Significance of Measuring Dimensions of Lumbar Lamina and Spinal Canal – A Cadaveric Study

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Abstract

Introduction: The incidence of lumbar nerve root compression and surgeries for its treatment like laminectomy, laminotomies are increasing. Similarly, intralaminar screw insertion and use of laminar hooks for stabilization is also gaining popularity. The dimensions of lumbar lamina are of importance for designing of lumbar spinal implants used. Method: The present study was under taken to measure vertical height of lumbar lamina and width of lumbar vertebral canal in cadavers. Lumbar spine was exposed from posterior midline approach in 20 formalin preserved cadavers. The dimensions of lumbar lamina L1 to L5 were recorded with the help of Digital Vernier Caliper after removal of soft tissue from the vertebrae. The data was analyzed using SPSS software version 23. Result: Range of transverse width of vertebral canal of L1 and L2 was 14-23 mm. It gradually reduces in L3, L4 and L5 (12-21 mm). There was no significant difference in width of vertebral canal between Male and female. Mean height of lamina at junction with transverse process at L2 was (25.7±2.8mm) which reduced from L3, L4 and was lowest in L5 (20.8±2). Mean height of lamina at junction with Spinous process increased from L1 to L2 (27.55±3.3) and decreased from L3, L4 and L5 being smallest (24.3±2.7). The gender, right and left differences for the dimensions of lumbar vertebral lamina were statistically insignificant. In 35 percent cases the spinous processes were fused which was an accidental finding. Conclusion: The data so collected will be of great significance for spinal surgeons and for designing of implant around this region.

Key words: *Lumbar vertebrae, Lumbar canal, Lumbar lamina, Spinous process*

Introduction

The incidence of lumbar nerve root compression and surgeries for its treatment like laminectomy, laminotomies are on the rise. Placement of laminar hooks & insertion of intralaminar screws, during surgical treatment of lumbar spine disorders, is gaining popularity. The knowledge of morphometry of lumbar vertebrae is crucial for surgeons during surgical interventions and placement of implants locally[1-9]. The dimensions of lumbar lamina are also essential for designing of lumbar spinal implants. So, the present study was under taken to measure dimensions of lumbar lamina and lumbar vertebral canal.

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Material & Method

This cadaveric study was carried out at the Department of Anatomy of a medical institute in India. Ethical approval to undertake the present study was obtained from the Institution Ethical Committee (IEC). Lumbar vertebra studied in 20 formalin-fixed adult human cadavers (10 female and 10 male). The age range of the cadavers was 60–95 years (mean, 77.5 years). We included sample in study which had intact vertebral column without any previous dissection, without any surgical procedures, without any trauma pathology of

spinal cord. We exclude sample from study which had carried out any surgical procedure, any external visible deformity of the vertebral column and external sign of injury. The cadavers were placed in a prone position on a flat table with hips extended. The skin was reflected from lower thoracic to sacral region and superficial and deep muscles of the back were identified and excised. The lumbar vertebrae counting from sacrum upward and cleaned. After taking measurements of lamina of L1 to L5 posterior neural arch was excised to measured transverse width of the vertebral canal with the help of Digital Vernier Caliper. The data was analyzed using SPSS software, version 23. For comparison, the level of significance (p value) is kept at 0.05.

Result

On both the sides, the mean height of lamina at its junction with transverse process at L2 was found to be highest (25.7±2.8mm), which gradually found to reduce from L3, L4 and was lowest in L5 (20.8±2). Bilaterally, the mean height of lamina at its junction with Spinous process was found to increase from L1 to L2 (27.55±3.3) and decreased from L3, L4 and L5 being smallest (24.3±2.7) (Table 1).

On both the sides, the mean height of lamina at junction with spinous process at L2 was found to be highest which gradually found to reduce from L3, L4 and was lowest in L5. We did not find any statistically significant difference for dimensions of lamina between Males & Females or between right & left sides. We did not find any statistically significant difference for dimensions of lamina between Males & Females or between right & left sides (Table 2).

Transverse width of Vertebral canal is also known as interpedicular distance. The present study found that the range of transverse width of vertebral canal of L1 and L2 was 14-23 mm. It gradually reduced in L3, L4 and L5 (12-21 mm). The mean transverse width of vertebral canal was compared at all the vertebral levels between males & female using two sample T tests. There was no significant difference in width of vertebral canal between Male and female at any level (Table 3 & Fig 2).

