

ANATOMICAL STUDY OF LUMBAR SPINAL CANAL DIAMETER ON MRI TO ASSESS SPINAL CANAL STENOSIS

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ABSTRACT

Introduction: Lumbar canal stenosis occurs due to narrowing of spinal canal diameter and is usually diagnosed by MRI.

Aims and Objectives of the study: To study and compare the lumbar canal diameters (Antero Posterior) and Cross sectional areas in symptomatic and asymptomatic patients with Lumbar canal stenosis diagnosed using MRI.

Materials and Methods: It is a prospective observational study. A total of 100 patients were subjected to MRI and canal diameters were measured. Among them 60 patients were symptomatic with low back pain and 40 patients were asymptomatic without any back pain. Fifty five patients were males and 45 were females. Majority (31%) were in the age group of 20-30 years.

Results: In symptomatic cases, 41 (68%) cases were stenosed. Stenosis at all the three levels was seen in 5 (12%) cases. At L3-L4, L4- L5 stenosis was seen in 6 (14%) cases, L4-L5, L5-S1 stenosis was seen in 22(53%) cases, L3-L4, L5-S1 stenosis was seen in 8(19%) cases. In asymptomatic cases, stenosis at all the three levels was seen in 5 (13%) cases and at L4-L5; L5-S1 stenosis was seen in 5(12.5%) cases, L3-L4, L5-S1 stenosis was seen in 2(5%) cases.

Conclusion: Even in symptomatic Patients, normal diameter of the spinal canal was noticed in 19 (32%) cases. Even in asymptomatic cases canal narrowing was noticed. Most of the symptomatic cases had normal Cross sectional area. Detailed history and clinical examination of the patient along with the radiological investigation of stenosis with MRI scan, will establish the diagnosis.

KEY WORDS: Lumbar canal stenosis, Canal diameter measurements, MRI, Diagnostic methods.

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INTRODUCTION

The spinal canal is the opening in each vertebra through which the spinal cord passes. Lumbar spinal canal is that portion of the spinal canal within the five lumbar vertebrae. The normal lumbar spinal canal diameter ranges between 15-27 mm. A diameter of less than 12 mm indicates stenosis and less than 10 mm is definitive stenosis. Lumbar spinal canal stenosis is the progressive narrowing of spinal canal that causes compression of nerve roots. It can be congenital, acquired or result from a combination of congenital abnormalities with superimposed degenerative changes.

Lumbar spinal stenosis does not cause symptoms unless its contents the spinal cord or the nerves are compressed. The syndrome of spinal canal stenosis includes bilateral lower extremity pain, numbness and weakness that is poorly localized and usually associated with low back pain. Magnetic resonance imaging is being used increasingly for the diagnosis of conditions causing acute low back pain and sciatica. Though some investigators have proposed that MRI alone is insufficient to justify treatment for spinal stenosis, several others reported that MRI is equivalent to that of CT while others reported that CT is better than MRI [1]. Currently in clinical practice, MRI scan is routinely used to diagnose Lumbar canal stenosis. Measurements of spinal canal are better measured by MRI [2].

Aims and Objectives of the study: To study and compare the lumbar canal diameters (Antero Posterior) and Cross sectional areas in symptomatic and asymptomatic patients with Lumbar canal stenosis diagnosed using MRI.

MATERIALS AND METHODS

It is a prospective Observational study. Totally 100 patients were subjected to MRI. Among them 60 patients were symptomatic with low back pain and 40 patients were asymptomatic without any back pain presented to Neurology ward in our hospital. Fifty five patients were males and 45 were females. Majority (31%) were in the age group of 20-30 years. The MRI was performed using 1.5 Tesla Avanto MRI machine of Seimens Ltd. Standard protocols were followed for the study. They include T1 W, T2 W

images in axial, sagittal and coronal planes. Patients between 20-70 years of age were evaluated, and were distributed at 10 year age intervals for analysis. We have excluded patients with age less than 20yrs, spinal deformities, history of trauma, past history of spine surgery.

