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Morphometric Study of Body of Lumbar Vertebrae: MRI Study

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ABSTRACT

Introduction- A typical vertebra has a ventral body; a dorsal vertebral (neural) arch, extended by lever-like processes; and a vertebral foramen, which is occupied in life by the spinal cord, meninges, and vessels. Fibrocartilage intervertebral discs connect opposing surfaces of neighboring bodies. Supporting the entire weight of the head and trunk, the entire column of bodies and discs creates the body's sturdy yet flexible central axis. Additionally, it transfers much stronger forces produced by muscles that are either directly or indirectly linked to it. In addition to forming a vertebral canal for the spinal cord, intervertebral foramina also carry mixed spinal nerves, smaller recurrent nerves, and blood and lymphatic vessels between adjacent neural arches, close to their connections with vertebral bodies.

Material and methods- A retrospective evaluation of the morphometric parameters of the lumbar vertebrae was conducted on 150 patients with lower back pain aged 25 to 75 years in the Department of Anatomy D Y Patil Medical College in collaboration with the Radiology Department of D Y Patil Hospital, Nerul, Navi Mumbai. Obtained patients data were separated in 6 groups, in the basis of patients ages, Group A (25-30 years), Group B (31-40 years), Group C (41-50 years), Group D (51-60 years), Group E (61-70 years) and Group F (71-75 years). Morphometric parameters of 1-5 Lumbar vertebrae were recorded with MRI.

Result- In the present study, the age of the patients ranged from 25 to 75 years old. The mean value and standard deviation of the age of patients were 48.586±13.208. The average anteroposterior diameter was 25.26±3.97, 26.81±3.15, 27.76±3.05, 28.31±3.02, and 28.72±3.95 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae, respectively. The average transverse diameter of lumbar vertebrae was 34.53±5.97, 36.88±6.08, 40.62±5.29, 42.64±4.85 and 43.87±7.82 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae respectively. The average vertical diameter of lumbar vertebrae was 20.54±1.88, 21.8±2.42, 22.09±2.42, 21.81±2.66, and 22.39±3.24 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae respectively.

Conclusion: This study revealed a significant correlation between the body of lumbar vertebrae and the patient's age.

Keywords: *Antero-posterior, vertical, transverse.*

1. INTRODUCTION

A typical vertebra has a ventral body; a dorsal vertebral (neural) arch, extended by lever-like processes; and a vertebral foramen, which is occupied in life by the spinal cord, meninges, and vessels. Fibrocartilage intervertebral discs connect opposing surfaces of neighboring bodies. Supporting the entire weight of the head and trunk, the entire column of bodies and discs creates the body's sturdy yet flexible central axis. Additionally, it transfers much stronger forces produced by muscles that are either directly or indirectly linked to it. In addition to forming a vertebral canal for the spinal cord, intervertebral foramina also carry mixed spinal nerves, smaller recurrent nerves, and blood and lymphatic vessels between adjacent neural arches, close to their connections with vertebral bodies [1,2]. The dorsal branches of the embryonic intersegmental somatic arteries provide the arterial supply to the vertebral column, its contents, and the soft tissues that are connected to it. The named artery concerned depends on the level of the column. The vertebral column's veins, inside and outside the vertebral canal, create complex plexuses along the entire column. Both groups join the intervertebral veins, anastomose easily with one another, and lack valves [3-5, 9-12].

Aim: To study the morphometric parameters of the body of lumbar vertebrae using MRI and to correlate the morphometric

parameters of the body of lumbar vertebrae with the patient's age.

2. MATERIALS AND METHODS-

A retrospective evaluation of the morphometric parameters of the lumbar vertebrae was conducted on 150 patients with lower back pain aged 25 to 75 years in the Department of Anatomy D Y Patil Medical College in collaboration with the Radiology Department of D Y Patil Hospital, Nerul, Navi Mumbai. Obtained patients data were separated in 6 groups, in the basis of patients ages, Group A (25-30 years), Group B (31-40 years), Group C (41-50 years), Group D (51-60 years), Group E (61-70 years) and Group F (71-75 years). Morphometric parameters of 1-5 Lumbar vertebrae were recorded with MRI. This study was conducted from January 2023 to March 2024. 1. Anteroposterior diameter of the body of lumbar vertebrae: Maximum Diameter from anterior to posterior margin body of lumbar vertebrae (Fig-01). 2. Transverse diameter of the body of Lumbar Vertebrae: Maximum Diameter between either side of the body of lumbar vertebrae (Fig-02). 3. Vertical Diameter of the body of Lumbar Vertebrae: Maximum Diameter from upper to Lower border body of lumbar vertebrae (Fig-03). All morphometric parameters were taken with the help of the Siemens Symphony Maestro Class MRI machine.

