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The effect of decompression with posterior spinal fusion on back and leg pain in lumbar canal stenosis

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ABSTRACT

Background: Lumbar canal stenosis, characterized by pain, numbness and neurological claudication, causes gradually worsening back and leg pain, which can lead to neurologic compromise and patient distress. Posterior lumbar interbody fusion (PLIF) has been used for spinal fusion, with any of the decompression procedures. We aimed to examine the effects of decompression with PLIF on back pain, leg pain and neurological claudication in patients with lumbar canal stenosis.
Methods: In this observational study, total of 50 patients with lumbar canal stenosis who underwent PLIF at Bharati Hospital were included from January, 2020, to April, 2022. Selected patients had LS spine X-rays and MRIs. Neurological claudication, VAS scores for back and leg pain and Oswestry Disability Index were assessed at 3 months, 6 months, 9 months and 12 months post-op.
Results: The majority (19 (38%)) of the patients were between the ages of 50 and 60, with 23 men and 27 women in total. 50% of study participants had pain in both legs. Neurologic claudication decreased significantly from pre-op to post-op and at 3, 6, 9 and 12 months' follow up, none of the patients reported it. A significant decrease in the mean of VSB and VSL was reported at post-op, 3, 6, 9 and 12 months. The ODI score also decreased significantly at post-op, 3, 6, 9 and 12 months.
Conclusions: PLIF with interbody fusion and local graft with posterior instrumentation gave significantly improved clinical and functional outcomes by significantly reducing pain, as determined by the VAS scores for back and leg pain.

Keywords: Lumbar spine, Lumbar canal stenosis, Oswestry disability index, Posterolateral fusion, Pedical screw, VAS score

INTRODUCTION

A narrowing of the spinal canal that compresses the spinal cord and nerves is known as lumbar canal stenosis. Pain, numbness in the lower limbs and neurological claudication are hallmark signs when walking or standing for extended periods of time.[1]

It is characterised by gradually worsening leg and back pain, which may lead to neurologic compromise and cause the patient great distress. It is widespread among the elderly population. In patients under the age of 60, the prevalence rate of relative and absolute acquired lumbar canal stenosis has been reported to be as high as 22.5% and 7.3%, respectively and to be 47.2% and 19.4%, respectively, in patients over the age of 60.[2]

Complex factors, such as disc protrusion, ligamentum flavum thickening and facet joint hypertrophy, could be the cause of spinal canal narrowing. Degenerative spondylolisthesis, which is another frequent cause and is characterised by the forward displacement of a vertebra as

a result of disc and facet degeneration, narrows the spinal canal even more.[3,4]

Low back pain (95%), neurological claudication (91%), leg pain (71%), lower limb weakness (33%) and bowel and bladder disturbance (12%) were the most prevalent symptoms among patients with lumbar canal stenosis. L3-L4 and L4-L5 were the levels where stenosis was most common.[5]

The most crucial element in determining whether or not patients have canal stenosis is their neurological claudication symptoms. During a physical examination, neurologic deficits or a worsening of symptoms may be found. On the other hand, few patients with canal stenosis have any abnormal findings upon examination.

Spinal imaging supports the clinical impression. Because many people with no symptoms are found to have radiographic abnormalities, clinical correlation is crucial.[3] Conservative therapies may be beneficial, but they rarely produce long-lasting improvements.[6] To relieve pain and stop progressive deformity, spinal instrumentation seeks to eliminate motion between the adjacent vertebrae.

A variety of surgical techniques have been employed to achieve successful spinal fusions, including intertransverse fusion, posterior lumbar interbody fusion, transforaminal lumbar interbody fusion, lateral lumbar interbody fusion and anterior lumbar interbody fusion.[7]

Decompression techniques for lumbar canal stenosis range from open, traditional procedures like laminectomy to minimally invasive ones like tubular decompression and micro-internal decompression.[8]

There is strong evidence that surgical intervention improves functional and disability status while providing effective relief from leg symptoms, but there is still some uncertainty regarding how surgical treatment will affect low back pain.

Low back pain is currently assessed using a variety of self-reported metrics and patient-reported results are well established.[9]

The goal of this study was to find out how surgical interventions, like decompression with posterior spinal fusion, affected people with lumbar canal stenosis who had back pain, leg pain and neurological claudication.

METHODS

Study design

The study was observational study. The study was carried out at the Department of Orthopedics of Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, a tertiary health care and teaching institution in Pune to evaluate the effect of decompression with posterior spinal fusion on back pain in patients with lumbar canal stenosis from January, 2020 to April, 2022.

Fifty patients with lumbar canal stenosis who underwent surgery in the department of orthopedics of Bharati hospital during the study period were included in the study by convenient sampling.

Patients over the age of 18 with back pain radiating to the lower limb and neurological claudication were recruited for the study, while those with a history of lumbar spinal surgery, pathological fracture and infective pathology (pott's spine and pyogenic infection) were excluded.