Table/Fig-1: Comparison of the Height of lumbar vertebrae lamina between Right and Left side

Vertebral Level	TOTAL (N= 30)			
	Right		Left	
	Height of Right Lamina at junction with Transverse process (Mean ±SD)	Height of Right Lamina at junction with Spinous process (Mean ±SD)	Height of Left Lamina at junction with Transverse process (Mean ±SD)	Height of Left Lamina at junction with Spinous Process (Mean ±SD)
L1	24.65 ± 0.63	26.45 ± 0.54	24.65 ± 0.63	26.45 ± 0.54
L2	25.7 ± 0.61	27.5 ± 0.74	25.7 ± 0.61	27.5 ± 0.74
L3	25.4 ± 0.68	25.9 ± 0.62	25.4 ± 0.68	25.9 ± 0.62
L4	22.35 ± 0.66	23.4 ± 0.67	22.35 ± 0.66	23.4 ± 0.67
L5	20.75 ± 0.44	21.25 ± 0.59	20.75 ± 0.44	21.25 ± 0.59

Table2: Comparison of the Height of lumbar vertebrae lamina bilaterally between Male and Female

	Height of Right Lamina at junction with Transverse process in mm (Mean ±SD)		Height of Right Lamina at junction with Spinous process in mm (Mean ±SD)		Height of Left Lamina at junction with Transverse process in mm (Mean ±SD)		Height of Left Lamina at junction with Spinous Process in mm (Mean ±SD)	
	Male (10)	Female (10)	Male (10)	Female (10)	Male (10)	Female (10)	Male (10)	Female (10)
L1	24.4 ± 2.5	24.9 ± 3.2	26.9 ± 2.5	26 ± 2.4	24.4 ± 2.5	24.9 ± 3.2	26.9 ± 2.5	26 ± 2.4
L2	25.6 ± 2.5	25.8 ± 3.1	28.7 ± 3.6	26.4 ± 2.7	25.6 ± 2.5	25.8 ± 3.1	28.7 ± 3.6	26.4 ± 2.7
L3	25.1 ± 2.1	25.7± 3.83	25.9 ± 2.64	26 ± 3.09	25.1 ± 2.18	25.7± 3.83	25.9 ± 2.64	26 ± 3.09
L4	22.5 ± 2.6	22.2 ± 3.42	23.7 ± 3.05	23.1 ± 3.14	22.5 ± 2.67	22.2 ± 3.42	23.7 ± 3.05	23.1 ± 3.14
L5	21 ± 1.63	20.5 ± 2.32	21.7 ± 2.83	20.8 ± 2.52	21 ± 1.63	20.5 ± 2.32	21.7 ± 2.83	20.8 ± 2.52

Table: 3 Transverse width of Vertebral canal.

Vertebra	Transverse width of vertebral canal (in mm)			
	Range	Males	Females	Total
		Mean ±SD	Mean ±SD	Mean ±SD
L1	14-23	18.2(±2.8)	19.6(±2.06)	18.9 (±2.5)
L2	14 - 23	18.6(±2.4)	19.2(±2.4)	18.9 (±2.4)
L3	13 - 22	17.9(±1.85)	18.8(±2.5)	18.4 (±2.2)
L4	12 - 21	17.4(±1.5)	18(±2.6)	17.7 (± 2.1)
L5	12 - 21	17(±2.16)	17(±2.3)	17 (±2.2)

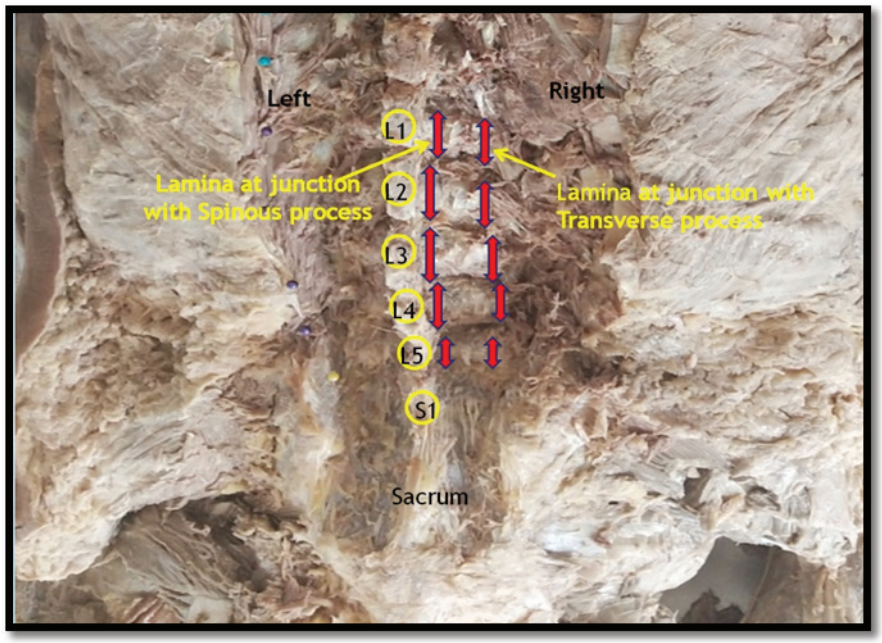

Fig-1: Measuments of Lamina at two points.

