

Morphometric study of the vertebral body in fully ossified dry human fifth lumbar vertebrae.

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Abstract

Background: Knowing the exact vertebral body size is an important factor in diagnosing and treating spinal deformation. For successful surgery and suitable instrumental design, adequate anatomical knowledge of the lumbar vertebra is needed. The present study was carried out to create a morphometric database of the bodies of the fifth lumbar vertebrae. **Material and Methods:** A cross-sectional, analytical type of study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka from January 2022 to December 2022. Measurement of superior and inferior body length was done using a digital Vernier caliper. **Results:** The mean (\pm SD) of the superior and inferior body length was higher in males than females and showed a statistically significant difference ($p < 0.001$). **Conclusion:** All the measured values of different variables of the fifth lumbar vertebra were greater in males than females. The current data should be considered during spinal surgery to avoid any complications that might result from the mispositioning of spinal implants.

Keywords: Superior vertebral body length, Inferior vertebral body length

Introduction

Despite the massive size of the fifth lumbar vertebra, the vertebral bodies experience tremendous loading stress due to the loads raised and transported by the upper extremities (1). Lumbar vertebral fractures are a common occurrence in osteoporosis. The vertebral body can develop any benign bone tumor, including chondroma, osteoma, fibroma, hemangioma, etc. The most frequent cancers to spread to the vertebrae are those of the breast, lung, prostate, kidney, gastrointestinal tract, and thyroid (2). For a variety of spinal conditions, including lumbar fractures, removal of tumors in vertebral bodies, gross spondylolisthesis, and lumbar instabilities, the lumbar spine must be fixed (3). Many devices, such as rods, plates, and wires can be placed on the spine for fixation or immobilization with the use of a screw. Most spine disorders can be directly accessed through the anterior approach through the vertebral body, which also permits ideal neural decompression, sufficient realignment, and robust reconstruction or fixation. To avoid difficulties following the anterior approach, morphometric analysis of the body of the fifth lumbar vertebra is crucial (4). This research is also crucial for selecting the right interbody device, like an artificial disc or inter-body cage, or for bone graft material for inter-body fusion (5). To facilitate diagnosis, treatment planning, and the development of novel surgical procedures in orthopedic and neurosurgery, this study establishes gender- and ethnicity-specific metric criteria for the body of the fifth lumbar vertebra.

Materials and Methods

This cross-sectional study was carried out to construct data on different dimensions of the body of fully ossified dry human fifth lumbar

vertebrae in the Department of Anatomy, Dhaka Medical College. It was ensured that all selected vertebrae were normal, and fully ossified without any congenital or degenerative. Linear measurements of Superior vertebral body length and inferior vertebral body length were done by Digital Vernier Caliper.

To measure the superior body length of the fifth lumbar vertebra, one dot was placed at the anterior aspect of the upper border of the vertebral body at the midsagittal plane marked by A, and another dot was placed at the posterior aspect of the upper border of the vertebral body marked by B. Then the fixed jaw of Vernier caliper was placed on marked point A and the sliding jaw was adjusted to meet the marked point B. The distance between A and B on the superior surface was taken as the superior body length of the fifth lumbar vertebra which was measured by the digital Vernier caliper in millimeters.

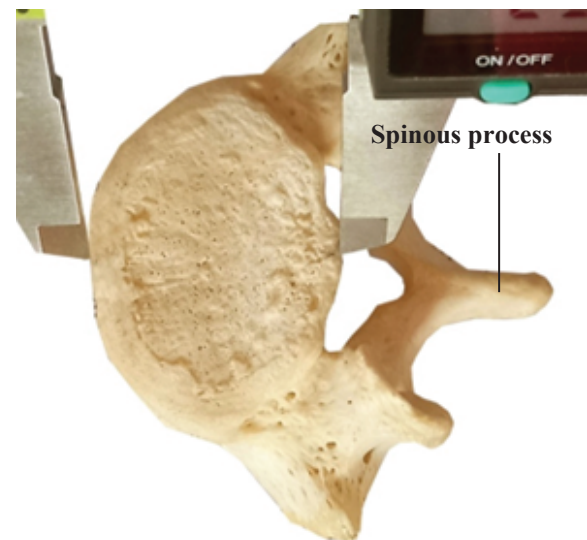


Figure I: Photograph showing the AB line which represents the superior body length of the fifth lumbar vertebra (Superior view)

To measure the inferior body length of the fifth lumbar vertebra another dot was placed at the anterior aspect of the lower border of the vertebral body at the midsagittal plane marked by A and another dot was placed at the posterior aspect of the lower border of the vertebral body at midsagittal plane marked by B. Then the fixed jaw of Vernier caliper was placed on marked point A and the sliding jaw was adjusted to meet the marked point B. The distance between A and B on the inferior surface was taken as the inferior body length of the fifth lumbar vertebra which was measured by the digital Vernier caliper in millimeter.



Figure II: Photograph showing the AB line which represents the inferior body length of the fifth lumbar vertebra (Inferior view)

Ethical Clearance

The study was carried out after approval of the Research Review Committee (RRC) and Ethical Review Committee (ERC) of Dhaka Medical College, Dhaka.