Fig 1- Anteroposterior Diameter of the body of Lumbar Vertebrae

Fig 2- Transverse diameter of the body of Lumbar Vertebrae

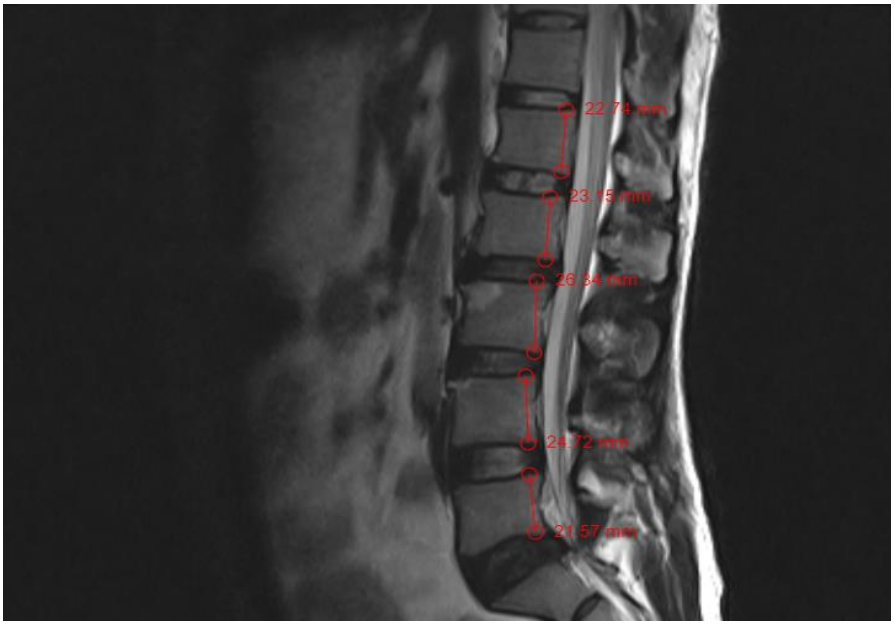

Fig 3- Vertical Diameter of the body of Lumbar Vertebrae

3. OBSERVATION AND RESULT:

In the present study, the age of the patients ranged from 25 to 75 years old. The mean value and standard deviation of the age of patients were 48.586±13.208. The average anteroposterior diameter was 25.26±3.97, 26.81±3.15, 27.76±3.05, 28.31±3.02, and 28.72±3.95 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae, respectively. The average transverse diameter of lumbar vertebrae was 34.53±5.97, 36.88±6.08, 40.62±5.29, 42.64±4.85 and 43.87±7.82 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae respectively. The average vertical diameter of lumbar vertebrae was 20.54±1.88, 21.8±2.42, 22.09±2.42, 21.81±2.66, and 22.39±3.24 mm at L1, L2, L3, L4, and L5 of lumbar vertebrae respectively.

Table No- 01: Showing the Mean Value and SD of Anteroposterior, Transverse, and Vertical diameters of the body of lumbar vertebrae in mm.

Parameters	Mean and SD (mm)				
	L1	L2	L3	L4	L5
Anteroposterior (mm)	25.26±3.97	26.81±3.15	27.76±3.05	28.31±3.02	28.72±3.95
Transverse (mm)	34.53±5.97	36.88±6.08	40.62±5.29	42.64±4.85	43.87±7.82
Vertical (mm)	20.54±1.88	21.8±2.42	22.09±2.42	21.81±2.66	22.39±3.24

Table No- 02: Correlations between the anteroposterior, transverse, and vertical diameter of the body of lumbar vertebrae with age of patents by Presson correlation and student t-test.

Parameters	Comparison with the age of patients	L1	L2	L3	L4	L5
Anteroposterior (mm)	r-value	0.091	0.0696	0.0677	0.2028	0.1498
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Transverse (mm)	r-value	0.2097	0.2794	0.1809	0.1514	0.1102
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Vertical (mm)	r-value	-0.294	-0.182	-0.253	-0.187	-0.390
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Correlations between the anteroposterior, transverse, and vertical diameter of the body of lumbar vertebrae with the age of patients are highly significant.

