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Corelation between extent of decompression radiologically and functional outcome in patients with lumbar canal stenosis-our experience at a teritiary care centre in central India

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Abstract

Aim: To study the relation of decompression with clinical outcome in patients with Lumbar Spinal Stenosis and analyse the antero-posterior diameter, inter ligamentous diameter, height of lateral recess and, lateral recess angle preoperatively and postoperatively, on the basis of MRI Scan.

Materials and methods: A total of 70 patients were included in this study. All patients included in the study were planned for MRI of the lumbar spine preoperatively. A subsequent MRI was done postoperatively at 1 week follow up. The MRI scan was performed on 18 channel 1.5 Tesla MRI system. Preoperative and Post operative measurement of antero-posterior spinal diameter, inter-ligamentous diameter, lateral recess height, lateral recess angle were taken. Clinical outcome was assessed at 1 week, 4 weeks and 3 months interval, with the help of Swiss Spinal Stenosis questionnaire.

Result: Most of the patients who underwent surgery expressed relief of symptoms post operatively and were able to do their daily activities. Radiologically there is significant increase in Antero posterior diameter, inter facet diameter, lateral recess height and lateral recess angle when compared on pre and postop MRI imaging.

Conclusion: In our study, surgical decompression was found to be effective in improving Antero posterior, inter ligamentous diameter, Lateral recess height and Lateral recess angle thereby suggesting that it successfully relieved the compression of neural elements in lumbar canal stenosis. This was also reflected in the marked improvement in the clinical outcome seen in the patients postoperatively.

Keywords: lumbar canal stenosis, anterior posterior diameter, inter facet diameter, lateral recess angle, lateral recess height

Introduction

In 1949, Verbiest became one of the first to define central lumbar stenosis and came to be known as the “pope of the spinal stenosis” 1, 2. He described three cases of stenosis of the lumbar vertebral canal wherein the interpedicular distance was normal but the AP diameter was grossly reduced. This publication became the watershed literature from which the term “Lumbar Canal Stenosis” was recognised.

In 1959, Verbiest classified stenosis into Absolute (AP diameter <10mm) and Relative (AP diameter <12mm). Lumbar canal stenosis can be either congenital or acquired.

Acquired lumbar canal stenosis can be due to factors such as hypertrophy or ossification of the ligamentum flavum, which cause dorsal compression of the thecal sac. Disc, spurs, or osteophytes, and, rarely, hypertrophy of the posterior longitudinal ligament may also compromise the available canal space. 3, 4 Symptoms of stenosis or neurogenic claudication are attributed to direct mechanical compression or indirect vascular insufficiency involving the lumbar nerve roots or cauda equina. While standing and walking increase lordosis and transiently exaggerate infolding of the ligamentum flavum, sitting and recumbence reverse the lordosis, open the canal, improve blood flow, and often cause temporary relief. Neurological findings include mechanical, motor, reflex and sensory signs that reflect the level or levels of involvement. 5 Bladder dysfunction is rare in young patients but is frequently encountered in the geriatric population with lumbar spinal stenosis.

In this study, we analyze the preoperative versus postoperative MRI measurements of spinal canal and correlate the extent of surgical decompression to improvement in clinical outcome. There are a few studies available which have evaluated the relation of decompression to clinical outcome on the basis of CT Scans. However, to the best of our knowledge, none of the available studies in Indian medical literature have used Magnetic Resonance Imaging (MRI) to determine the same.

Materials and Methods

This prospective study was conducted in department of neurosurgery of Sri Aurobindo Institute of Medical Sciences, Indore. All the patients were admitted to neurosurgery department of this hospital. All patients of lumber canal stenosis secondary to bony over growth, degenerative disc, ligamentum flavum hypertrophy, lateral recess stenosis, foraminal stenosis (combination of these lesions or any of these pathologies) are included in this study. Patients with segmental instability were excluded.

A total of 70 patients were included in this study. All patients included in the study were planned for MRI of the lumbar spine preoperatively. A subsequent MRI was done postoperatively at 1 week follow up. Clinical outcome was assessed at 1 week, 4 weeks and 3 months interval, with the help of Swiss Spinal Stenosis questionnaire. The MRI scan was performed on 18 channel 1.5 Tesla MRI system. Preoperative and Post operative measurement of antero-posterior spinal diameter, inter-ligamentous diameter, lateral

recess height, lateral recess angle.

- Dimensions of lumbar canal at pathological levels are measured.