Data Processing And Analysis

The data collected from morphological studies were processed to get mean values and stan-

dard deviations as applicable. The statistical analysis was done by unpaired Student’s t-test for comparison between variables between males and females by using computer-based software, Statistical Package for Social Science (SPSS) version 26.0. Statistical analysis was accepted at a p-value equivalent to or less than 0.05 ($p < 0.05$).

Results

The result is shown in Tables I and Figure 3.

The mean \pm SD of superior and inferior body length in males was 31.95 ± 2.06 mm and 31.22 ± 1.97 mm and in females was 29.87 ± 2.07 mm and 29.33 ± 1.89 mm respectively. The range of superior and inferior body length in males was 26.14 mm to 36.70 mm and 25.84 mm to 36.43 mm and in females was 25.47 mm to 34.77 mm and 25.70 mm to 34.16 mm respectively. The mean superior and inferior body length of the fifth lumbar vertebra was found to be higher in males than in females and the difference was statistically significant ($p < 0.001$).

Table I: Superior and inferior body length of fifth lumbar vertebra in male and female (N = 140)

in mm	Sex		p-value
	Male (n= 76) (Mean \pm SD)	Female (n=64) (Mean \pm SD)	
Superior body length	31.95 ± 2.06 (26.14 – 36.70)	29.87 ± 2.07 (25.47 – 34.20)	.000*
Inferior body length	31.22 ± 1.97 (25.84 – 36.43)	29.33 ± 1.89 (25.70 – 34.16)	.000*

Values in parentheses indicate range values. Comparison of values between males and females was done by Unpaired Student’s ‘t’ test.

* = Significant at $p < .001$

n = Sample size in each group

N = Total number of samples

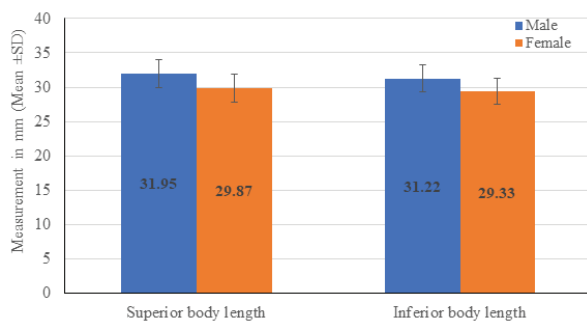


Figure III: Bar diagram showing superior and inferior body length of fifth lumbar vertebra in male and female.

Discussion

It is well established that the morphometric data varies within different sex, race, ethnic, and regional groups (6,7). Population-based normal variations of vertebral body diameters of the fifth lumbar vertebra in the Bangladeshi population are not well documented in the literature. Hence there is a need for our metrical data. The results of the current study were compared with the results of different researchers abroad. Observed results of morphological parameters of the present study showed some similarities as well as dissimilarities with the available data present in different publications.

The mean \pm SD superior body length of the fifth lumbar vertebra in this study in males and females was 31.95 ± 2.06 mm and 29.87 ± 2.07 mm respectively. The superior body length of the fifth lumbar vertebra was greater in males than in females and it was found statistically significant ($p=0.000$). The measured values of the present study were almost like the findings found by Das, et al. (3) (2021, pp.23-29) who conducted a study on the North Indian population and reported that the mean superior body length of the fifth lumbar vertebra was 29.23 ± 4.89 mm. The similarity might be due to similar race and geographical area. According to Azu, et al. (8) (2016, pp.1345-51) conducted a study on the South

African population and recorded that the mean superior body length of the fifth lumbar vertebra was 36.08 ± 4.40 mm and 35.16 ± 2.16 mm in males and females respectively. However, the values of the mean superior body length of the fifth lumbar vertebra were higher than in the present study. The dissimilarity might be due to variations in race.

The mean \pm SD inferior body length of the fifth lumbar vertebra in this study in males and females was 31.22 ± 1.97 mm and 29.45 ± 1.91 mm respectively. The inferior body length of the fifth lumbar vertebra was greater in males than in females and it was found statistically significant ($p=0.000$). Londhe and Garud (9) (2020, pp.77-80) carried out a study on the Indian population and reported that the mean inferior body length of the fifth lumbar vertebra was 29.8 ± 3.3 mm. The mean values of inferior body length were almost like the present study. The similarity might be due to the same race and geographical area. The measured values of the present study were found dissimilar to the findings reported by Alam, et al. (10) (2014, p.421) who conducted a study on the Pakistani population and reported that the mean inferior body length was 33.03 mm and 31.91 mm in male and female respectively. The dissimilarity might be due to multifactorial etiological factors like environment, genetics, geography, and nutrition.

Conclusion

The present study attempted to provide morphometric baseline data of the vertebral body of the fifth lumbar vertebrae which will serve as a normative reference. Knowing the exact vertebral size and shape is an important factor in diagnosing and treating spinal deformation. For successful surgery and suitable instrumental design, adequate anatomical knowledge of the lumbar vertebra is needed. The current data should be considered during spinal surgery to avoid any complications that might

result from the mispositioning of spinal implants. For genuine use, further progressive study in the same direction with a larger sample size from a skeletal collection with known age, sex, stature, and ethnicity is desirable.

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