Research Article

Significance of measuring of dimensions of lumbar spinal canal on plain radiographs in narrow spinal canal

Shastrakar Rupali Sureshrao[1*], Kasote Arunkumar P[2]

[1]Department of Anatomy, Padmashree Dr. D. Y. Patil Medical College, Nerul, Navi Mumbai, Maharashtra, INDIA.
[2]Department of Anatomy, Government Medical College, Nagpur, Maharashtra, INDIA.
Email: rupalimuthal@rediffmail.com

Abstract

The present study was carried out on 200 subjects with 100 asymptomatic control and 100 symptomatic cases of low backache, sciatica and neurogenic claudication of more than 6 months duration of age group 30 -80 years. The aim of the study was to find out the dimensions of the lumbar spinal canal on plain radiographs of the lumbar spine in normal and symptomatic subjects and to compare them. It was found that the lower normal limit of the transverse diameter of the lumbar spinal canal was 20 mm and antero-posterior diameter was 15.2 mm on plain radiographs of asymptomatic healthy subjects. Anteroposterior diameter was found to be more adversely affected in narrow spinal canal.

Key words: Radiographs, Lumbar spine, Neurogenic claudication, Sciatica.

[*]**Address for Correspondence:**
Dr. Shastrakar Rupali Sureshrao, Department of Anatomy, Padmashree Dr. D. Y. Patil Medical College, Nerul, Navi Mumbai, Maharashtra, INDIA.
Email: rupalimuthal@rediffmail.com

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INTRODUCTION

Low back pain resulting from degenerative diseases of the lumbosacral spine is a major cause of morbidity, disability and lost productivity. A ubiquitous and potentially disabling cause of osteoarthritic pain of the lower back and legs is stenosis of the lumbar spinal canal (Alvarez J. A., Hardy R. H.,1998). In 1954, Verbiest first published his work on narrowing of the spinal canal. The factor responsible for non spondylotic low back pain is the narrow lumbar spinal canal, which is defined as any type of narrowing of the spinal canal, nerve root canal (tunnel) or intervertebral foramina that results in compression of the lumbosacral nerve roots or cauda equina. (Grabias S.,1980). So in this study dimensions of the lumbar spinal canal were measured in normal and symptomatic subjects presenting with symptoms supposed to be related to narrow spinal canal by simple investigation like plain radiograph of the lumbar spine.

MATERIAL AND METHODS

The present study was carried out in the department of Anatomy at Government Medical College**,** Nagpur. The symptomatic subjects for the study were the patients attending the Orthopedic OPD for different complaints suggestive of narrow spinal canal. Their X-rays were taken in the Radiology department with their informed consent. Overall plain radiographs (both anteroposterior and lateral view) of 200 subjects were included in the study.

Control

Inclusion criteria: 1.normal healthy subjects , 50 male and 50 female without any complaints suggestive of back pathology.

2.Age range between 30-80 years.

Exclusion criteria: Subjects with significant skeletal anomalies , other problems likely to influence growth and development and younger age group (less than 19 years) were excluded to avoid lowering of the mean as lumbar spinal canal is distinctly narrower in them.(Hink V. C., Clark W. M., Hopkins C. E. May 1966).

Cases

Inclusion criteria: symptomatic subjects aged between 30-80 years with symptoms supposed to be related to narrow lumbar spinal canal that is,

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1. Chronic low back pain (more than 6 months duration),
2. Sciatica (which is defined as low back pain with radiation to one or both legs may be associated with numbness and paraesthesia)
3. Neurogenic claudication (as described by Gelderen V.,1948) and Ehni G.(Nov 1969), is characterized by leg pain, leg achiness, numbness and tingling as well as cramping and weakness, symptoms worsens with walking and distance reduces progressively.