Table No- 03: Showing the Mean Value and SD of Anteroposterior, Transverse, and Vertical diameters of the body of lumbar vertebrae (at different age group) in mm. [VDBLV- Vertical diameter body of lumbar vertebrae, APDLV- Anteroposterior diameter body of lumbar vertebrae and TDBLV- Transverse diameter body of lumbar vertebrae]

Parameters	A (25-30)	B (31-40)	C (41-50)	D (51-60)	E (61-70)	F (71-75)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
VDBLV- 1	20.67±1.74	22.002±1.07	19.65±2.12	19.94±1.16	20.28±1.87	20.41±1.18
VDBLV-2	21.32±2.17	23.302±2.059	20.79±2.22	21.33±2.28	21.78±2.50	20.46±1.27
VDBLV-3	22.01±2.95	23.37±2.151	21.69±2.195	21.40±3.09	21.702±1.67	19.805±5.02
VDBLV-4	21.66±3.59	22.91±2.598	21.32±2.182	21.28±2.67	21.608±2.76	20.15±3.11
VDBLV-5	22.92±3.28	24.13±3.091	22.63±2.456	21.36±4.05	20.9±2.66	18.49±1.75
APDBLV-1	22.027±1.68	25.77±2.679	24.36±5.008	26.72±5.47	25.61±2.36	25.14±2.67
APDBLV-2	25.68±1.203	27.03±2.486	25.76±3.62	28.56±3.40	26.94±3.05	26.77±0.67
APDBLV-3	26.78±0.79	28.66±3.492	26.13±3.324	28.23±2.95	28.55±1.63	28.52±1.51
APDBLV-4	26.83±0.84	28.43±3.215	27.218±3.092	28.29±2.30	29.76±2.81	29.47±5.64
APDBLV-5	26.88±0.97	29.64±4.738	26.36±4.113	30.73±2.32	29.42±2.60	31.56±0.78
TDBLV-1	29.39±2.15	34.93±6.257	33.29±7.43	34.20±4.87	36.95±3.79	36.57±0.014
TDBLV-2	33.30±4.107	35.78±6.455	35.80±7.39	38.10±4.28	39.46±4.39	38.355±4.09
TDBLV-3	38.12±2.057	40.13±5.62	40.064±6.801	41.99±5.12	41.57±3.11	40.74±0.81
TDBLV-4	39.08±4.14	40.94±4.877	43.3022	43.74±2.66	43.04±4.15	41.87±2.29
TDBLV-5	40.78±4.97	41.16±6.63	45.802±10.23	44.62±4.78	43.887.74	45.62±1.35

4. DISCUSSION:

Table No- 04: Comparison of the mean value of the Antero-posterior diameter body of lumbar vertebrae with the previous study

Authors	L1	L2	L3	L4	L5
Deepak R D [6]	28.15	27.85	28.73	29.00	29.23
Nuket GM [8]	34.16	35.71	36.67	35.5	39.16
Azu o [13]	30.43	31.80	32.50	34.08	35.52
In Present Study	25.26	26.81	27.76	28.31	28.72

The mean value of the anteroposterior diameter of L1 vertebrae was 28.15, 34.16, and 30.43 mm in the study done by Deepak R D, Nuket GM, and Azu O respectively. In the present study, the mean value of the L1 vertebrae is 25.26mm. Our finding is quite similar to the study done by Deepak R D, and lesser than the previous study done by Nuket GM, and Azu O. The mean value of the anteroposterior diameter of L2 vertebrae was 27.85, 35.71, and 31.80mm, in the study done by Deepak R D, Nuket GM, and Azu O respectively. In the present study, the mean value of the L2 vertebrae is 26.81mm. Our finding is quite similar to the study done by Deepak R D and less than the previous study done by Nuket GM and Azu O. The mean value of the anteroposterior diameter of L3 vertebrae was 28.73, 36.67, and 32.50mm, in the study done by Deepak R D, Nuket GM, and Azu O respectively. In the present study, the mean value of the L3 vertebrae is 27.76mm. Our finding is similar to the study done by Deepak R D and less than the previous study done by Nuket GM and Azu O. The mean value of the anteroposterior diameter of L4 vertebrae was 29.00, 35.5, and 34.08mm, in the study done by Deepak R D, Nuket GM, and Azu O respectively. In the present study, the mean value of the L4 vertebrae is 28.31mm. Our finding is similar to the study done by Deepak R D and less than the previous study done by Nuket GM and Azu O. The mean value of the anteroposterior diameter of L5 vertebrae was 29.23, 39.16, and 35.52mm, in the study done by Deepak R D, Nuket GM, and Azu O respectively. In the present study, the mean value of the L5 vertebrae is 28.72mm. Our finding is similar to the study done by Deepak R D and less than the previous study done by Nuket GM and Azu O.