1. **Antero-posterior diameter** is measured on T1W or T2w axial level as the distance between the posterior border of the vertebra and the the calsac posteriorly.
2. **Inter-ligamentous diameter** measured on T2 W axial as the distance between the inner borders of ligamentum flavum at the point joining the facets in MRI.
3. **Height of lateral recess** distance between the most anterior point of the superior articular facet and the posterior border of the vertebral body.
4. **Lateral recess angle** between the lines parallel to the floor and the roof of the lateral recess.

MRI of the lumbosacral spine preoperatively and postoperatively at one week interval were taken.
Functional outcome was evaluated with help of swiss spinal stenosis questionnaire

Observation & Results

Table 1: Age and sex wise distribution of the studied cases

Age group	Male (With %)	Female (with %)	Total (%)
20-29	4	0	4
	5.71%	0.0%	5.71%
30-39	10	2	12
	14.28%	2.85%	17.14%
40-49	20	2	22
	28.57%	2.85%	31.4%
50-59	14	8	22
	20%	11.42%	31.4%
60±	8	2	10
	11.42%	2.85%	14.28%
Total	56	14	70
Mean±SD	46.65±12.41	53.4±10.64	

Table 1 shows about the distribution of the studied cases according to age and sex. Male cases were predominantly higher than those of female subjects. Among the male majority of the cases were seen in 40 to 59 years age group while among female category majority of the cases (11.42%) were observed in 50-59 year age range and 2.85% each in other age range.
The mean age of male subject was found at 46.65±12.41 year while the mean age of female cases was 53.4±10.64year. Statically the difference between the mean presenting age of male and female was not statistically significant (P>0.05)

Table 2: Distribution of cases according to lumbar vertebrae level

Level	No. of cases	Percent
L2-L3	4	5.71%
L3-L4	30	42.85%
L4-L5	54	77.14%
L5-S1	4	5.71%

Majorities (77.14%) of the cases were presented with L4-L5 followed by 42.85% with L3-L4 and only 4 case was seen in L2-L3 level. and L5-S1 level (shown in table 2:)

Table 3: Mean pre and post operative comparison of vertebral canal measurements

Dimensions	Mean pre op	Mean post op	T-statistic	Significance
AP Diameter	6.43±1.7502	12.82±2.1105	10.248	p<0.0001
Interfacet distance	6.69±4.8677	14.96±3.5346	7.042	p<0.0001

This table describes about the mean pre and post operative finding of various vertebral canal measurements. (Shown in table 3)
The Mean AP diameter was observed at 6.43±1.75 at pre oP while its post operative observations were 12.82±2.11 which showed a significant increase in antero-posterior diameter (P<0.0001)
The result of inter facet distance showed on 6.69 ± 4.86 for pre operative and 14.96 ± 3.53 for postoperatively. The postoperative findings were significantly increased from Pre operative measurements (P<0.0001)

Table 4: Mean pre and post operative comparison of lateral recess height

Dimensions	Pre op	Post op	T-statistic	Significance
LRH left	1.863±1.0005	3.203±0.4406	6.277	p<0.0001
LRH right	1.950±0.9933	3.260±0.5164	5.888	p<0.0001

The mean pre operative LRH left was observed at 1.86 ± 1.00 while postoperative results were 3.203±0.44 and the changes were statistically highly significant (P<0.0001)
Similarly results were noted for the LRH right which was 1.95 ± 0.99 in preoperative and 3.26 ± 0.51 for post operative patients and this was too statistically significant (P< 0.0001). (Shown in table 4)

Table 5: Mean pre and post operative comparison of lateral recess angle

Dimensions	Pre op	Post op	T-statistic	Significance
LRA left	18.39±6.1728	71.02±5.1505	6.860	p<0.0001
LRA right	19.59±5.6977	68.55±5.1693	5.648	p<0.0001

The mean pre operative LRA left was observed at 18.39±6.17 while postoperative results 71.02±5.15 were and the changes were statistically highly significant (P<0.0001)
Similarly results were noted for the LRA right which were 19.59±5.69 in preoperative and for post operative 68.55±5.16 patients and this was too statistically significant (P< 0.0001). (Shown in table 5).

