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Original Research Article

EVALUATION OF LUMBAR VERTEBRAL CANAL AT DISC LEVEL IN SYMPTOMATIC AND ASYMPTOMATIC SUBJECTS: A RADIOLOGICAL EVALUATION

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ABSTRACT

Background: Spinal stenosis is defined as the narrowing of central spinal canal or its lateral recesses. Stenosis of spinal canal becomes important only when it results in interference with the normal functions of the contents of the canal. Narrowing of spinal canal seems to be a normal part of advancing age but certain uncertainties persist as regards to radiological definition of lumbar spinal canal stenosis.

Material & Method: The present study was aimed to evaluate the clinical relevance of stenosis of spinal canal through the most recent technique, MRI. Fifty symptomatic and 18 asymptomatic subjects were included. Antero-posterior and transverse diameters of vertebral canal were compared between symptomatic and asymptomatic subjects and statistically analyzed.

Results & Discussion: The present study clearly shows that in both symptomatic and asymptomatic subjects there is a gradual decrease in the antero-posterior diameter from above downwards . The minimum antero-posterior and maximum transverse diameter was seen at L_4L_5 level making this level susceptible to compressive symptomatology. Apparent stenosis was observed in some asymptomatic subjects.

Conclusion: Radiological evaluation alone is not sufficient to define lumbar spinal canal stenosis.

KEY WORDS: Lumbar canal, Radiological Study, Stenosis.

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INTRODUCTION

The normal bony anatomy of spinal canal consists of a series of intraosseous and interosseous segments. The intraosseous segment has a completely enclosed central spinal canal, the vertebral body, pedicles and laminae forming the bony ring and interosseous segment has an incomplete bony ring, the

posterior margin of the central spinal canal being formed by ligamentum flavum and laterally by intervertebral foramina. Any one or more of the following conditions namely, narrowing of the central spinal canal, narrowing of the lateral recess and narrowing of the neural foramen can be termed as the lumbar spinal canal stenosis (LSS) [1,2]. The concept of LSS has been known since Verbiest's, report on idiopathic developmental stenosis in French [3], Dutch [4], and in English populations [5]. LSS is most commonly classified as either primary, caused by congenital abnormalities or secondary (acquired) resulting from degenerative changes, local infection, trauma or surgery [6,7].

Patients with LSS complain of low back pain, lower extremity pain and/or numbness, and neurogenic intermittent claudication. Although the incidence and prevalence of symptomatic LSS have not been established, LSS is the most frequent indication for spinal surgery in the lumbar region in patients older than 65 years [8, 9]. Degenerative LSS anatomically involves the central canal, lateral recess, neural foramina or any combination of these locations. Decrease in the antero-posterior, transverse or combined diameter of central canal leads to its stenosis. Various anatomical and radiological measurements of lumbar spinal canal have been used to define the LSS and to correlate the symptoms of LSS with the extent of reduction in the dimensions of the canal. There is poor correlation of extent of narrowing of the canal with the severity of the symptoms and even severe anatomical spinal stenosis may be present in completely asymptomatic patients [10,11]. There is no generally accepted "gold standard" for the diagnosis of LSS [12,13]. Magnetic resonance imaging (MRI) still remains the imaging modality of choice for assessment of LSS. The present MRI study was undertaken to evaluate the antero-posterior and transverse diameters of the lumbar spinal canal at the level of intervertebral discs in both symptomatic and asymptomatic patients and to correlate the presence of stenosis with clinical symptoms.

MATERIALS AND METHODS

The present study was carried out in the Department of anatomy in collaboration with the Department of Radio-diagnosis and NMC-Sky Imaging Centre, LLRM Medical College, Meerut during the session 2008-2009. The study is longitudinal comparative type with 68 cases, both symptomatic and asymptomatic, enrolled randomly coming with the referral from the Neurosurgery and Orthopedic departments to Radiodiagnostic Centre for MRI of lumbosacral region. Out of total 68 cases, 50 were symptomatic having complaints suggestive of spinal cord/spinal nerve compression, rest 18 cases were asymptomatic cases included in the study for comparison.

Fig. 1: Axial T2 weighted images at intervertebral disc level (L1-L2, L2-L3, L3-L4 and L4-L5 discs) to show the measurements of antero-posterior and transverse diameter of lumbar vertebral canal in a symptomatic patient. The level of axial image is shown in the reference T2 W sagittal image.

