

A STUDY OF TRANSVERSE DIAMETER OF LUMBAR VERTEBRAL CANAL IN NORTH INDIAN POPULATION

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ABSTRACT

Lumbar spinal stenosis is a medical condition occurring due to reduction in the diameter of bony vertebral canal. The transverse diameter of the canal plays a significant role in determining diagnostic criteria for defining stenosis. The present study aims at defining baseline values of transverse diameter of lumbar vertebral canal in healthy north Indian population by radio-diagnosis. Fifty healthy subjects, within age range of 20-70 years were radio-imaged and transverse diameter of vertebral body and canal were assessed. There was a gradual increase in diameter from L1 to L5 vertebral levels. The means of transverse diameter of vertebral body and vertebral canal show no significant differences between genders and the results were compared with earlier published research work. There are subtle differences in morphometry of lumbar canal in different population group suggesting regional and ethnic differences.

KEY WORDS: Spinal Stenosis, Lumbar Canal, Interpedicular Diameter, Transverse Diameter.

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INTRODUCTION

Low back pain is one of the most common health problems affecting up to 85% of people at least once in their lifetime [1]. The causes of low back pain are multi-factorial, but the narrowing of the lumbar canal plays a significant role. According to Christenson PB, Schonstrom NS et al, Hamanashi C et al the measurement of transverse diameter of lumbar canal is an important tool for diagnosis of narrowing of lumbar canal referred to as lumbar spinal stenosis (LSS) [2-4].

The study of Amonoo-Kuofi HS, Hinck et al shows that the normal values of transverse diameter

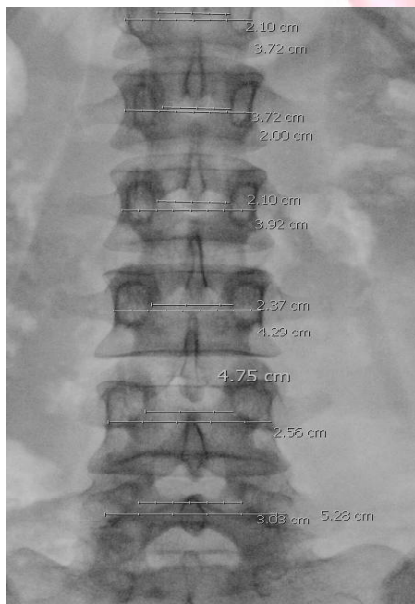
(TDVc) show gender and regional variations and these values have been used to diagnose cases of LSS by morphometric evaluation [5-7]. As this parameter is of paramount significance for diagnosing LSS, therefore a normal morphometric values in a population are essential to diagnose LSS. The present study, therefore aims to define the normal values for TDVc of lumbar spine for population of NCR-Delhi, India; region and compare and contrast the results with that of earlier research work.

MATERIALS AND METHODS

This was an observational cross-sectional study, where a pre-defined questionnaire based on

Oswestry and Quebec LBP questionnaire was prepared and provided to subjects [8]. Based on the response of the questionnaire, only asymptomatic subjects, between 20-70 years of age (mean age 44.54±14.52years) were enrolled into the study. There were 26 male (mean age 45.0±15.1 years) and 24 females (mean age 44.04±14.2 years) All subjects provided with a written informed consent. After obtaining institutional ethical clearance, the subjects were radioimaged in the department of Radiology of Santosh Medical college, Ghaziabad, India. The radiographs were taken on Philips digital imaging system for selected subjects in supine position with X-ray beam centred at L3 vertebral level .The images were interpreted on Philips dicom viewer after scanning for any gross vertebral column defects. A total of 50 images from asymptomatic adults of both sexes were procured and further analysed for interpedicular diameter and transverse diameter of vertebral body from L1 to L5 vertebral levels. The transverse diameter, also referred to as interpedicular distance of vertebral canal (TDVc) was taken as the distance between medial margins of pedicles in millimetres [7,8]. The transverse diameter of vertebral body (TDVb) was taken as the shortest distance at the most constricted part of the vertebral body (mid body level) [9,10] (Fig. 1). The values were tabulated after grouping for sex and statistical analysis was performed using Microsoft Excel Tool Pak data analysis kit and SPSS version 19.

Fig. 1: Methodology to measure transverse diameter of vertebral body and vertebral canal.



