Original Article

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A Study of Transverse Diameter of The Lumbar Spinal Canal in Plain Radiograph in Population of Telangana, India

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Abstract

Background: The present study was conducted to determine Transverse diameter (inter-pedicular distances) of the lumbar spinal canal measured in plain antero-posterior radiograph of 140 subjects (80 males, 60 females) aged between 20 to 60 years in population of Telangana. **Subjects and Methods :** The present study was conducted in the department of Anatomy, in a teaching medical college and hospital in Hyderabad, Telangana, India. It comprised of antero-posterior plain radiographs of lumbar spine of 140 subjects, aged between 20 to 60 years. Transverse diameter of the lumbar spinal canal or inter-pedicular distances (IPD), and transverse diameter of the vertebral body was measured using electronic Digital Vernier calipers, and the ratio between transverse diameter of vertebral canal and transverse diameter of the corresponding vertebral body were analyzed. **Results:** Out of 140 patients, males were 80 and females were 60. The mean inter-pedicular distance (IPD) at L1 was 24.2 mm in males and 23.4 mm in females, and at L5 was 30.2 mm in males and 29.6 mm in females. Mean transverse diameter of lumbar vertebral canal (I.P.D) is minimum at L1 vertebra in both sexes. The maximum values of I.P.D were recorded for vertebra L5 for both sexes. The values of IPD are higher in male population in comparison to female counterparts. The mean width of the vertebral body is gradually increasing from L1 to L5. Ratio between transverse diameter of vertebral canal and transverse diameter of the corresponding vertebral body is seen to be constant (0.6) at all lumbar level in both the sexes. **Conclusion:** Authors found that there is variation in the size of the lumbar vertebral canal between males and females. Even after the revolution of various imaging techniques like CT Scan, MRI, etc., the plain radiography remains the mainstay of investigative procedure particularly in rural setup.

Keywords: Inter-pedicular distance, Lumbar vertebral canal, Lumbar spine

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Introduction

Lumbar part of vertebral canal lodges the cauda equina and narrowing of the bony ring of the canal which may be developmental or acquired may lead to compression of these nerve roots and causes low back pain.[1] Huizinga et al, in their studies on lumbar vertebrae obtained from Dutch cadavers, found that in developmental stenosis the interpedicular distance were normal, whereas the mid- sagittal diameters were reduced a fact later confirmed by Larsen.[2] Lumbar canal stenosis is one among the major causative factors producing low back pain.[2]

Low back pain is one of the most common health problems affecting up to 85% of people at least once in their lifetime.[3] Stenosis due to decreased sagittal diameter has been reported in the cervical spine as well as in the lumbar spine.[4] Ahmad T et al, in their study of lumbar canal by MRI shows that stenosis of the spinal canal is due to decreased inter-pedicular distance.[5] It has been suggested that reduced interpedicular distance is one of the causes of primary narrowing of the spinal canal. Reports of value of lumbar interpedicular distance of white Americans, black and white South Africans, Nigerians, Spanish subjects and in adult Saudis have shown that the transverse diameter of lumbar spinal canal exhibits ethnic variations.[5,6] 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).[7–9] The study of Amonoo-Kuofi HS, Hinck et al shows that the normal values of transverse diameter of lumbar canal show gender and regional variations and these values have been used to diagnose cases of LSS by morphometric

evaluation.[10–12] Hence the present study was conducted to determine inter- pedicular distances (IPD) of the lumbar vertebrae measured in plain antero-posterior radiograph in population of Telangana, India, to get a glimpse over the range of I.P.D of lumbar spinal canal in adult population.

Subjects and Methods

In the present study, antero-posterior plain radiographs of lumbar spine of 140 patients were selected, 80 males and 60 females, aged between 20 to 60 years. Whereas radiographs of the patients suffering from any congenital spinal deformities or with spinal injuries were excluded from the study. After obtaining institutional ethical clearance, the study was conducted in the department of Anatomy, in a teaching medical college and hospital in Hyderabad, Telangana, India. All subjects were informed regarding the study and data such as name, age, gender etc. was recorded after obtaining their written consent.

The radiographs were taken on Philips digital imaging system for selected subjects in the recumbent position centered on L3. Transverse diameter of the lumbar spinal canal and transverse diameter of the vertebral body was measured using electronic Digital Vernier calipers [Figure 1] and were recorded to the nearest 100^{th} of millimeters. Transverse diameter of the lumbar spinal canal was measured as the minimum distance between the medial surfaces of the pedicles of a given vertebra / Inter-pedicular distance (IPD) . Transverse diameter of the vertebral body was measured as the minimum distance across the waist of the vertebral body [Figure 2]. Results were tabulated and subjected to statistical analysis. The ratio between transverse diameter of vertebral canal and transverse diameter of the corresponding vertebral body were analyzed. P value less than 0.05 was considered significant.

