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## RESEARCH ARTICLE

## A RADIOGRAPHIC STUDY OF INTERPEDICULAR DISTANCE OF THE LUMBAR VERTEBRAE MEASURED IN PLAIN ANTERO-POSTERIOR RADIOGRAPHS

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### Abstract

Interpedicular distance of lumbar spinal canal is measured in plain anteroposterior radiographs of 300 adult subjects (150 males & 150 females) of known sex and age between 25 to 40 years from sonapat district. The aim of this work is to study 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. We found that mean transverse diameter of spinal canal goes on increasing from L1 to L5 both in males and females.

North Indians have greater IPD at all level from L1 to L5 than that of haryanvis subjects. So present study confirms that there is ethnic as well as racial variation in size of lumbar spinal canal. Interpedicular distance of females is less as compared to the males at all vertebral levels in haryanvis subjects. So this study is essential to have normal values and ranges for the transverse diameter of lumbar spinal canal for different populations.

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## INTRODUCTION

Lumbar region is the most vulnerable area for the common symptom of backache. The lumbar part of spinal canal encloses the cauda equina. Narrowing of the canal which can be either developmental or acquired will lead to compression of the cauda equina and subsequent pain; it may be associated with neurological symptoms and signs. Hence it is of great clinical value to measure the dimensions of spinal canal.

It is obvious that various measurements of lumbar vertebrae and intervertebral discs are useful in clinical practice. Many workers have studied various dimensions of lumbar vertebrae, especially the dimensions of spinal canal (Hinck et al., 1966<sup>1</sup>; Eisenstein S., 1977<sup>2</sup> etc.).

In the lumbar region the spinal canal is triangular in shape and is limited anteriorly by posterior surfaces of vertebral bodies of lumbar region, intervertebral discs and posterior longitudinal ligament covering them; laterally by pedicles; posterolaterally by laminae and ligamenta flava and posteriorly by junction of laminae with spinous processes. (Williams P. L. and Warwick R., 1978)<sup>3</sup>.

According to Eisenstein S. (1976)<sup>4</sup> the shape of the upper lumbar spinal canal is almost circular and this changes gradually to triangular form in the lower lumbar region. Thus the lumbar spinal canal provides an appropriate transition between obviously circular shape of thoracic spinal canal and markedly triangular shape of

sacral spinal canal. The clinical relevance of trefoil configuration lies in possible predispose to compression of lumbar and sacral nerve roots.

Spinal canal, vertebral body and intervertebral disc are inaccessible to physical examination; hence various imaging methods are required for study of these structures in living such as Plain radiography, Transverse axial tomography, Ultrasound, Computerized tomography and M.R.I ,ect.

To study the dimensions of spinal canal and / or vertebral body, many workers have used plain radiography (Hinck V. C. et al., 1966<sup>1</sup>; Eisenstein S., 1977<sup>2</sup>).

The careful study of plain radiographs of lumbar spine gives much more information than the information obtained by other techniques like ultrasound. (Hawkes C. H. and Roberts G. M., 1980)<sup>5</sup>.

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. Hinck v.c. et al., 1966<sup>1</sup> (White Americans); Eisenstein S., 1977<sup>2</sup> (South African Caucasoids); Amonoo Kuofi H. S., 1982<sup>6</sup> (Nigerians); Amonoo Kuofi H. S. at al., 1990<sup>7</sup> (Saudis); Piera V. et al., 1988<sup>8</sup> (Spanish) and Sudha Chhabra et al., 1991<sup>9</sup> (North Indians) 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.

Furthermore, plain radiography is more economic from patient's point of view. Therefore, use of plain radiography is made in the present work to study various dimensions of lumbar vertebrae for population of Haryana. Knowledge of normal values of this parameter could be important in detecting isolated segmental changes.

## MATERIAL AND METHODS

For present study, radiographic measurements were obtained from normal antero-posterior radiographs of lumbar spine of 300 adult subjects ( 150 males & 150 females ) between 25 to 40 years from Radiology Department of B.P.S.G.M.C. for women khandpur kalan sonapat. These radiographs were diagnosed as normal by experienced radiologists. The radiographs showing any obvious abnormality were excluded from the study.

The measurements were made by using a scale calibrated to 0.5 mm. The dimensions of all lumbar vertebrae were studied. The interpedicular distance was obtained from the antero-posterior radiographs of lumbar spine. This corresponds to transverse diameter of spinal canal and was obtained by measuring the minimum distance between the shadows of pedicles of same vertebra.