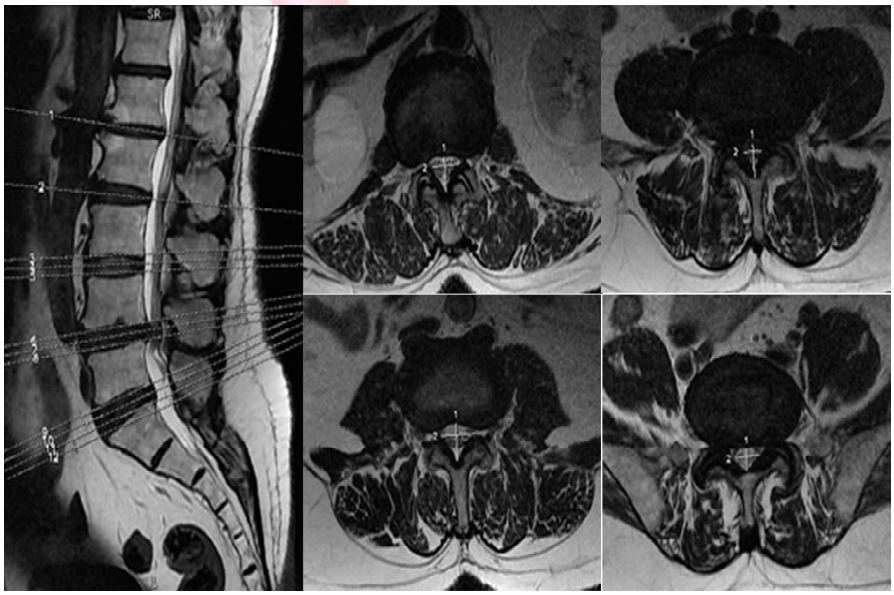
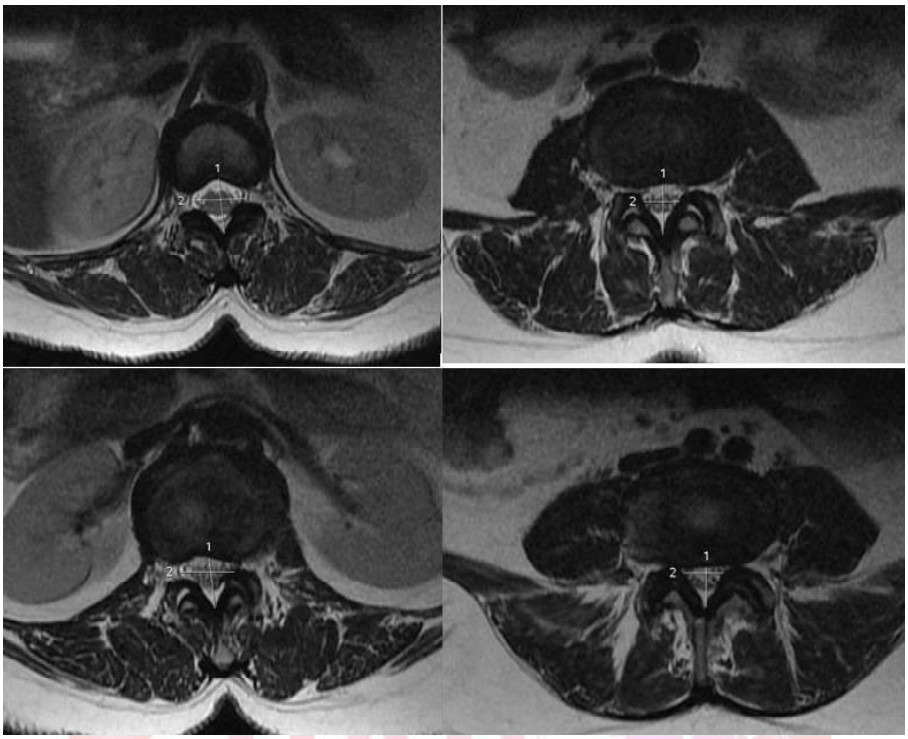


Fig. 2: Axial T2 weighted images at intervertebral disc level to show the measurements of antero-posterior and transverse diameter of lumbar vertebral canal in an asymptomatic patient.



Exclusion criteria: (1) Lumbar vertebral fracture (2) vertebral abnormalities (3) previous spinal surgery (4) Spinal tumours (5) Pott's spine (6) Paget's disease (7) gross spinal pathology.

A detailed history was recorded and examination of every case was also done. Questions were put up regarding the complaints of backache, leg pain, muscular weakness, site and radiation of pain, aggravating or relieving factors, bladder and parasympathetic disturbances and duration of the symptoms. The MRI machine of 1.5 Tesla of G.G. Company with LCD projector was used to measure vertebral canal by antero-posterior diameter and transverse diameter at disc level of each lumbar level in axial T2 weighted images. The antero-posterior diameter of the central canal was measured as the midsagittal distance between the posterior border of the vertebra and the lamina posteriorly. The maximum transverse diameter of the canal was also measured. (Figure-1,2). The data was statistically analyzed using unpaired 't' test with Welch correction.