Selected patients were subjected to X-ray LS spine and MRI LS spine. Data was collected in a pre-designed proforma which included a table for Numeric Rating Scale (VAS Scale), Oswestry Disability Index, history, clinical neurological examination and patient information.

It was collected through interviews and a review of medical records. Patients were followed up after immediate post-op at 3 months, 6 months, 9 months and 12 months and neurological claudication, VAS score for back pain and leg pain and Oswestry Disability Index were assessed.

Ethical consideration

The study was conducted after obtaining clearance from the Institutional Ethics Committee.

Statistical analysis

The data was analysed using SPSS (Statistical Package for Social Sciences) version 26.0 software. For qualitative variables, rates, ratios and percentages (%) were calculated and compared using the Chi-square test.

A mean standard deviation (SD) was calculated for quantitative data and means were compared between groups using the students' t test. A two-tailed test with a p value of<0.05 was considered significant.

RESULTS

This study aimed to assess the impact of decompression combined with posterior spinal fusion on back pain in 50 patients with lumbar canal stenosis who underwent surgery.

The study involved various levels of lumbar canal stenosis (LCS), with all patients undergoing posterior lumbar interbody fusion (PLIF).

Specifically, 15 patients (30%) had PLIF at L3-L5, 13 (26%) at L4-L5, 10 (20%) at L4-S1, 9 (18%) at L2-L5 and 1 patient each (3.3%) at L1-L5, L2-S1 and L3-S1.

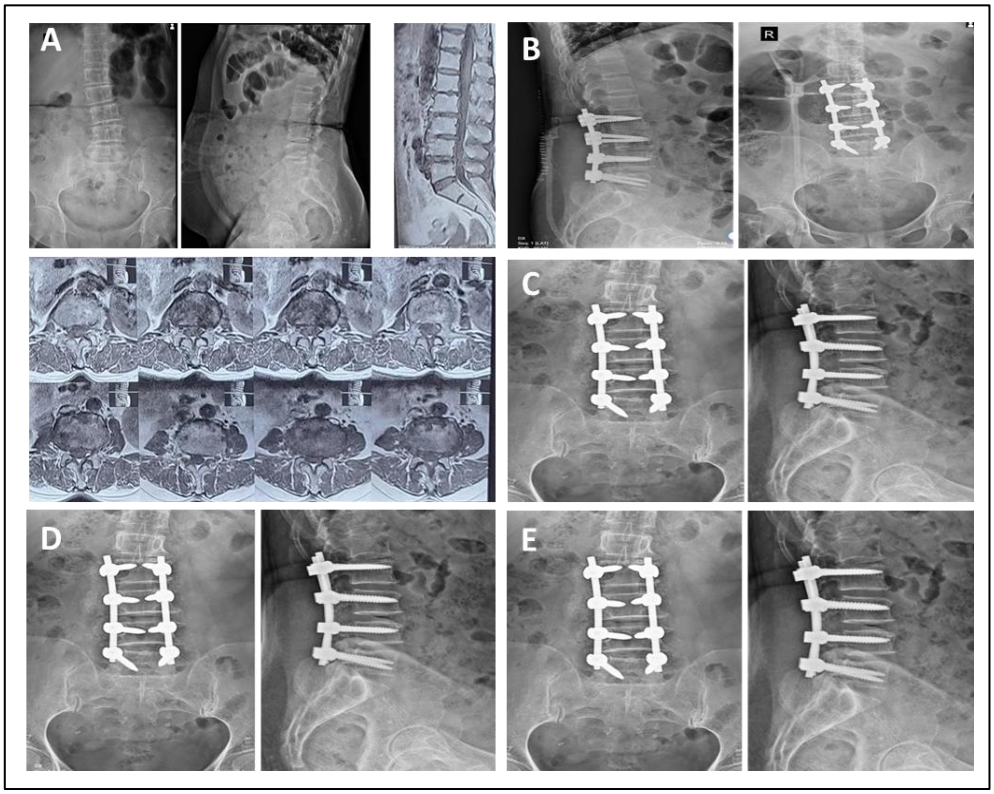

Figure 1: Case 1 showing pre-op X-ray and MRI and post-op X-rays; A) pre-op X-ray and MRI (L3-L5 LCS), B) immediate post-op X-ray (L3-L5 PLF), C) 3 months post-op X-ray, D) 6- months post-op X-ray, E) 1 year post-op X-ray.

