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Sonu Tyagi

Asst. Professor, Department of
Anatomy, N.C.C.H, Israna,
Panipat, Haryana, India

Sudha Chhabra

Retd. Proff. & Ex-HOD,
Department of Anatomy, Pt.
B.D.S. PGIMS, Rohtak,
Haryana, India

Ravi Kant Narayan

Junior Resident, Department of
Anatomy, Pt. B.D.S. PGIMS,
Rohtak, Haryana, India

Morphometric study of width and height of lumbar pedicles in population of Haryana

Sonu Tyagi, Sudha Chhabra and Ravi Kant Narayan

Abstract

Pedicles form an important part of lumbar spine. They help in transmission of weight in lumbar spine. The Present study is done on 30 adult human lumbar vertebrae. 23 skeletons are of males & 7 are of females. Sliding Digital Vernier Caliper is used to measure height and width of Lumbar pedicles. Analysis showed positive correlation in width of levels and the width being maximum at L5. The height of lumbar pedicles showed negative correlation from L3 to L5 levels.

Keywords: lumbar vertebrae, pedicle screw fixation, sliding digital vernier caliper

1. Introduction

Lumbar Vertebrae have strong and large pedicles. Pedicles are used to place screws through them in spinal fixation of lumbar spine. Spinal fixation is used in conditions like fracture in lumbar spine, resection of tumours in vertebral bodies, gross spondylolisthesis and lumbar instabilities.

The pedicle screw fixation is used in laminectomized patients. The success of technique depends upon the size of screw for a particular pedicle size, and a presence or absence of osteoporosis in pedicle^[8,17].

The pedicle screws have disadvantages as mismatched size of screw and pedicle result in failure of instrumentation, cortex perforation of pedicle and fracture of pedicle. The complications associated with oversized pedicle screw are dural tears, leakage of cerebrospinal fluid and injuries to nerve roots^[2].

The characteristic morphology of lumbar pedicles particularly L5, helps in preventing forward slide of L5 over S1. The medial aspects of the pedicle directed obliquely from vertebral canal in lower lumbar vertebrae. This help in sacro iliac load transmission^[8].

The horizontal diameter of pedicle decides the screw diameter. The transverse (width) and vertical (height) parameters of pedicle help in determining the screw path. So, the pedicle morphometry becomes important in the selection of most suited pedicle screw.

Most of previous study on morphometry of the pedicle based on a common pool of vertebrae (male and female vertebrae were pooled together)^[10, 12, 13, 21, 23]. However, statistically significant sex differences present in pedicle morphometry in white population^[2, 6, 11]. Also human skeletons show racial variations. The morphometry of the pedicle may vary from population to population^[22].

Singel *et al.* measured the height and width of lumbar pedicles in the Saurashtra region of Gujarat state find that the width of lumbar pedicles increasing from L1 to L5 irrespective of gender. Therefore, it is necessary to measure the height and width of lumbar pedicles in the Haryana population.

2. Materials and Methods

23 male and 7 female lumbar vertebrae are considered for the present study of pedicle morphometry. The vertebral columns are obtained from preserved sets of bones of individual dead bodies received at Anatomy Department, PGIMS, Rohtak, Haryana. All vertebrae and other bones are fully ossified. All sets of vertebra included in the study are normal. The parameters measured were:

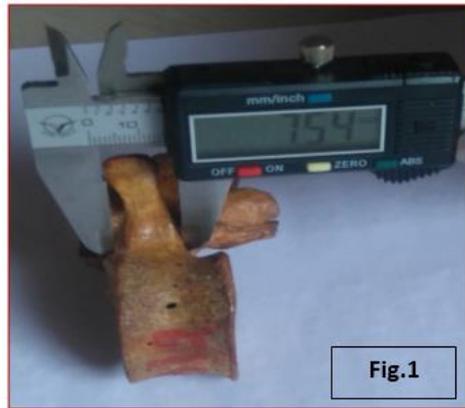
Correspondence

Sonu Tyagi

Asst. Professor, Department of
Anatomy, N. C. C. H, Israna,
Panipat, Haryana, India

(a) Vertical Height of pedicle (h) in mm: (Fig. 1)

The closest points just opposite each other on the upper and lower margins of pedicles, in the vertical plane on its lateral



aspect and their distance are measure in mm. First, record is taken on right pedicle and then on left.