### Observations and results:

**Table No. I :**Interpedicular distance (mm) in both sexes.

Level	Sex group	Mean	S. D.	Calculated range $\pm$ 3 S.D.	P-Value
L <sub>1</sub>	Male	24.06	$\pm$ 2.2	17.6-30.54	< 0.001
	Female	21.64	$\pm$ 3.4	11.4-31.8	
L <sub>2</sub>	Male	24.73	$\pm$ 2.2	18.1-31.33	< 0.001
	female	23.31	$\pm$ 2.4	16.11-30.5	
L <sub>3</sub>	Male	26.01	$\pm$ 2.4	18.66-33.36	< 0.001
	female	24.02	$\pm$ 2.5	16.52-31.52	
L <sub>4</sub>	Male	27.15	$\pm$ 3.9	15.15-39.15	< 0.001
	female	25.71	$\pm$ 2.4	18.5-32.9	
L <sub>5</sub>	Male	31.34	$\pm$ 5.9	13.34-49.34	< 0.001
	female	29.01	$\pm$ 3.4	18.8-39.2	

The observation table no. I shows that,

A)I.P.D. (the transverse diameter of spinal canal) goes on increasing from L<sub>1</sub> to L<sub>5</sub>

B) It also shows that the values of transverse diameter of spinal canal are smaller in females as compared to males. The difference between the mean values of males and females are statistically significant .

C).The values less than the lower limits of the calculated range may be suggestive of spinal canal stenosis at that particular segmental level. Similarly, the values more than the upper limits of the calculated range are suggestive of intraspinal tumor at that particular segmental level for males and females respectively

**Observations table No. II :**

Mean transverse diameters (mm) of spinal canals in males between previous studies and present study.

Authors	sex	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
Eisenstein 1977. (South African Caucasoids)	male	23.00	24.00	23.00	24.00	26.00
	female	22	22	23	23	25
Eisenstein 1977 (Zulus)	Male	21.00	22.00	22.00	23.00	26.00
	female	20	21	21	22	24
Amonoo Kuofi H. S. 1982 (Nigerians)	Male	22.60	22.70	24.50	26.00	28.70
	female	21.3	22.5	23.7	25.4	28.4
Amonoo Kuofi H. S. et al. 1990 (Saudis)	Male	25.10	25.30	26.30	27.20	30.90
	female	23.5	24	25.2	26.9	29
Sudha Chhabra et al. 1991 (North Indians)	Male	26.00	27.70	29.70	35.50	37.40
	female	24.1	25.7	27.3	31.1	34.4
Present study (sonapat District)	Male	24.06	24.73	26.01	27.15	31.34
	female	21.64	23.31	24.02	25.71	29.01

**TABLE II:** comparison of mean transverse diameter of spinal canal between previous studies and present study

From the observations of table No. II it is clear that there is a minimal variation in the transverse diameter of spinal canal among various ethnic groups.

In this comparison, values of transverse diameter of spinal canal are highest in **North Indians (Sudha Chhabra et al., 1991)<sup>9</sup>** and the lowest in **Zulus (Eisenstein S., 1977)<sup>2</sup>**. The values of present study group fall in between the two.

The values of the present study group are comparable with those of **Nigerians (Amonoo Kuofi H. S. et al., 1990)<sup>7</sup>**. When compared with North Indians, the values are slightly less. This may be because of obvious difference in the builds of the two.

## DISCUSSION

Diagnosis and management of vertebral column disorder like congenital malformations, deformities, degenerations, trauma and malignant processes got advancement by various imaging techniques like CT Scan, MRI. Even after this revolution radiography remains the mainstay of investigative procedure particularly in rural setup.

Table I shows that I.P.D. (the transverse diameter of spinal canal) goes on increasing from L<sub>1</sub> to L<sub>5</sub> and values are smaller in females as compared to males with a statistically significant difference. It is evident from table II that the values of transverse diameter of spinal canal are highest in North Indians and lowest in Zulus and present study groups are comparable with **Nigerians<sup>6</sup>**.

In the present study attempt has been made to determine standard normal minimum interpedicular distance as a preliminary to clinical investigation of transverse spinal canal stenosis as it is suggested that thickening of lamina causes narrowing of spinal canal which reduces the IPD s of the spinal canal and is the second most common cause of narrowing of spinal canal. (**Saches B. Frankel J.**)<sup>10</sup>

The IPD in the present study when compared with previous such studies showed a significant difference at all lumbar levels. Thus there is a necessity of separate range for male and female population of any particular region.

## CONCLUSION:

In the present study normal antero-posterior radiographs of lumbar spine of three hundred adult subjects (150 males and 150 females) of Sonapat District are studied. The parameters used in the study is transverse diameters of spinal canal.

Thus, this study has presented a set of radiographic measurements and results obtained by evaluating normal radiographs of Sonapat District Subjects.

It is found that the transverse diameter of spinal canal goes on increasing from L1 to L5. A statistically significant difference in mean values in male and females proving sexual dimorphism. Comparison of these values with those of other ethnic groups showed a significant difference. This corroborates the ethnic variation of dimensions of lumbar vertebrae .

Furthermore, careful study of these parameters and indices may be useful in radiological detection of clinical conditions like bony spinal canal stenosis, some cases of intraspinal tumors, vertical compressions of vertebral bodies and prolapsed intervertebral discs.

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Conflict of interest: nil

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