Figure 1: Measurement of interpedicular distance from digital Vernier caliper.

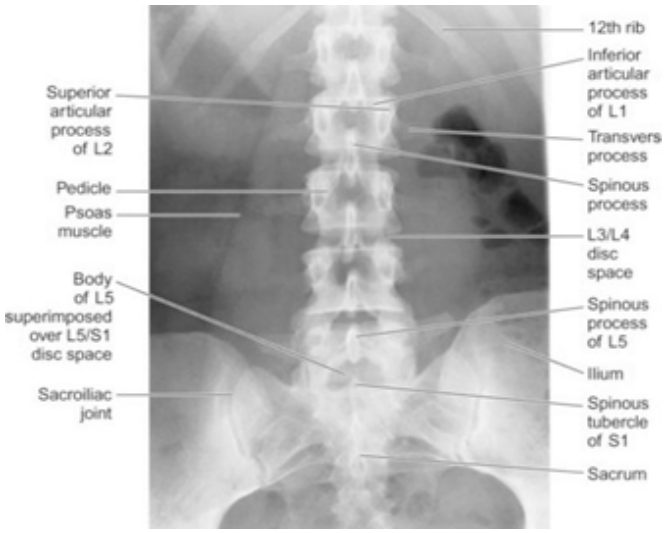


Figure 2: Anterior-posterior radiograph showing inter-pedicular distance

Results

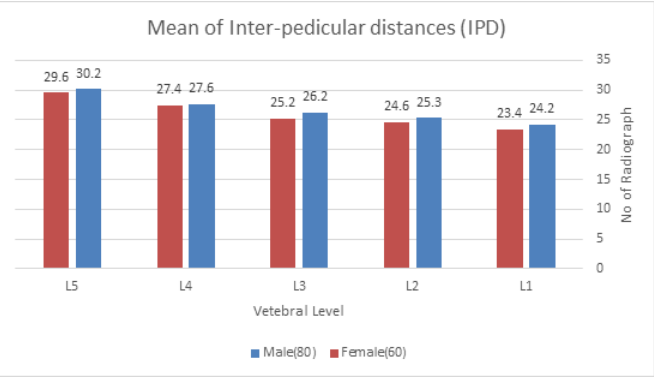
Table 1: Measurement of Inter-pedicular distances (mm) in both sexes

Mean of Inter-pedicular distances (IPD) (mm)			
Level	**Male(80)**	**Female(60)**	**P value**
L 1	24.2	23.4	< 0.04
L 2	25.3	24.6	< 0.01
L 3	26.2	25.2	< 0.05
L 4	27.6	27.4	< 0.92
L 5	30.2	29.6	< 0.81

[Table 1] shows that mean inter-pedicular distance (IPD) in males and females. Mean transverse diameter of lumbar vertebral canal (I.P.D) is minimum at L1 vertebra in both sexes. The maximum values of I.P.D were recorded for vertebra L5 for both sexes. The values of IPD are higher in male population in comparison to female counterparts. The difference between the mean values of males and females are statistically significant .

[Graph 1] show that mean inter-pedicular distance (IPD) in males and females. Mean transverse diameter of lumbar vertebral canal (I.P.D) is minimum at L1 vertebra in both sexes. The maximum values of I.P.D were recorded for vertebra L5 for both sexes. The values of IPD are higher in male population in comparison to female counterparts.

[Table 2] shows that Mean width of body of lumbar vertebrae is minimum at L_1 and maximum at L_5 showing a gradual



Graph 1: **Measurement of inter-pedicular distances in both sexes**

Table 2: Relationship between the width of the vertebral body and mean IPD of the lumbar spinal canal and canal/body ratio

Level	Male			Female		
	IPD mean	W(mm	C/B	IPD mean	W(mm	C/B
L1	24.2	39.2	0.6	23.4	38.2	0.6
L2	25.3	42.5	0.6	24.6	40.5	0.6
L3	26.2	44.8	0.6	25.2	42.8	0.6
L4	27.6	46.3	0.6	27.4	45.7	0.6
L5	30.2	51.7	0.6	29.6	49.2	0.6

increase from level L_1 to L_5 *in* both sexes. Mean Inter-pedicular distance of the lumbar spinal canal is minimum at L_1 and maximum at L_5 showing a gradual increase from level L_1 to L_5 in both sexes. Ratio between transverse diameter of vertebral canal and transverse diameter of the corresponding vertebral body is seen to be constant (0.6) at all lumbar level in both the sexes.

Discussion

The importance of the size and shape of the spinal canal in relation to the occurrence of symptoms of cord or root compression especially, when spondylosis changes supervene has been recognized since last few decades.[13] Most of the earlier work on stenosis is concerned with the cervical region, but in more recent years a similar condition has been fully recognized in the lumbar region also. Stenosis is due to reduced sagittal diameter as well as reduced interpedicular distance has been notice by clinicians in the past few decades.[11–13]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.[14]

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.[8–12] The measurements of this diameter reports gender and regional variability but presently there is no data available that applies to healthy/normal individuals of Telangana, population of south Indian.