Patients included in this study were classified into two groups:

Symptomatic (Group 1): Patients with symptoms of lumbar canal stenosis like incapacitating pain in the back and lower extremities, numbness, tingling sensations and neurogenic claudication.

Asymptomatic (Group 2): Patients visiting for routine preoperative screening and those referred from department of neurology and as part of routine screening in quadriplegia without any lumbar spine pathology.

The subjects were arranged as male and female in the following age groups:

1. 21-30 years
2. 31-40 years
3. 41-50 years
4. 51-60 years
5. More than 60 years.

All subjects underwent MRI examination of the lumbar spine. The MRI was performed on 1.5 Tesla Avanto MRI machine of Seimens Ltd. Standard protocols were followed for the study. They include T1 W, T2 W images in axial, sagittal and coronal planes. Third lumbar vertebra to first sacral vertebra were studied. For each of the vertebra, the antero posterior diameters of the lumbar vertebral canal, sagittal diameter and cross sectional area of the spinal canal were measured in axial, sagittal and coronal planes. The measurements were recorded in millimeters. Comparisons of antero posterior, sagittal and cross sectional areas between asymptomatic and symptomatic cases were done.

The normal lumbar spinal canal ranges between 15-27 mm diameters. Antero posterior diameter less than 12 mm is evidence of stenosis and less than 10 mm is definitive stenosis. Normal range for Cross sectional area of lumbar spine is 180 ± 50 sq. mm, a range between 100 to 70 sq. mm is considered as moderate stenosis, and less than 70 sq. mm is severe stenosis. The results

were analysed and compared between symptomatic and asymptomatic patients.

RESULTS

In symptomatic cases, 41 (68%) cases were stenosed. Stenosis at all the three levels was seen in 5 (12%) cases. At L3-L4, L4- L5 stenosis was seen in 6 (14%) cases, L4-L5, L5-S1 stenosis was seen in 22(53%) cases, L3-L4, L5-S1 stenosis was seen in 8(19%) cases. In asymptomatic cases, stenosis at all the three levels was seen in 5 (13%) cases and at L4-L5; L5-S1 stenosis was seen in 5(12.5%) cases, L3-L4, L5-S1 stenosis was seen in 2(5%) cases.

Graph 1: Symptomatic and asymptomatic age group distribution.

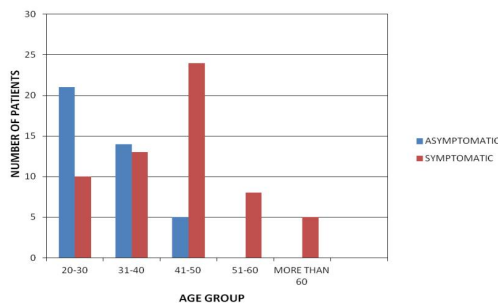


Table 1: Symptomatic patients Antero posterior diameter Analysis.

Total no of cases	60
Stenosis	41 (68%)
Normal diameter	19 (32%)
Stenosis at all three levels	5 (12%) cases
Stenosis at 2 levels	
L3-L4, L4-L5	6(14%) cases
L4-L5, L5-S1	22 (53%) cases
L3-L4, L5-S1	8 (19%) cases

Table 2: Showing Asymptomatic patients Antero Posterior Diameter.

Total	Vertebral level	40
Stenosis at all the three levels	L3-L4, L4-L5, L5-S1	5 (13%)
Stenosis at two levels	L3-L4, L4-L5	Nil
	L4-L5, L5-S1	5(12.5%)
	L3-L4, L5-S1	2(5%)

Table 3: Cross sectional diameter in Symptomatic patients.