Table No- 05: Comparison of the mean value of the transverse diameter body of lumbar vertebrae with the previous study

Authors	L1	L2	L3	L4	L5
Deepak R D [6]	42.51	41.71	42.25	42.75	43.4
Nuket GM [8]	48.12	52.2	53.7	56.45	57.25
In Present study	34.53	36.88	40.62	42.64	43.87

The mean value of the transverse diameter of L1 vertebrae was 42.51 and 48.12mm, in the study done by Deepak R D and Nuket G M respectively. In the present study, the mean value of the transverse diameter of the L1 vertebrae is 34.53mm. Our finding is less than the previous study done by Deepak R D, and Nuket GM. The mean value of the transverse diameter of L2 vertebrae was 41.71 and 52.2mm, in the study done by Deepak R D and Nuket G M respectively. In the present study, the mean value of the transverse diameter of the L2 vertebrae is 36.88mm. Our finding is less than the previous study done by Deepak R D, and Nuket GM. The mean value of the transverse diameter of L3 vertebrae was 42.25 and 53.7mm, in the study done by Deepak R D and Nuket G M respectively. In the present study, the mean value of the transverse diameter of the L3 vertebrae is 40.62mm. Our finding is similar to the previous finding by Deepak R D and less than the study done by Nuket GM. The mean value of the transverse diameter of L4 vertebrae was 42.75 and 56.45mm, in the study done by Deepak R D and Nuket G M respectively. In the present study, the mean value of the transverse diameter of the L4 vertebrae is 42.64mm. Our finding is similar to the previous finding by Deepak R D and less than the study done by Nuket GM. The mean value of the transverse diameter of L5 vertebrae was 43.4 and 57.25mm, in the study done by Deepak R D and Nuket

G M respectively. In the present study, the mean value of the transverse diameter of the L5 vertebrae is 43.87mm. Our finding is similar to the previous finding by Deepak R D and less than the study done by Nuket GM.

Table No- 06: Comparison of the mean value of the vertical diameter body of lumbar vertebrae with the previous study.

Authors	**Mean value of vertical diameter body of lumbar vertebrae**				
	L1	L2	L3	L4	L5
Deepak R D [6]	22.17	22.73	22.79	23.65	23.70
Zhizhen Chen [7]	26.1	26.64	28.14	29.34	28.18
In Present Study	20.54	21.8	22.09	21.81	22.39

The mean value of the vertical diameter of L1 vertebrae was 22.17 and 26.1mm, in the study done by Deepak R D and Zhizen C respectively. In the present study, the mean value of the vertical diameter of the L1 vertebrae is 20.54mm. Our finding is quite similar to the previous finding by Deepak R D and less than the study by Zhizen C. The mean value of the vertical diameter of L2 vertebrae was 22.73 and 26.64mm, in the study done by Deepak R D and Zhizen C respectively. In the present study, the mean value of the vertical diameter of the L2 vertebrae is 21.8mm. Our finding is less than the Deepak R D and Zhizen C study. The mean value of the vertical diameter of L3 vertebrae was 22.79 and 28.68mm, in the study done by Deepak R D and Zhizen C respectively. In the present study, the mean value of the vertical diameter of the L3 vertebrae is 22.09mm. Our finding is similar to the previous finding by Deepak R D and less than the study by Zhizen C. The mean value of the vertical diameter of L4 vertebrae was 23.65 and 29.34mm, in the study done by Deepak R D and Zhizen C respectively. In the present study, the mean value of the vertical diameter of the L4 vertebrae is 21.81mm. Our finding is quite similar to the previous finding by Deepak R D and less than the study by Zhizen C. The mean value of the vertical diameter of L5 vertebrae was 23.70 and 28.18mm, in the study done by Deepak R D and Zhizen C respectively. In the present study, the mean value of the vertical diameter of the L5 vertebrae is 22.39mm. Our finding is quite similar to the previous finding by Deepak R D and less than the study by Zhizen C.

5. CONCLUSION:

The present study concluded that the parameters and dimensions gathered for this study serve as baseline normative data for the Indian population. Due to population-specific differences in body dimensions, it helps doctors comprehend the morphological importance of the lumbar vertebrae to clinical diagnosis of lower backache (LBA) and may also have forensic significance. This study revealed a significant correlation between the body of the lumbar vertebrae and the patient's age. Vertical diameter is maximum at Group B (31-40 years) and similar at Group C, D, E and F. Anteroposterior diameter is maximum at Group D (51-60 years) and Maximum transverse diameter of body of lumbar vertebrae at Group C (41-50 years) and D (51-60 years).

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