the morphometry of the vertebral body and their variations would be of immense help to the treating neurosurgeons, orthopedicians and spinal surgeons.

METHODS

Type of study

It was a cross sectional observational study.

The study was conducted on dry human typical thoracic vertebrae, obtained from the bone collection of the Department of Anatomy, Andhra Medical College, Visakhapatnam, costal region, Andhra Pradesh. 82 undamaged typical thoracic vertebrae were selected for the study. The vertebrae were of undetermined gender and age. Each vertebra was assigned a serial number. Anatomical measurements were taken on these specimens using a digital vernier caliper.

Inclusion criteria

Dried thoracic vertebrae from the osteology section of department of anatomy, Andhra medical college, Visakhapatnam.

Exclusion criteria

Damaged thoracic vertebrae were not included.

The following parameters were recorded in a proforma:

Anteroposterior distance of the vertebral body- It is the distance between the anterior border and posterior border of the superior surface of the vertebral body in the midline (Figure 1A).

Superior transverse diameter of the vertebral body - It is the maximum transverse diameter of the vertebral body at the superior surface (Figure 1B).

Inferior transverse diameter of the vertebral body - It is the maximum transverse diameter of the vertebral body at the inferior surface (Figure 1C).

Anterior height of the body- It is the vertical distance between the superior and inferior surface of the body in the midline anteriorly (Figure 1E).

Right and left lateral height of the body- It is the vertical distance between the superior and inferior surface of the body on the lateral side of the vertebra (Figure 1D).

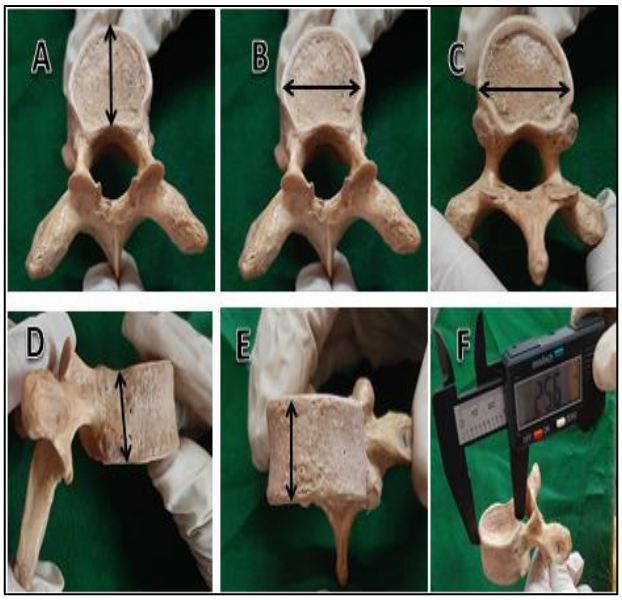

Figure 1: Various measurements taken on the vertebral body: A) anteroposterior distance; B) superior transverse diameter; C) inferior transverse diameter; D) right and left lateral diameter; E) anterior height; F) measurement with digital Vernier callipers.

RESULTS

The anteroposterior distance of the vertebral body ranged from 14.5-27.5 mm with a mean of 21.77 mm (Figure 2).

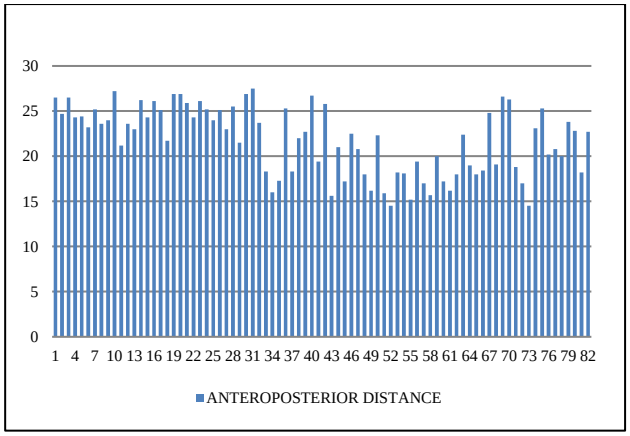

Figure 2: Anteroposterior distance.