Age Group	L3-L4 CSA			L4-L5 CSA			L5-S1-CSA		
	Normal	Moderate Narrowing	Severe Narrowing	Normal	Moderate Narrowing	Severe Narrowing	Normal	Moderate Narrowing	Severe Narrowing
21-30	10	0	0	6	4	0	7	3	0
31-40	12	1	0	10	3	0	7	5	1
41-50	24	0	0	22	2	0	19	5	0
51-60	8	0	0	8	0	0	6	2	0
>60	5	0	0	5	0	0	3	1	1
Total	59	1	0	51	9	0	42	16	2

Table 4: Showing distribution of spinal canal Antero posterior and Cross sectional area at all the levels of Lumbar spine. (CSA = Cross Sectional Area)

Vertebral level		No	Mean	S D	P Value
L3-L4 A P D	Asymptomatic	40	13.7675	0.2186836	0.0716
	Symptomatic	60	19.945	2.884726	
L4-L5 A P D	Asymptomatic	40	13.0325	0.2044177	0.7547
	Symptomatic	60	13.09833	0.2274583	
L5-S1 A P D	Asymptomatic	40	11.6225	0.2165758	0.8752
	Symptomatic	60	11.775	0.2506103	
L3-L4 SD	Asymptomatic	40	11.7375	0.1813721	0.0135
	Symptomatic	60	10.71833	0.219116	
L4-L5 SD	Asymptomatic	40	11.04	0.2042096	0.0883
	Symptomatic	60	10.56667	0.2495969	
L5-S1 SD	Asymptomatic	40	10.99	0.2273684	0.5494
	Symptomatic	60	9.978333	0.2610388	
L3-L4 CSA	Asymptomatic	40	144.24	6.961037	0.0135
	Symptomatic	60	180.8333	4.360227	
L4-L5 CSA	Asymptomatic	40	135.295	8.028528	0.0577
	Symptomatic	60	155.1483	4.200175	
L5-S1 CSA	Asymptomatic	40	112.9125	7.051641	0.366
	Symptomatic	60	142.1317	7.23455	

OBSERVATIONS

Even in symptomatic cases normal diameter of the spinal canal was noticed in 19 (32%) cases. Even in asymptomatic cases, canal narrowing was noticed. Most of the symptomatic cases had normal Cross sectional area.

DISCUSSION

Lumbar canal stenosis is a common clinical condition we often see in Back Pain Clinic. The diagnosis is mainly by MRI rather than X-ray and CT scan [2]. MRI is found to be a sensitive and a better investigation, compared to other non-invasive modalities like X-rays, Ultrasound and Computerized tomography. Kent DL et al. in 1992 [1] in his comparative study on diagnostic evaluation found that MRI to be the most sensitive test. It also emerged as the procedure of choice during a comparative study on fifty seven patients by Bischoff et al. in 1993 [3]. Malghem J et al. in 2009 [2] compared antero posterior diameter of spinal canal at L4 and the thecal sac at L4-L5 on MRI and CT in a group of patients and found that MRI was superior to CT. MRI was taken as the investigating modality in the present study and found to be accurate in diagnosing the lumbar canal stenosis.

Eisenstein S in 1976 [4] on studying antero-posterior diameter in one thousand three hundred and forty lumbar vertebrae concluded that it was the most accurate parameter for evaluation of spinal stenosis. In the present

study, the mid sagittal diameter was the basic parameter to assess lumbar spinal stenosis between levels L3 and S1. F Postacchini et al. in 1980 [5] measured lumbar spinal diameter on seventeen patients of spinal stenosis and found that combined stenosis (developmental and degenerative) to be segmental in nature at two or more levels usually at L4-L5 and L5-S1.

In our study, even in symptomatic patients we have noticed a normal canal diameter measurement which implies that diagnosis is not made only by MRI but more importantly by clinical examination. MRI investigation is only used as a confirmation tool in patients with Lumbar canal stenosis.

Limitations of the Study: MRI though it is very accurate, it is time consuming procedure to perform. Patients with metallic implants due to previous surgeries cannot be taken for MRI study. Claustrophobia is one of the limitations of MRI.

CONCLUSION

Even in symptomatic cases normal diameter of the spinal canal can be noticed. Physical measurements of canal diameter alone cannot be the criteria to diagnose lumbar canal stenosis. The diagnosis of Spinal stenosis should be based on clinical findings like radiculopathy, neurogenic claudication, weakness, bowel and bladder dysfunction. Detailed history and physical examination of the patient along with the anatomic demonstration of stenosis with MRI scan can establish true diagnosis.

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Conflicts of Interests: None

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