Exclusion criteria: Those with short (acute) duration of complaints , absent peripheral pulses and any history of trauma or lifting heavy weight were excluded. The radiographs of the control and cases were taken in lying down position with an anode film distance of 110 cm. centered on L_3 vertebra. X-rays were taken in anteroposterior and lateral views. All measurements were made by Vernier Calipers and were recorded in millimeters. Keeping in view the aims of the study, following observations were made on x-rays:

- Transverse diameter of the lumbar spinal canal (TC) was measured as the minimum distance between the medial surfaces of the pedicles of a given vertebra (interpedicular distance).
- Antero-posterior (AP) diameter of the lumbar spinal canal(B) in lateral radiographs from middle of the back of the vertebral body to the base of the opposing spinous process, which can be recognized by tracing forwards its inferior margin.
- Transverse diameter of the vertebral body(C) was measured as the minimum distance across the waist of the vertebral body, which is between its upper and lower border.
- AP diameter of the vertebral body (D) at the level of inferior margin of spinous process.
- Canal to body ratio calculated i.e. Jone's Spinal Index(ratio of product of transverse diameter of the canal (A) and anteroposterior diameter of the canal (B)to the product of transverse diameter of the body (C) and anteroposterior diameter of body (D) that is, AB:CD (Jones and Thomson ,1968).

From above measurements mean values and standard deviation were calculated for each vertebral level.By calculating this ratio, it is possible to determine whether this individual measurements are within normal limits for respective vertebral body size or not.

Statistical Analysis

- Continuous variables were presented as mean ± standard deviation.
- Categorical variables were expressed in percentages.
- Age group comparisons, transverse diameter and anteroposterior diameter of the lumbar spinal canal of males and females of control and cases were compared by 'Unpaired t-test'.
- Categorical data was analyzed by 'Chi- square test'.
- Fisher Exact test was applied for small numbers. P value less than 0.05 was considered as statistical significance.

OBSERVATION & RESULTS

The most common vertebral level involved in narrowing of the spinal canal with associated degenerative changes is L_5 , followed by L_3 - L_4 (Garfin S. R., Rydevik B. L ; 1999). Considering this fact most of the observations in this study were made at L_4 and L_5 level.

Table 1: Mean transverse diameter (MTC) of the lumbar spinal canal in mm, standard deviation (SD) in mm in male and female subject of control and cases

Vertebral Level	Male					Female				
	Control		Cases		p value	Control		Cases		p value
	MTC	SD	MTC	SD		MTC	SD	MTC	SD	
L_1	23.00	1.95	22.35	1.90	0.0946N	22.06	1.83	21.22	1.68	0.0187*
L_2	23.95	1.92	23.22	1.84	0.0551N	23.00	1.85	22.21	1.48	0.0204*
L_3	24.92	2.22	24.16	2.02	0.0765N	23.98	1.86	23.61	1.89	0.3263N
L_4	26.82	2.21	26.29	2.47	0.2609N	25.95	2.07	25.92	2.32	0.9457N
L_5	29.90	2.43	29.12	2.82	0.1416N	29.28	2.05	28.05	2.13	0.0041*

*significant ($p<0.05$) N- non significant($p>0.05$)

Table 2: Mean anteroposterior diameter (MAPC) of the lumbar spinal canal in mm, standard deviation (SD) in mm in male and female subject of control and cases

Vertebral Level	Male					Female				
	Control		Cases		p value	Control		Cases		p value
	MAPC	SD	MAPC	SD		MAPC	SD	MAPC	SD	
L_1	17.85	1.00	17.59	1.64	0.3409N	17.69	0.97	17.58	1.24	0.6224N
L_2	18.50	1.08	17.44	1.74	0.0004**	18.38	1.08	17.41	1.42	0.0002**
L_3	18.87	1.27	16.52	1.84	0.0000**	18.71	1.29	17.04	1.39	0.0000**
L_4	18.84	1.43	15.10	1.95	0.0000**	18.39	1.34	15.44	1.80	0.0000**
L_5	18.61	1.66	14.76	2.17	0.0000**	17.90	1.37	15.19	1.68	0.0000**

N –Non significant($p>0.05$) **Highly significant

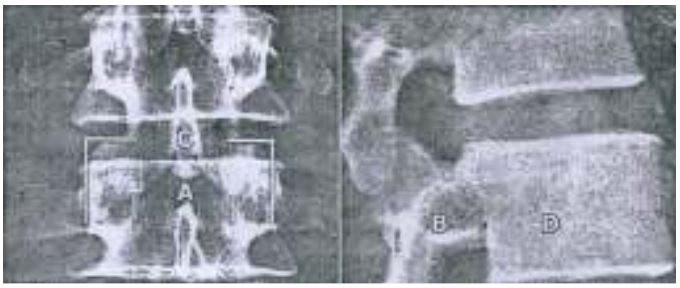

Figure 1: Showing anteroposterior and lateral radiographs of the lumbar spine

Legend:
A: Transeverse diameter of the lumbar spinal canal
B:Anteroposterior diameter of the lumbar spinal canal
C: Transeverse diameter of the lumbar vertebral body
D: Anteroposterior diameter of the lumbar vertebral body