RESULTS

The transverse diameter of vertebral body increased gradually from L1 towards L5 vertebral level in the population studied. The deviation from mean was highest at L5 level suggesting higher variations in diameters at this level. The transverse diameter of vertebral canal also increased from L1 towards L4 and shows a drop in value at L5 vertebral level. As the diameter was greatest at L4 vertebral level, so was the deviation from the mean at that level. The descriptive statistics for diameters of canal and body are depicted in table 1

Table 1: Mean transverse diameter of vertebral body and canal at lumbar vertebral levels.

vertebral level	Transverse diameter vertebral body TDVb (in mm)				Transverse diameter vertebral canal TDVc (in mm)			
	Mean	SD	Range	Min-Max	Mean	SD	Range	Min-Max
L5	42.29	4.65	23.3	30.5-53.8	29.25	5.05	29.2	9.2-38.4
L4	41.25	4.17	23.5	30.2-53.7	29.35	5.28	29.9	9.2-39.1
L3	39.31	3.36	18	28.9-46.9	28.09	5.59	28	10.8-38.8
L2	38.17	4.35	25.2	21.5-46.7	27.57	5.52	24.6	12.5-37.2
L1	37.08	3.92	21.2	22.8-44.0	27.25	5.73	27.3	11.9-39.2

Table 2: Comparison of TDVb and TDVc in both the genders.

vertebral level	GENDER	Transverse diameter vertebral body				Transverse diameter vertebral canal			
		Mean	SD	p-value	result	Mean	SD	p-value	result
L5	MALE	42.34	4.73	0.116	NS	28.16	5.85	0.116	NS
	FEMALE	42.25	4.66			30.4	3.79		
L4	MALE	42.34	4.73	0.53	NS	28.16	5.85	0.099	NS
	FEMALE	40.06	3.17			30.63	4.36		
L3	MALE	39.55	3.39	0.6	NS	27.35	6.27	0.33	NS
	FEMALE	39.04	3.43			28.9	4.73		
L2	MALE	38.14	4.99	0.95	NS	26.71	5.99	0.255	NS
	FEMALE	38.2	3.63			28.51	4.91		
L1	MALE	37.25	4.19	0.758	NS	26.42	5.97	0.29	NS
	FEMALE	36.9	3.68			28.15	5.44		

The mean transverse diameters for vertebral body for females show gradual decrease in values from L5 towards L1 vertebral levels, while in males the values are similar at the lower two vertebral levels followed by a gradual drop in values till L1 vertebral levels (Fig 2).The values were similar at L2 vertebral level and the mean results are found to be non-significant between genders at all vertebral levels.

The mean transverse diameter of vertebral canal was greater in females than males' at all vertebral levels (Table2). The maximum diameter of canal was seen at L4 level in females while the values were similar at L5-L4 levels in

males with gradual drop in values to L1 level (Fig. 3). The difference in mean values for both the genders was insignificant statistically (Table 2).

Fig. 2: Comparison of TDVb in males and females.

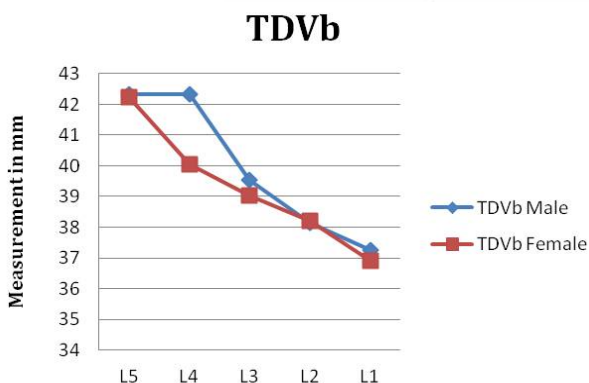


Fig. 3: Comparison of TDVc in males and females.

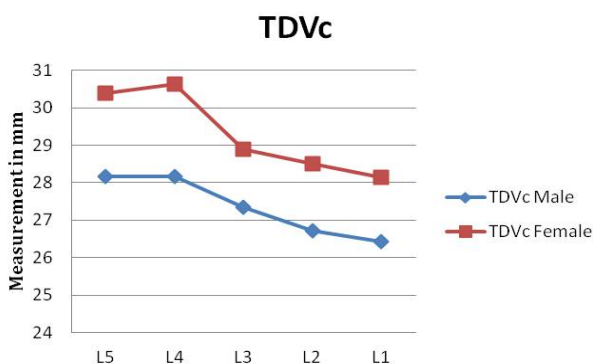
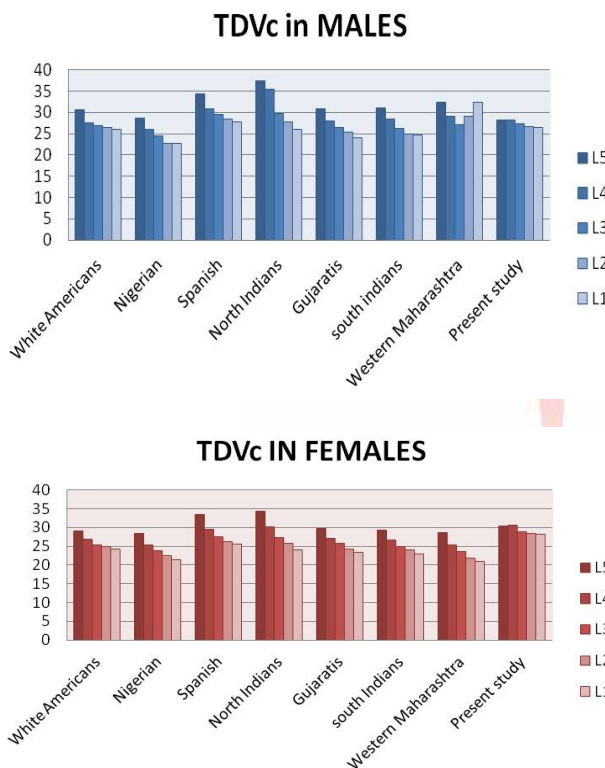