**(b) Pedicle width (w) in mm: (Fig.2)**

The deepest points on the lateral and medial aspects of each pedicle. The thickness is measured at these points, at right angles to the long axis of pedicle in 'mm'. First reading is taken for right pedicle and then for left.

All these measurement are taken in millimeters with the help of digital vernier caliper. The mean and standard deviations for each side is calculated and student 't' test is used to

determine the difference between right and left sides. As there is no significant statistical difference between the parameters for right and left sides; hence the data are pooled together.

3. Observations and Results

Observations are recorded separately for both males and females.

Table 1: Shows the mean, standard deviation and 't' value of height and width of pedicles of male and female lumbar vertebrae.

		Males(n=23)		Females(n=7)		't' value	
		height(h)	width(w)	height(h)	width(w)	height(h)	width(w)
L1	Mean S.D.	14.40mm ±1.53	7.67mm ±1.29	13.17mm ±1.79	7.98mm ±3.09	0.99	0.30
L2	Mean S.D.	14.64mm ±0.95	7.40mm ±1.56	13.09mm ±1.86	8.32mm ±2.79	0.96	0.25
L3	Mean S.D.	14.83mm ±0.95	8.72mm ±1.60	12.11mm ±2.92	9.03mm ±3.12	0.99	0.23
L4	Mean S.D.	14.41mm ±1.53	11.18mm ±2.78	12.30mm ±1.99	12.03mm ±2.21	0.02	0.82
L5	Mean S.D.	14.00mm ±2.49	15.82mm ±2.19	13.68mm ±3.60	16.49mm ±1.84	0.91	0.22

Table-1 shows the mean, standard deviation and 't' value of height and width of pedicles of male and female lumbar vertebrae. The width of pedicles increases from L1 to L5 expects L2 in male lumbar vertebrae. The minimum width of pedicles in male lumbar vertebrae is found at L2 level (7.40 mm). The maximum width of pedicle in male lumbar vertebrae is found at L5 level (15.82mm).

The width of pedicles increases from L1 to L5 in female lumbar vertebrae. The minimum width of pedicles in female lumbar vertebrae is found at L1 level (7.98 mm). The maximum width of pedicle in female lumbar vertebrae is found at L5 level (16.49 mm).

The height of pedicles decreases from L1 to L5 in male lumbar vertebra except L2 and L3. The minimum height of pedicles in male lumbar vertebrae is found at L4 level (14.00 mm). The maximum height of pedicle in male lumbar vertebrae is found at L3 level (14.83 mm).

The height of pedicles decreases from L1 to L3 and then increasing from L4 to L5 in female lumbar vertebra. The minimum height of pedicles in female lumbar vertebrae is found at L3 level (12.11 mm). The maximum height of pedicle in female lumbar vertebrae is found at L5 level (13.68 mm).

4. Discussion

According to Table-2, Amonoo-Kuofi reveals that the width of pedicles in males and females is maximum at L5 with 14.2 mm and 12.5 mm respectively. According to the Singel *et al*, it is maximum at L5 with 18.2 mm and 19.5mm respectively

and present study shows that maximum at L5 with 15.82 mm and 16.49 mm respectively. Difference in female lumbar vertebrae in Haryana population is more as compare to study done by Amonoo- Kuofi.

