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A STUDY OF METRIC MEASUREMENT OF LUMBAR VERTEBRAE IN THE POPULATION OF CENTRAL INDIA

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Abstract: The need for a quantitative data base for geometrical and mechanical models of the vertebral column is expressed often by researchers and practitioners, but no comprehensive anthropometric survey for spinal segment modeling has been published. The purpose of this paper is to present a set of anthropometric measurements on dried cadaveric lumbar vertebrae. This includes statistical analysis for distributions of the various dimensions, relations and correlations of vertebral dimensions. The Present study was conducted on 210 adult lumbar vertebrae in department of Anatomy, R.D. Gardi Medical College, Ujjain, India. The Height, length, width of vertebral body, of lumbar vertebrae were measured with the help of Sliding Vernier Caliper. There was a gradual increase in the transverse diameter of the body of vertebra from L_1-L_5. There was also a- increase in the antero- posterior diameter from L_1 to L_5.

Keywords: Lumbar Vertebrae, Diameter of Body of Vertebrae, Sliding Vernier Caliper.

INTRODUCTION

Human lumbar vertebrae support the weight of the upper body. Loads lifted and carried by the upper extremities cause significant loading stress to the vertebral bodies. In between the body of vertebrae are inter-vertebral discs made of fibrous cartilage that act as shock absorbers and allow the back to move [(1)]. Wide individual variations within common patterns of body and disc anatomy may appear. These force the surgeon to understand the individual anatomy of the patient, in order to achieve clinical success, and to appreciate the patterns of lumbar vertebrae anatomy during anterior approach. In recent years, anterior lumbar inter body fusion, in association with a variety of methods to stabilize both the implant and motion segment, has increased in popularity. Expandable vertebral body replacement material can provide solid anterior column constructs with restoration of height and sagittal alignment [(2)].

The anterior route provides direct access to most spine diseases and allows optimal neural decompression and the possibility of adequate realignment and strong reconstruction/fixation. Stability of the vertebral column is achieved, resolution of clinical pain is rapid and almost complete, and the rate of surgical complications is very low [(3)]. A thorough knowledge of anatomic descriptions and dimensions of vertebra is necessary for development of implantable devices and spinal instrumentation. Internal fixation techniques are required for various spinal problems like spinal fractures, gross spondylolisthesis and spinal instabilities. For internal fixation, a screw is inserted through the pedicle into the body of a vertebra. With the help of screw, various devices (rods, plates or wires) can be applied to spine for immobilization or fixation. Thus, for proper implant design and placement, detailed and accurate knowledge of morphology of vertebrae is necessary.

MATERIAL AND METHOD

In the present work fully ossified 210 male and female lumbar vertebrae were used for direct gross morphometry. They were collected from preserved sets of bones obtained from individual cadavers received at Department of Anatomy, R. D. Gardi Medical College, Ujjain. Only the normal and completely ossified vertebrae were included in the study. Lumbar vertebrae for osteometric study were kept on the table and different measurements were taken directly on the bones. Sliding vernier caliper was used to measure the different parameters. The Vernier caliper is an extremely precise measuring instrument; the reading error is 1/20 mm = 0.05 mm. To ensure that the full diameters were measured, the different axes were kept perpendicular to the caliper. The jaws were closed lightly on the vertebra. Each parameter was measured twice and then recorded. The methodology followed was as described in Hrdlicka's Practical Anthropometry (1952).

Diameters of Vertebral body:

1. **Vertical Height of body in mm:** This was noted by a sliding vernier caliper. The closest points just opposite each other on the upper and lower margins of body, in the vertical plane on its anterior and posterior aspect were considered and their distance measured in mm. First, record was taken on anterior and then on posterior. The method adopted for measuring the height was according to HRDLICKA`S Practical Anthropometry.

2. **Antero-posterior diameter:** The closest points just opposite each other on the upper margins of body, in the horizontal plane on its anterior and posterior aspect were considered and their distance measured in mm.