RESULTS AND DISCUSSION

Lumbar spinal stenosis (LSS) is most commonly classified as either primary, caused by congenital abnormalities or secondary (acquired stenosis) resulting from degenerative changes or as consequences of local infection, trauma or surgery [6,7,14]. Despite the previously mentioned seemingly clear definition of LSS, a thorough review of the literature reveals noticeable uncertainties concerning diagnosis and treatment of LSS [15-17]. Magnetic resonance imaging (MRI) has become the imaging modality of choice for lumbar spinal canal stenosis (LSS) due to limitations and radiation risks of computed tomography (CT) and spinal radiography [18]. Central canal stenosis may result from a decrease in the antero-posterior, transverse or combined diameter secondary to loss of disc height with or without bulging of the intervertebral disc [17] and to exclude the defects of intervertebral disc, measurements were done at the disc level. In present study antero-posterior diameter observed in asymptomatic patients at L1-L2 level was 17.50 ± 0.25 mm which continuously decreased to 14.00 ± 0.42 mm at L4-L5 level. (Table-1) The corresponding values in symptomatic patients were 14.90 ± 0.26 mm and 12.76 ± 0.24 mm respectively. On comparison of antero-posterior diameter of symptomatic with asymptomatic cases it was noted that the values were statistically more significant at L1-L2 and L2-L3 levels only. These observations of asymptomatic patients were very similar to

Elhassan et al who observed the longest mean AP diameter at L1 (17.5 ± 2.0 mm in males and 18.1 ± 2.7 mm in females) and the shortest at S1 (15.9 ± 3.2 mm in males and 15.4 ± 3.2 mm in females) in normal Sudanian population [19].

Table 1: Comparison of Anteroposterior Diameter (in mm) of Lumbar Vertebral Canal in Symptomatic and Asymptomatic Subjects.

Level	Anteroposterior Diameter in mm (Mean ± SEM)		p value
	Symptomatic cases (n=50)	Asymptomatic cases (n=18)	
L_1L_2	14.90 ± 0.26***	17.50 ± 0.25	0.0001
L_2L_3	14.98 ± 0.25 ***	17.11 ± 0.28	0.0001
L_3L_4	14.22 ± 0.29 **	15.78 ± 0.35	0.004
L_4L_5	12.76 ± 0.24 *	14.00 ± 0.42	0.01

Significance: * Mild, ** Moderate, *** High
NS = Nonsignificant; SEM = Standard Error of Mean

Table 2: Comparison of Transverse Diameter of Lumbar Vertebral Canal (in mm) in Symptomatic and Asymptomatic Subjects.

Level	Transverse Diameter in mm (Mean ± SEM)		p value
	Symptomatic cases (n=50)	Asymptomatic cases (n=18)	
L_1L_2	20.56 ± 0.32^{NS}	21.00 ± 0.27	0.43
L_2L_3	20.30 ± 0.34*	21.72 ± 0.28	0.01
L_3L_4	20.18 ± 0.36***	22.56 ± 0.20	0.0003
L_4L_5	21.70 ± 0.45**	23.94 ± 0.29	0.004

Significance: * Mild, ** Moderate, *** High
NS = Non-significant; SEM = Standard Error of Mean

At L_4L_5 level our values correlated with previous study of Hinck et al [20] and Larson and Smith [21] who stated that APD of 12-13 mm is to be considered as narrow and with Anderson et al [22] who stated that APD <14 mm is a risk factor. Observation that APD in asymptomatic subject decreases from L_1L_2 to L_4L_5 was similar to observation of Janjua and Muhammad [23], Rama Devi and Rajagopalan [24]. Tong et al studied asymptomatic subjects of greater than 55 year old by MRI and found that mean osseous spinal canal diameter gradually decreased from 20.4 mm at L_{1-2} level to 16.00 mm at L_5-S_1 which also supports our observations [25]. They also suggested that the lower-limit cutoff for the osseous spinal canal diameter should be 10.7 and 11.9 mm to achieve 95 % and 90% specificities.

Transverse diameter of the central canal showed a gradual increase from L1-L2 level to L4L5 level in both symptomatic and asymptomatic subjects (Table- 2). Maximum values are found at L4L5 level in both symptomatic and asymptomatic subjects. This is in contrast to antero-posterior diameter which gradually decreased. Transverse diameter of symptomatic and asymptomatic subjects when compared was statistically significant at all levels except L_1L_2 with a high significance at L_3L_4 level. This observation correlated well with the study of Rama Devi and Rajagopalan [24] who have stated that there is gradual increase in transverse diameter from L_1 to L_5.

It is obvious that the dimensions of the central canal changes with levels and hence LSS can be segmental affecting single or multiple segments [26]. There is lack of consensus about the lower-limit cutoff value to define spinal stenosis and different authors use antero-posterior diameter values ranging from 9 mm to 12 mm to define LSS [26-29]. Moreover our study and many others have indicated that many patients showing radiological evidence of LSS have no signs or symptoms and those showing clinical symptoms have normal lumbar spinal canal.

CONCLUSION

Lumbar canal stenosis of degenerative type may present with few symptoms or with significant disability . Some time even severe anatomical spinal stenosis may be present in asymptomatic patients but most of the time it correlates with the dimensions of spinal canal.

MRI measurement of lumbar canal is sensitive tool without radiation hazard and with high sensitivity to find out real dimensions of lumbar canal at different levels and it can also be used to establish a standard value of parameter which can differentiate between symptomatic and asymptomatic persons.

Conflicts of Interests: None

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