Superior transverse diameter of the vertebral body ranged from 18.1-38.7 mm with a mean of 28.22 mm.

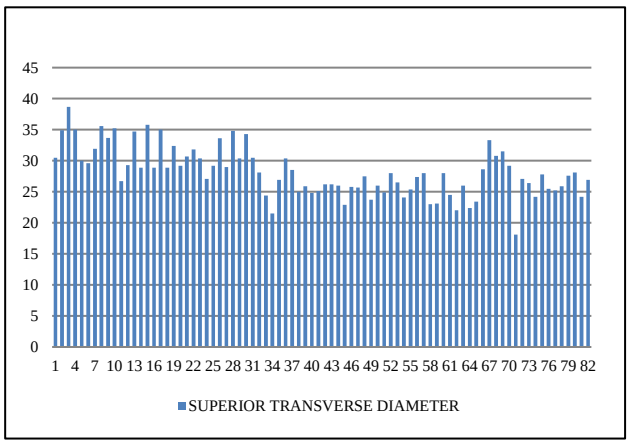

Figure 3: Superior transverse diameter.

Inferior transverse diameter of the vertebral body ranged from 22.6-41.2 mm with a mean of 31.3 mm.

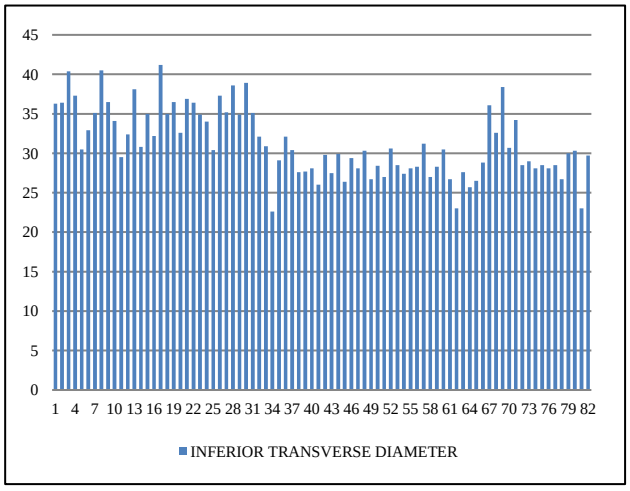

Figure 4: Inferior transverse diameter.

Anterior height of the vertebral body ranged from 10.2-24.1 mm with a mean of 18.17 mm.

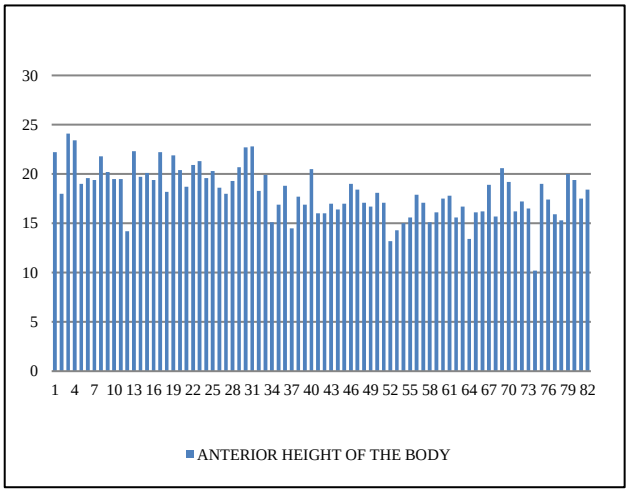

Figure 5: Anterior height.

Right and left lateral height of the vertebral body ranged from 9.0-24.7 mm with a mean of 18.4 mm.