3. **Transverse diameter:** The closest points just opposite each other on the middle of body, in the horizontal plane on its transverse aspect of body were considered and their distance measured in mm.

OBSERVATION AND RESULTS

Observations have been reported. First incorporates direct gross three dimensional measurements of vertebrae. Results were recorded in both male and female vertebrae. Mean values of diameter of body (anterior-posterior, transverse, anterior height, posterior height) of LI to L5 vertebrae of both the sexes are shown.

- The transverse diameter of the body in the specimen ranged from 38.3 mm at L_1 to 43.3mm at L_5 [Table 1]. There was a gradual increase in the transverse diameter from L_1 to L_5.

- The anterior-posterior diameter of the vertebral body, when measured in the specimens, varied from 27.3 mm at L_1 to 31.4 mm at L_5 [Table.2]. There was also a gradual increase in the transverse diameter from L_1 to L_5.

- There were changes in anterior height and posterior height of body. First from L_1 . L_4 there is more posterior height than anterior height and than in L_5 there is more anterior height than posterior height [Table 3-4].

Table.1: Mean transverse diameters of vertebral body (TD-VB)

	TD-VB
L1	38.3
L2	38.5
L3	39.3
L4	39.6
L5	43.3

Table.2: Mean Anterior-Posterior diameters of vertebral body (APD-VB)

	APD-VB
L1	27.3
L2	27.5
L3	28.3
L4	29.3
L5	31.4

Table.3: Mean Anterior- height of vertebral body (AH-VB)

	AH-VB
L1	22.9
L2	22.8
L3	21.8
L4	21.8
L5	23.1

Table.4: Mean Posterior-height of vertebral body (PH-VB)

	PH-VB
L1	24.8
L2	24.8
L3	23.6
L4	23.4
L5	21.6

DISCUSSION

This study has been conducted to evaluate lumbar vertebrae anatomy of the Indian Anatolian population in terms of morphometric measurements in healthy cases as well as giving guidance to the surgeons during anterior approach.

The use of technologies for the treatment of degenerative spinal diseases, traumatic body of vertebra dislocation, tumors has undergone rapid clinical and scientific development. Lumbar interbody fusion can be performed using a posterior, anterior or combined approach ([4]). It has been extensively studied in combination with various techniques for spinal stabilization from anterior approach. Much clinical research on anterior fixation technique is aimed at representing a management of vertebra and disc pathologies such as fractures, degenerative disease with fractures, neoplasms, and spinal infections etc.[3,5]. The technique was used for lesion excision, corpectomy and vertebral body reconstruction with cages, realignment, and/or plating or screwing [3] but there is considerable disagreement about defining normality. Degenerative disease or instability in the lumbar vertebrae and discs may necessitate fusion and stabilization supplemented by instrumentation between lower thoracic vertebrae and the sacrum.

However, screw placement in a reasonable position is more difficult to achieve because of inadequate anatomical knowledge about the lumbar vertebrae. Measurements of size and volumetric definition for body of lumbar vertebrae is of importance for preventing complications after anterior approach such as cage dislocations and adjacent level vertebral body fractures after placement of expandable cages [6].

The observations presented here have defined many anatomical parameters that should be taken into consideration for screw fixation to avoid injury of vascular and neural structures during spinal instrumentation involving the lumbar vertebrae and intervertebral discs.

CONCLUSION

There was a gradual increase in the transverse diameter of the body of vertebra from L_1-L_5. There was also a- increase in the antero- posterior diameter from L_1 to L_5.

We aimed to contribute to neurosurgeons for safe surgical intervention by these data. We believe that calculation of various parameters in different human populations from both Western and Eastern countries are useful for correct screw selection in various spinal stabilization procedures. The cadaveric analysis technique is simple, reliable, unbiased and inexpensive. Further studies are needed with larger samples in order to support our data. As a result, more real and accurate implant size choosing might be provided using this method.

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