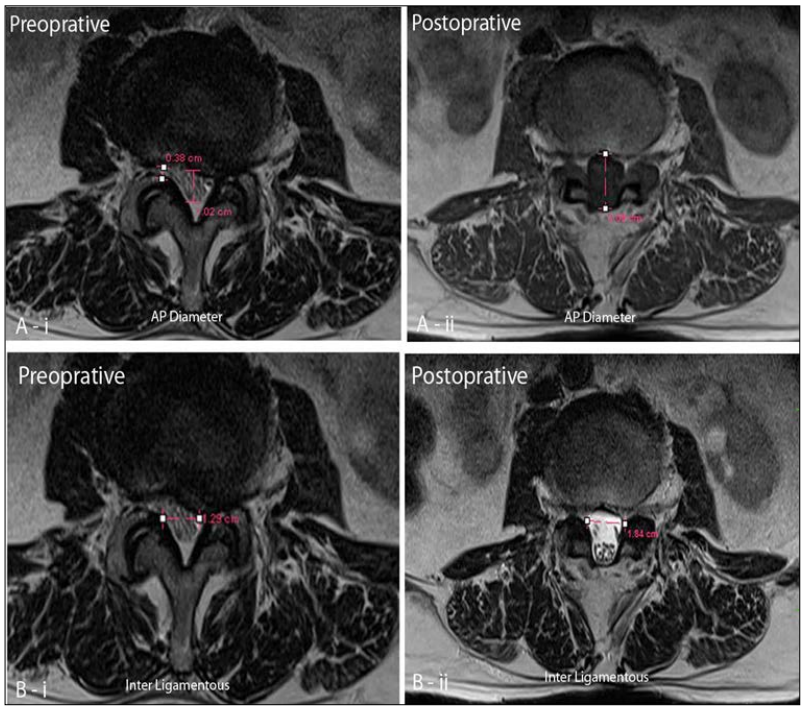

Fig 1: A-i= Pre op AP diameter-10.2mm, A-ii= post op A P diameter-20.1mm, B-i = Pre op IL diameter-12.9mm, B-ii= Post op IL diameter-18.4mm

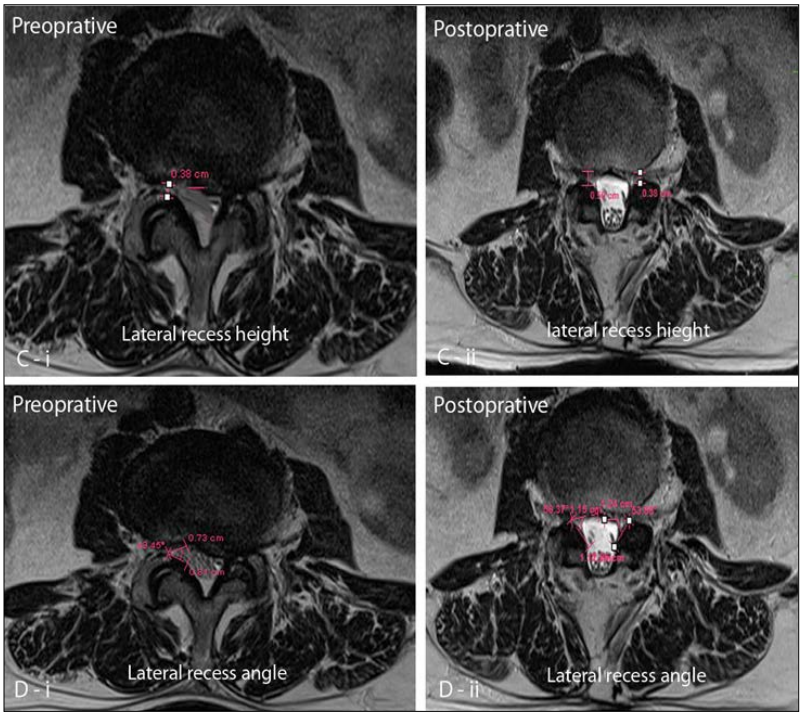

Fig 2: C-i= Pre op LRH Rt- 3mm Lt-0mm, C-ii= Post op LRH Rt-5mm Lt-3.9m, D-i= Pre op LRA Rt-43 degree Lt-0 degree, D-ii= Post op LRA Rt-56.37 degree Lt-53.55 degree

Table 6: Post operative swiss spinal score

XIII. The overall result of your back peration?	1week	percentage	4 week	percentage	3 month	Percentage
1. Very satisfied	56	80	64	91.4%	66	94.20%
2. Somewhat satisfied	14	20	6	8.57%	4	5.71%
3. Somewhat dissatisfied	0	0	0	0	0	0
4. Very dissatisfied	0	0	0	0	0	0
XIV. Relief of pain after your operation?						
1. Very satisfied	68	97.4%	70	100%	70	100%
2. Somewhat satisfied	2	2.85%	0	0	0	0
3. Somewhat dissatisfied	0	0	0	0	0	0
4. Very dissatisfied	0	0	0	0	0	0