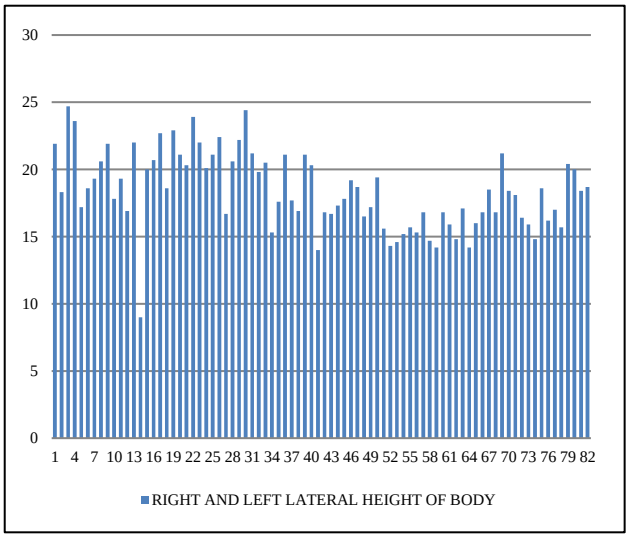

Figure 6: Right and left lateral height.

DISCUSSION

Several anatomical studies have been carried out for typical thoracic vertebrae in different countries. Previous authors have studied the vertebrae using different methods such as plain x-rays, direct specimen measurements, and quantitative three-dimensional anatomic techniques. These include Panjabi et al, Tan et al, Singh et al, Gupta et al, Kunkel et al, Patil et al, Vasantha et al.[8-14] However, Berry et al studied only the second and seventh thoracic vertebrae.[15]

The following tables show the comparison between previous studies and the present study.

Table 1: Comparison of the mean anteroposterior distance of the vertebral body in typical thoracic vertebrae with other studies.

Study	Year	Country	Material for study	Mean (in mm)
Panjabi et al[8]	1991	USA	Dry bones	24.26
Tan et al[9]	2004	Singapore	Dry bones	20.21
Patil et al[13]	2014	India	Dry bones	20.78
Vasantha et al[14]	2017	India	Dry bones	21.96
Present study	2022	India	Dry bones	21.77

Table 2: Comparison of the mean transverse diameter of the vertebral body in typical thoracic vertebrae with other studies.

Study	Year	Country	Material for study	Mean (in mm)
Panjabi et al[8]	1991	USA	Dry bones	26.06
Tan et al[9]	2004	Singapore	Dry bones	23.84
Singh et al[10]	2011	India	Dry bones	25.9
Patil et al[13]	2014	India	Dry bones	27.02
Vasantha et al[14]	2017	India	Dry bones	27.9
Present study	2022	India	Dry bones	29.76

Table 3: Comparison of the mean anterior height of the body in typical thoracic vertebrae with other studies.

Study	Year	Country	Material for study	Mean (in mm)
Tan et al[9]	2004	Singapore	Dry bones	15.04
Kunkel et al[12]	2011	Germany	Cadaveric, radiographic	15.84
Singh et al[10]	2011	India	Dry bones	17.39
Patil et al[13]	2014	India	Dry bones	17.17
Vasantha et al[14]	2017	India	Dry bones	17.71
Present study	2022	India	Dry bones	18.17

The mean of the anteroposterior distance of the vertebral body in the present study is greater than the mean value of Tan et al and Patil et al, but less than the mean value of Panjabi et al and Vasantha et al.[8,9,13,14]

The mean of the transverse diameter of the vertebral body in the present study is greater than the mean values of all previous studies.

The mean of the anterior height of the vertebral body in the present study is greater than the mean values of all previous studies.

There are some limitations of the study. As the study was performed on a small number i.e. on 82 dried typical thoracic vertebrae, the results of the study cannot be generalized to the whole population.

CONCLUSION

The present study provides information for more accurate modeling and designing of vertebral body implants and instrumentations for the Indian population which was very useful to guide the procedures for preclinical evaluation of spinal implants, bone grafts for traumatic, degenerative, and neoplastic diseases of the thoracic vertebrae.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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