Figure 2: Anteroposterior and lateral radiographs of the asymptomatic subjects

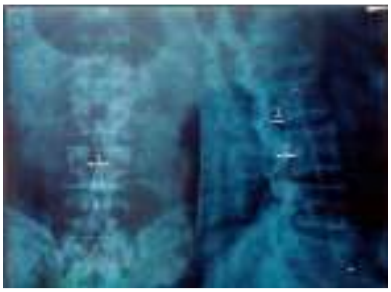

Figure 3: Anteroposterior and lateral radiographs of the lumbar spine in subjects with narrow lumbar spinal canal.

Legend:
Arrow 1 shows narrow transeverse diameter of the lumbar spinal canal.
Arrow 2 shows narrow anteroposterior diameter of the lumbar spinal canal.
Arrow 3 shows flattened intervertebral foramina.

DISCUSSION

Table 3: Comparisons of values of transverse diameter of lumbar spinal canal given by different authors

Sr. No.	Author	Year	Transverse diameter of lumbar spinal canal (mm)
1.	Roberson	1973	25
2.	Eisenstein	1977	20
3.	Tacar and Demirant	2003	20
4.	Present study	2009	20

In this study it was found that the mean transverse diameter (MTC) of the lumbar spinal canal increases gradually from L_1 to L_5. The value of standard deviation is highest at L_5 suggesting greater variation at this level. The mean transverse diameter (MTC) of the spinal canal in males is at higher level than in females at each vertebral level not exceeding 1mm. These findings are consistent with studies of Amonoo Kuofi H. S. (1982), Amonoo Kuofi H. S., Patel P. J. (1990) , Nirvan A. B., Pensi C.A. (2005). Out of 100 cases only 5(5%) of subjects were having transverse diameter of the lumbar spinal canal less than 20 mm which is statistically insignificant when compared to controls. Baddeley H.

(1976) suggested that the transverse diameter of the spinal canal (interpedicular distance) is not related to stenosis. Ivanov I., Milenkovic Z. (1998) emphasized on anteroposterior diameter of the lumbar spinal canal as the cause of narrow spinal.

Table 4: Comparisons of values of anteroposterior diameter of lumbar spinal canal given by different authors

. No.	Author	Year	Anteroposterior diameter of lumbar spinal canal (mm)
1.	Epstein and collegues	1962	15
2.	Roberson	1973	15
3.	Eisenstein	1977	15
4.	Ivanov I., Milenkovic Z.	1998	15
5.	Tacar and Demirant	2003	15
6.	Present study	2009	15.2

Out of 100 subjects, 51(51%) subjects were found to have anteroposterior diameter of the lumbar spinal canal less than 15 mm, which was statistically highly significant. When number of subjects with anteroposterior diameter of the lumbar spinal canal less than 15 mm in controls were compared with cases ,the difference was highly significant at lower three vertebrae.

CONCLUSION

Considering transverse diameter of the canal, males have wider canals than females .The lower normal limit of the transverse diameter of the lumbar spinal canal was 20 mm on plain anteroposterior radiographs of the lumbar spine. Transverse diameter of the lumbar spinal canal is not a valid indicator of narrow spinal canal. It is reduced only minimally or just at the lower limits of normal in symptomatic subjects. The lower normal limit of the anteroposterior diameter of the lumbar spinal canal was 15.2 mm on plain lateral lumbar spine radiographs. Anteroposterior diameter of the lumbar spinal canal is affected commonly in the narrow spinal canal. When it is below 15mm, it is indicative of narrowing of spinal canal in midsagittal plane. Maximum numbers of cases were having value of anteroposterior diameter of the lumbar spinal canal less than 15 mm at lower three lumbar vertebrae. This shows that anteroposterior diameter is affected most commonly in these vertebrae. Plain radiographs, it is true do not indicate the cross sectional shape of the canal, nor do they demonstrate the degree of soft tissue thickening, but various parameters used in this study can be used as an inexpensive, easy screening methods for narrow spinal canal.

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