XV. The ability to walk after your operation?						
1. Very satisfied	48	68.57%	56	80%	60	85.71%
2. Somewhat satisfied	14	20	10	14.20%	6	6.57%
3. Somewhat dissatisfied	8	11.2%	4	5.71%	4	5.71%
4. Very dissatisfied	0	0	0	0	0	0
XVI. Your ability to do housework, yardwork, or job after your operation?						
1. Very satisfied	48	68.57	54	77.10%	60	85.71%
2. Somewhat satisfied	14	20%	10	14.20%	6	6.57%
3. Somewhat dissatisfied	8	11.42%	6	8.57%	4	5.71%
4. Very dissatisfied	0	0	0	0	0	0
XVII. Your strength in your thighs, legs, and feet?						
1. Very satisfied	36	51.82%	48	68.57%	54	77.10
2. Somewhat satisfied	26	37.14%	16	22.85%	12	17.14%
3. Somewhat dissatisfied	8	11.42%	6	8.57%	4	5.71%
4. Very dissatisfied	0	0	0	0	0	0
XVIII Your balance, or steadiness, on your feet?						
1. Very satisfied	48	80%	60	85.71%	64	91.40%
2. Somewhat satisfied	8	11.42%	4	5.71%	2	2.85%
3. Somewhat dissatisfied	6	8.57%	6	6.57%	4	5.71%
Very dissatisfied	0	0	0	0	0	0

Discussion

Results of decompression technique in our series were good. We used a digital console a measurement tool for evaluation of spinal canal anatomy. There was significant improvement in anteroposterior diameter in our series (pre-operative 6.43±1.75 *vs.* post-operative 12.82±2.11). Increase in AP diameter is due to removal of ligamentum flavum and disc compressing the neural tissue. Although there was no previous similar study on MRI measurements providing AP diameter increment after lumbar decompression.

Decompression significantly increased the interfacet distance (preoperative 6.69 ± 4.86 vs. post-operative14.96 ± 3.53 interfacet diameter). There was no such measurement in any of the previous study. The resultant increase in inter facet diameter is due to removal of ligamentum flavum and partial facet removal.

The change in the lateral recess height (preoperatively LRH (L) 1.86±1.0, (R) 1.95±0.99 *vs.* postoperative LRH (L) 3.20±0.44, (R) 3.26±0.51) was statistically significant. We also found statistically significant differences in lateral recess angle (preoperatively LRA (L) 18.39±6.17, (R) 19.59±5.69 vs. postoperative LRA (L) 71.02±5.15, (R) 68.55±5.16) in endoscopically treated patients. This statistical difference in lateral recess height and angle is due to adequate removal of ligamentum flavum and disc at the roof and floor respectively. There was no such measurement in any of the previous study.

Following, decompression surgery, the patients were administered questions from the Swiss Spinal scale pertaining to patient satisfaction after treatment. At 1 week postoperative follow-up, 80% of the operated patients reported that they were "Very Satisfied" with the treatment but 20% were "somewhat satisfied". However, subsequently at 4th week and 3rd month follow-up, 91.4% and 94.20% patients, respectively, were very satisfied with the treatment results.

There was a reported 100% relief of pain at 4th week follow-up and this result was maintained 3 months post-operatively with none reporting recurrence of pain. Yet, only 85.71% of the patients reported that they were very satisfied with their ability to walk, 3 months postoperatively and 5.17% were "somewhat dissatisfied".

Around 68.57% of the patients were very satisfied with their ability to do homework, yardwork or job 1 week after the operation, 11.42% were somewhat dissatisfied. The percentage of patients who were very satisfied increased to 85.17% at 3 months follow-up. However, 2 patients (5.71%) remained somewhat dissatisfied even at 3 month follow up. These patients had paraplegia at initial presentation.

About, 51.82% of the patients reported very satisfied with the strength in their thighs, legs and feet at 1 week follow-up, and almost 77.1% reported similar level of satisfaction at 3 months postoperatively.

A good majority (80%) were very satisfied with their balance or steadiness on their feet at 1 week follow-up. And almost 91.4% reported being very satisfied at 3 months of follow up.

None of the patients reported being "very dissatisfied" with their treatment results.

Conclusion

In our study, surgical decompression was found to be effective in improving Anteroposterior, interligamentous diameter, Lateral recess height and Lateral recess angle thereby suggesting that it successfully relieved the compression of neural elements in lumbar canal stenosis. This was also reflected in the marked improvement in the clinical outcome seen in the patients postoperatively. All the patients included in the study reported a significant relief of pain reducing the need for administration of long term analgesic medications and their associated complications. Moreover, none of the patients reported absolute dissatisfaction following surgery. There weren't any reported postoperative complications in any of the patients included in the study, further bolsters the claim that this procedure is not only effective but is also safe.

Thus, based on the results of our study, we believe that surgical decompression should be recommended in symptomatic patients of lumbar canal stenosis as it would result in a favorable clinical outcome.

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