The size of the lumbar spinal canal is easily measured by antero-posterior plain radiographs of lumbar spine. Various studies have emphasized, that the ideal X-ray projections for measuring interpedicular distance is the antero-posterior view and this parameter is important in assessing the size of canal.[6,13,15] The present study was conducted to determine inter-pedicular distances of the lumbar vertebrae measured in plain antero-posterior radiograph in population of Telangana.

Chaudhary et al,[16] and Bhaumik et al,[17] in their respective studies on 300 adult subjects from Sonipat district and 1000 adult subjects of western Rajasthan respectively, reported that mean transverse diameter of lumbar vertebral canal (I.P.D) is minimum at L1 vertebra and maximum at L5 vertebra in both sexes. The values of IPD are higher in male population in comparison to female counterparts. Nirvan et al,[18] in their study of inter-pedicular distances of lumbar vertebral canal at levels L_1 to L_5 in plain antero-posterior radiographs of the lumbar spine of 202 subjects (101 male, 101 female), also reported that mean transverse diameter (inter-pedicular distance) is minimum at L_1 (24.0 mm in male and 23.3 mm in female) and maximum at L_5 (30.9 mm in male and 29.8 mm in female) showing a gradual increase from level L_1 to L_5.

Chhabra S et al,[19] studied the interpedicular distances of North Indian population in Rohtak (Haryana) and they also noted the same cephalocaudal increase of interpedicular distances in lumbar vertebral column. The highest values of I.P.D. were noted on L5 (37.4 mm and 34.4 mm) respectively in males and females and the lowest values were recorded (26.0 mm and 24.1 mm) at L1 vertebra for males and females, respectively.

Study of various dimensions of spinal canal has been carried out by radiographic method in various ethnic groups as well as in both sexes of same ethnic group. Eisenstein S., 1977,[1] (South African Caucasoids); Amonoo Kuofi H. S., 1982,[11] (Nigerians); Hinck V.C. et al., 1966,[12] (White Americans); Sudha Chhabra et al., 1991,[19] (North Indians); Amonoo Kuofi H. S. at al., 1990,[20] (Saudis); and Piera V. et al., 1988,[21] (Spanish) have studied dimensions of lumbar spinal canal in both sexes of a particular ethnic group. By careful observations of their studies, it was found that the dimensions of spinal canals vary in various ethnic groups thus, emphasizing the need to have values and

ranges for the transverse diameter of the canal for different populations.[1,11,12,19–21]

In the present study, it was found that the mean inter-pedicular distance (IPD) at L1 was 24.2 mm in males and 23.4 mm in females, at L2 it was 25.3 mm in males and 24.6 mm in females, at L3 it was 26.2 mm in males and 25.2 mm in females, at L4 it was 27.6 mm in males and 27.4 mm in females and at L5 it was 30.2 mm in males and 29.6 mm in females. The gradual increase of mean inter-pedicular distance (IPD) from L1 to L5 is seen in all earlier research works like Chaudhary S et al, Bhaumik et al, Nirvan et al and Chhabra S et al.[16–20] Ratio between transverse diameter of vertebral canal and transverse diameter of the corresponding vertebral body is seen to be constant (0.6) at all lumbar vertebral level in both the sexes. The difference in males and females are found to be significant as compared to earlier research works of Vinay KV et al, on South Indian population.[22]

However, unlike the present study, Janjua MZ et al,[13] and Sethi R et al,[14] studies showed that the various dimensions of lumbar spinal canal gradual decrease from L1 to L5 level and the mean inter-pedicular distance (IPD) at L1 was greater in females in comparison to males at all vertebral levels. The difference in mean values for both the genders was statistically insignificant.

A comparative analysis of present study with the previous study by others authors of different regional Indian population groups suggest that the smallest mean inter-pedicular distances was observed in Guajarati's followed by South Indians than of North Indians region suggesting environmental and ethnic factors as source of geographical differences. Similarly, a comparative analysis of present study with the previous study by others authors of different racial or ethnic groups suggest that the smallest diameter was observed in Nigerian population followed by White Americans, Spanish population and present study population.[1,11,12,19–21] This suggests racial variations in mean inter-pedicular distances. Thus, from the above observations no specific value can be considered as normal values for the mean inter-pedicular distances because it differs on grounds of racial and geographical distribution.

Conclusion

Authors found that there is variation in the size of the lumbar vertebral canal between males and females. There is a cranio-caudal increase of transverse diameter of spinal canal /I.P. D and the width of body of lumbar vertebrae from L1-L5 vertebrae. Even after the revolution brought by the various imaging techniques like CT Scan and MRI etc., still the plain radiography remains the mainstay of investigative procedure particularly in rural setup.

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