In table 2 Amonoo-Kuofi suggest that the height of lumbar pedicles in both males and females is increasing from L1 to L5. Singel *et al* reveals that the height of lumbar pedicles is decreasing from L2 to L5 in both males and females. Our study shows that the height of lumbar pedicles is increasing from L1 to L3 and then decreasing from L4 to L5 in male lumbar vertebrae and in female lumbar vertebrae the height of lumbar pedicles is decreasing from L1 to L3 and then increasing from L4 to L5.

This can be because of the difference in methods adopted by Amonoo-Kuofi and the present study. Amonoo-Kuofi studied the plain radiographs of lumbar spine whereas the present study is based on measurement of lumbar pedicles on the lumbar vertebrae with the help of digital vernier caliper. This difference is due to the different environmental and social factor operating in community.

Also another feature for this contrast can be that of racial variation. Amonoo-Kuofi had studied different population of particular race in Saudi Arabia; Singel *et al* conducted study on Gujarat state whereas the present study is conducted on Indian population of Haryana state.

During growth and development of human body weight transmission and physical stress appear to play important roles in morphological and functional adaptation of the vertebral column.

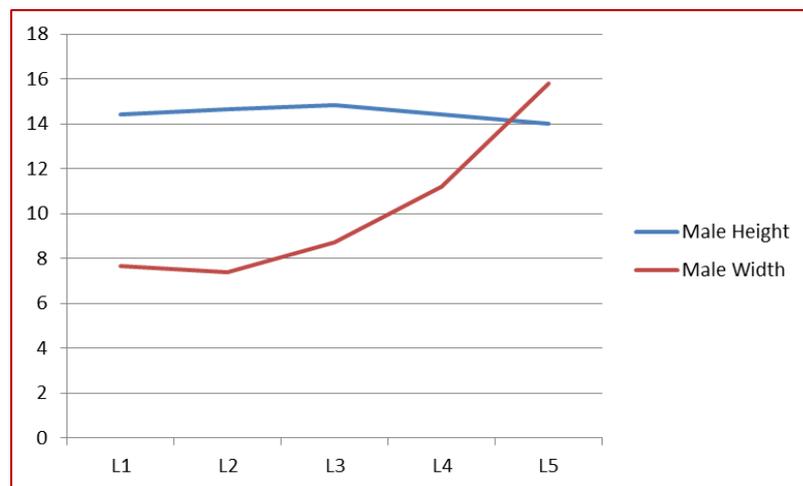
Table 2: Comparison of different study with present study.

Amonoo-Kuofi			Singel <i>et al.</i>			Present study		
Level	Male	Female		Male	Female		Male	Female
L1 Height(h) Width(w)	19.4 10.3	16.3 8.7	Height(h) Width(w)	14.7 8.2	15.5 8.5	Height(h) Width(w)	14.40 7.67	13.17 7.98
L2 Height(h) Width(w)	18.9 10.7	15.3 9	Height(h) Width(w)	15 8.5	14.5 8.75	Height(h) Width(w)	14.64 7.40	13.09 8.32
L3 Height(h) Width(w)	19.3 12.1	15.9 10.5	Height(h) Width(w)	14.7 10.4	14.8 10.6	Height(h) Width(w)	14.83 8.72	12.11 9.03
L4 Height(h) Width(w)	19.9 13	16.1 11.1	Height(h) Width(w)	14 13.5	14 13.8	Height(h) Width(w)	14.41 11.18	12.30 12.03
L5 Height(h) Width(w)	20.7 14.2	17.5 12.5	Height(h) Width(w)	13.4 18.2	13.25 19.25	Height(h) Width(w)	14.00 15.82	13.68 16.49

5. Conclusion

Thus, according to the above discussion, the present study concludes that there is increase in width of lumbar pedicles proceeding from L1 to L5 and the width being maximum at L5 which help in weight transmission. Referring to the above

discussion, the present study concludes that the height of lumbar pedicles decreases as we move from L3 to L5 levels i.e.: at the lower lumbar levels and the height but maximum at L2 levels which help in the transmission of weight.



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