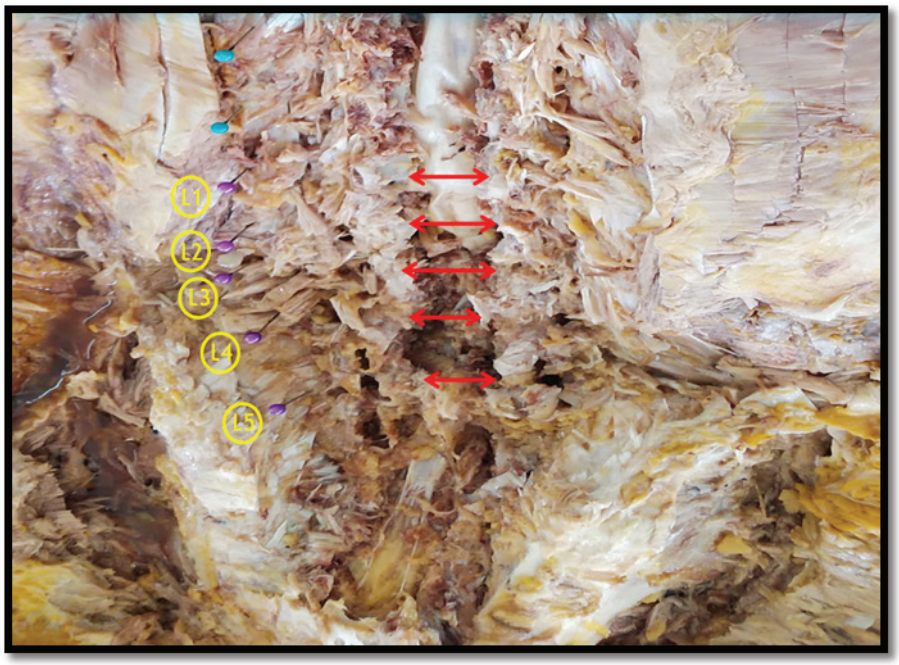

Fig:2 Transverse width of Vertebral canal.

Discussion

Clinical significance of morphometric study of Lumbar Canal and Lamina is a well-established fact.

Standard Laminectomy surgery is routinely performed to relieve the symptoms of nerve compression in lumbar canal stenosis. It is also done for lumbar disc herniation. The use of intralaminar screw and laminar hooks is also gaining popularity. Laminar screws are used for spine fixation during fractures and in scoliosis correction. The knowledge of morphometry of lumbar lamina is thus of paramount importance for spinal surgeons for performance of laminectomy & successful placement of implants locally.

The present study has generated a data base for cadaveric study of gender-wise dimensions for lumbar vertebrae lamina. The present study has measured the

different dimensions of lumbar vertebrae in cadavers with the use of digital vernier caliper. Azu et al (2016) in their study have asserted that direct measurements may give more accurate and reproducible results compared to those from imaging technique10. Tharani et al (2018) have studied the height of lumbar vertebra lamina on dry vertebra14. The mean height of lamina in their study was found to be smaller than that of present study bilaterally.

However, in their study also the mean height of L2 lamina was found to be largest and showed gradual decrease from L3-L5. This finding is analogues to the present study. The research has established that the anatomical narrowing of the lumbar vertebral canal and intervertebral foramina may cause compression of the cauda equina and the emerging nerve roots. The manifestations of compression are pain in the lower back and lower limbs on walking, weakness and paranesthesia along the distribution of the affected nerve roots.

Transverse diameter of the lumbar vertebral canal (interpedicular distance) is a reliable index for the assessment of the size of the canal2. So, the present study has attempted to determine the data base for transverse diameter of lumbar vertebral canal. There was no significant difference in width of vertebral canal between Male and female at any level.

The result of present study for transverse width of vertebral canal varies from the previous reports in the literature. Tarek et al (2013) in their study have reported that the mean transverse width gradually increases from L1 to L5. He has reported that the transverse diameter in lumbar vertebral canal are 1 to 1.5 mm higher in males while in present study the it was found to be higher in females5.

Conclusion

The present study has determined the dimensions of lumbar vertebral canal & lamiae in Indian population. The data so collected will be of great significance for spinal surgeons dealing with this region and also for designing of implant used around this region.

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Conflicts of Interest: The author declares no conflict of interest.

Ethical Clearance: Ethical approval to undertake the present study was obtained from the Institution Ethical Committee (IEC)

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