



MORPHOMETRIC ANALYSIS OF TRANSVERSE DIAMETER OF LUMBAR SPINAL CANAL IN PLAIN RADIOGRAPHS OF WESTERN MAHARASHTRA POPULATION

Anatomy

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ABSTRACT

Background: The present study was conducted to estimate interpedicular distance of normal lumbar spinal canal to know whether there are regional, ethnic or racial variations and also to know radiographical measurements of spinal canal from normal lumbar vertebrae. **Method:** Interpedicular distance of lumbar spinal canal is measured in plain antero-posterior radiographs of 300 adult subjects (150 males & 150 females) of known sex and age between 25 to 40 years from Kolhapur region. **Results:** Mean transverse diameter of spinal canal goes on increasing from L1 to L5 both in males (24.31 to 31.61mm) and females (22 to 29.33mm). In this study, out of 300 subjects males (150) and females (150). The mean interpedicular distance (IPD) at L1 were 24.31mm in males and 22 mm in females and at L5 were 31.69 mm in males and 29.33 mm in females. **Conclusion:** Authors found that there is variation in the size of the lumbar vertebral canal between males and females. The North Indians have greater IPDs at all level from L1 to L5 than that of Western Maharashtra population. So this present study confirms that there is an ethnic as well as racial variation in the size of lumbar spinal canal. Interpedicular distance of females is less as compared to the males at all the vertebral levels in Western Maharashtra population. So this study is essential to have normal values and ranges for the transverse diameter of lumbar spinal canal for different populations. 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 spinal canal, Lumbar spine

INTRODUCTION

Low backache is a most common health problems affecting up to 85% of people at least once in their lifetime¹. The etiology in many of these patients is narrowing of the lumbar spinal canal. The incidence and implications of lumbar spinal canal stenosis are gaining increasing attention. Stenosis due to decreased sagittal diameter has been reported in the cervical spine as well as in the lumbar spine². 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)³⁻⁵.

The values of the normal interpedicular diameter are different at the various levels of the lumbar spinal canal in individuals of the same race, but in individuals of various races it differs at the identical levels. Narrowing of the spinal canal may be developmental, or it may be the consequences of degenerative changes from ageing, injury or disease, or of spinal surgeries.

The importance of the radiographic measurement of the spinal canal was first emphasized in 1934 by Elsberg and Dyke⁶ who established the normal range of Interpedicular distance in thoracic and lumbar spine and applied it for the diagnosis of intra-spinal tumors.

Study of various dimensions of spinal canal has been carried out by radiographic methods in various ethnic groups as well as in both sexes of same ethnic group and it was found that the dimensions of spinal canal vary in various ethnic groups.^{7,8,9,10,11,12,13} Sarpyener¹⁴ created awareness by first recognizing the clinical importance of lumbar canal stenosis.

Hence the present study was conducted to estimate interpedicular distances (IPD) of the lumbar vertebrae measured in plain antero-posterior radiograph in Western Maharashtra population, to know whether there are regional, ethnic or racial variations and also to know radiographical measurements of spinal canal from normal lumbar vertebrae

MATERIAL AND METHODS

In present work, radiographic measurements were obtained from normal radiographs of 300 adult subjects (150 males and 150 females), of known sex & age between 25 to 40 years from populations of Kolhapur region. The radiographs of both sexes have been taken in supine position with anode film distance of 100 cm. centered on L3.

Radiographs reported normal by the Radiologist were included in the study. The following measurements were taken by using Electronic Digital Vernier Caliper from A-P radiographs of lumbar spine.

a) Interpedicular distance (IPD)

Transverse diameter of spinal canal was obtained by measuring the minimum distance between the shadows of pedicles of same vertebra. (Fig. no.1)



Fig. no.1 A-B Interpedicular distance

Observations And Results

Table-1: Mean Transverse diameter (mm) of spinal canal.

	Sex	Range(mm)	Mean(mm)	± S.D.	P-Value
L1	Male	21.0 - 28.0	24.31	1.70	< 0.001
	Female	15.0 - 25.0	22.00	2.62	
L2	Male	22.0 - 30.0	25.03	1.94	< 0.001
	Female	20.0 - 26.0	23.22	2.12	
L3	Male	20.0 - 30.0	26.37	2.42	< 0.001
	Female	20.0 - 27.0	24.39	1.89	
L4	Male	22.0 - 32.0	27.66	2.62	< 0.001
	Female	22.0 - 28.0	26.17	1.50	
L5	Male	25.0 - 40.0	31.69	3.78	< 0.001
	Female	25.0 - 35.0	29.33	2.38	

Table 1 show that range and mean transverse diameter of spinal canal goes on increasing from L1 to L5 in both male and female. Mean IPDs is minimum at L1 (24.31mm in males & 22mm in females) and maximum at L5 (31.69mm in males & 29.33mm in females). It is also seen that the measurements of transverse diameter of spinal canal is less in females as compared to males.