Fig. 4: Comparison of TDVc for males in different population groups.



DISCUSSION

Lumbar spinal stenosis is one of the most common reason for spinal surgical interventions nowadays but still radiological data defining set measurement points to quantify stenosis are limited, especially in population from Northern part of India. Hence this signifies the importance of present study. Diagnostic imaging techniques continue to play a pivotal role in the diagnosis, clinical and surgical management of lumbar spinal stenosis. Of all the diagnostic procedures, radio-diagnosis continues to be the most commonly applied methodology due to its cost effectiveness and easy availability. Though, various morphometric parameters of lumbar vertebral canal are assessed but the measurement of the transverse diameter (interpedicular distance) of lumbar canal is considered to be the most reliable indicator to define a stenotic canal [3-7]. The measurements of this diameter reports gender and regional variability but presently there is no data available that applies to healthy/normal individuals of north Indian population. In the present study an attempt is made to define standard parameters of lumbar canal width in healthy individuals which make up to be a preliminary investigation for stenotic canal.

The transverse diameter of vertebral body increases cranio-caudally suggesting change in size of the vertebral column with respect to its weight bearing functions. The increase in size of lower lumbar vertebrae is attributed to it being site of maximum load bearing, performing extensive flexion, extension, rotation and gliding movements. The difference in males and females are found to be non-significant as compared to earlier research works of Vinay KV et al. on South Indian population [11], however the gradual increase of diameter caudally is seen in all earlier research works in different population groups [12,6,7,10]

The transverse diameter of vertebral canal was seen to be higher in females at all vertebral levels, contrary to earlier studies where females had lower width of the canal [13-15,6,7]. Though values were different in both the genders for vertebral canal diameters but the difference was statistically insignificant. The width of the canal

was greater at lower lumbar levels which is the site of transition towards sacral angulation. The tendency for greater diameters at L4 and L5 level is an adaptation to accommodate sacral nerve roots during angular movements of the spine around the transitional region of mobile lumbar segment and immobile sacrum [16]. The larger transverse diameter of the canal in females suggest lower incidence of LSS in females than males as has been stated by Ishimoto et al [17]. It was also observed that though in other population groups the TDVc increased gradually from L1 towards L5 but in our study the males followed this pattern but in females after gradual increase till L4 vertebra, the values drop at L5 level.

A comparative analysis of present study with the other population groups suggest that the smallest diameter was observed in Nigerian population followed by White Americans, present study population and Spanish population (Fig. 4,5) [18,5-7,10,11,13-15]. This suggests racial variations in TDVc. The result were quite variable with the earlier work on North Indian population by Sudha Chabra et al 1991 [14], as the selection criteria for the sample were different. The present study focuses on the normal healthy subjects while in many early studies details regarding the symptomatology of the subject were ill defined. Also the values differ with respect to regional selection of population sample, being smaller in Gujarati's and South Indians than of NCR-Delhi region suggesting environmental and ethnic factors as source of geographical differences. The L5 vertebral level shows a marked increase in all population groups except in present study group, where values were almost similar in all lower lumbar levels. These observations probably suggest that no specific value can be designated as normal for the diameters of lumbar canal as values differ on grounds of racial and geographical distribution.

CONCLUSION

Of the several factors responsible for lumbar spinal stenosis, one of the factor is transverse diameter of the vertebral canal. In the present study transverse diameter of lumbar canal suggests sexual and geographic differences at each

vertebral level. The variations in diameter do not exhibit significant differences between genders as observed in other population groups. There occur racial differences in size of vertebral canal in different population groups thus emphasising the need for obtaining the data which will help in radiological diagnosis of lumbar spinal stenosis. These variations are of significance in diagnosing cases of lumbar spinal stenosis. Such cases can be taken up for postural and rehabilitative therapies to prevent occurrence of low back pain.

Conflicts of Interests: None

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