The difference between the mean values of males and females is statistically significant.

Table no. 2: Comparison of mean transverse diameter (mm) of spinal canal in males between previous studies and present study.

Authors	N	L1	L2	L3	L4	L5
White Americans	59	25.9	26.5	26.8	27.6	30.7
Caucasoid	78	23	24	23	24	26
Zulus	108	21	22	22	23	26
Nigerians	150	22.6	22.7	24.5	26	28.7
Saudis	160	25.1	25.3	26.3	27.2	30.9
North Indians	124	26	27.7	29.7	35.5	37.4
South Indians	80	24.2	25.3	26.2	27.6	30.2
Gujarat	101	24	25.4	26.4	27.9	30.9
Present study	150	24.3	25	26.4	27.7	31.7

Table no. 3: Comparison of mean transverse diameter (mm) of spinal canal in females between previous studies and present study.

Authors	N	L1	L2	L3	L4	L5
White Americans	59	24.3	24.9	25.4	26.9	29.9
Caucasoid	35	22	22	23	23	25
Zulus	54	20	21	21	22	24
Nigerians	140	21.3	22.5	23.7	25.4	28.4
Saudis	180	23.5	24	25.2	26.9	29
North Indians	91	24.1	25.7	27.3	31.1	34.4
South Indians	60	23.4	24.6	25.2	27.4	29.6
Gujarat	101	23.3	24.3	25.8	27	29.8
Present study	150	22	23.2	24.4	26.2	29.3

Table 2 and 3 shows that mean interpedicular distance goes on increasing from above downwards

DISCUSSION

Visualization of vertebral column by various imaging techniques has revolutionized the diagnosis and management of vertebral column disorders like deformities, congenital or traumatic, degenerative and malignant processes. In spite of these advances like CT scan and MRI; radiology remains mainstay of investigative procedure in rural setup to diagnose and manage vertebral column disorders.

As the age group selected for the present study is very the much same as the age group used for the earlier such studies, the ethnic difference in the IPD can be compared easily. Hink et al⁷ have shown that before age of 19 years, the lumbar spinal canal is distinctly narrower than it is in adult.

Saches B. and Frankel J.¹⁵ suggested that thickening of lamina causes narrowing of spinal canal which reduces the IPDs of the spinal canal and is the second most common cause of narrowing of spinal canal. So in the present study attempt has been made to estimate standard normal minimum interpedicular distance as a preliminary to clinical investigation of transverse spinal canal stenosis.

When the present study was compared with the data available from the previous studies there was a significant difference at all lumbar level. Thus there is a necessity of separate study of normal range for male and female population of any particular region.

Table 2 & 3 show a comparison between the mean interpedicular distance of lumbar spinal canal at levels from L1 to L5 in males and females observed in present study and those reported for other population of the world. The IPDs increases steadily from L1 to L5 vertebrae in all populations. It is evident from the table 2 & 3 that values of transverse diameter of spinal canal are highest in North Indians¹² and lowest in Zulus,¹⁶ than that of Kolhapur region. The present study groups are comparable with those of Nigerians⁹ and Gujarati's¹⁷. Also it is observed that interpedicular distance of present study are comparatively lower at upper three lumbar levels and slightly higher at fourth & fifth lumbar level than that of White Americans in males, but in females the mean IPDs are lower at L1 & L2 and higher at L3, L4 & L5 levels.

Table 3 confirmed the findings of ethnical difference in different races of world and support the statement, "There are no mean values of the vertebral dimensions that are valid for all population. A comparison between present data and the published data on interpedicular distance

at lumbar levels of other population also shows that there are marked differences between the mean values reported for the population of different geographic areas. The reason for their difference is not clear, but interplay of racial, ethnic & environment factors cannot be ruled out.^{17 and 18}

CONCLUSION

In this cross sectional study on plain radiographs of lumbar region of 150 male and 150 female asymptomatic subjects of Kolhapur region, the transverse diameter of lumbar spinal canal were measured.

On analysis of observations, it was found that IPD of lumbar spinal canal goes on increasing from L1-L5 in both sexes. But there is a statistically significant difference in mean values in males and females proving sexual dimorphism.

Comparison of these values with those of other ethnic groups showed significant difference. This corroborates the ethnic variation of dimensions of lumbar vertebrae. Though there is existence of racial, ethnic, geographical variations, interesting fact noted during the study is that canal body ratio remains constant for all lumbar vertebrae all over the world.

In this study, we tried to put forth normal parameter for diameter of lumbar spinal canal in both sexes of Kolhapur population separately, which will definitely be useful for early detection of various pathologies like intraspinal tumors, spinal canal stenosis, congenital malformations on a simple, basic, cheap, easily available investigation like radiograph. 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.

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