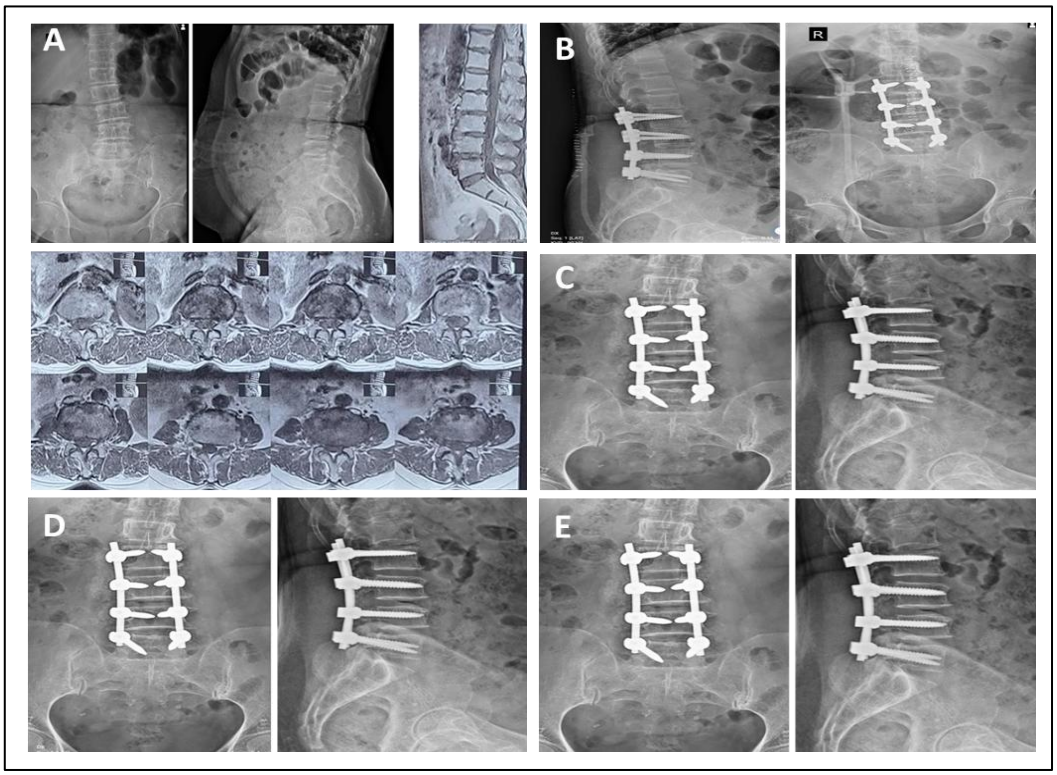

Figure 2: Case 2 showing pre-OP X-ray and MRI and post-OP X-rays; A) pre-op X-ray and MRI (L2-L5 LCS), B) immediate post-op X-ray (L2-L5 PLF), C) 3- months post-op X-ray, D) 6- months post-op X-ray, E) 1-year post-op X-ray.

Table 1: Comparison of distribution of patients according to presence or absence of neurological claudication.

	Yes		No		P value
	N	%	N	%	
Pre-operative	31	62.00	19	38.00	<0.0001*
Post-operative	9	18.00	41	82.00	
At 3 months	0	0.00	50	100.00	
At 6 months	0	0.00	50	100.00	
At 9 months	0	0.00	50	100.00	
At 12 months	0	0.00	50	100.00	

*Statistically significance

Table 2: Comparison of means of VAS score scale for back (VSB) at various follow up of patients.

Follow-up period	VAS for back pain			VAS for leg pain		
	Mean	SD	P value	Mean	SD	P value
Pre-Operative	6.76	1.51	<0.0001*	5.72	1.44	<0.0001*
Post-Operative	4.74*	1.44		3.70*	1.29	
At 3 Months	3.42*	1.12		2.04*	0.94	
At 6 Months	2.36*	0.89		1.08*	0.75	
At 9 Months	1.54*	0.76		0.40*	0.60	
At 12 Months	0.70*	0.61		0.10*	0.30	

Pre-operative Vs. post-operative, 3, 6, 9 and 12 months, p<0.0001; *Statistically significance

Table 3: Comparison of means of ODI score at various follow up of patients.

ODI	Mean	SD	P value
Pre-operative	0.66	0.18	<0.0001*
Post-operative	0.43*	0.14	
At 3 months	0.28*	0.10	
At 6 months	0.17*	0.07	
At 9 months	0.08*	0.03	
At 12 months	0.02*	0.01	

Pre-operative vs. post-operative, 3, 6, 9 and 12 months, p<0.0001; *Statistically significance

The average age of the patients was 55.40±12.99 years. Most patients (19 or 38%) were between 50 and 60 years old, with the next largest group being 61-70 years old (13 or 26%). Among the 50 patients, 27 were female and 23 were male. Half of the participants (50%) experienced pain in both legs.

DISCUSSION

Narrowing of the central canal, the lateral recess or the neural foramen are the three conditions that lead to spinal stenosis. It may result in progressive disability in some cases, severe discomfort and disruption of daily activities.[1] The main difficulty in surgically treating spinal stenosis is providing adequate decompression without putting at risk the lumbar spine's stability.[10-12]

In order to treat lumbar spinal stenosis, surgery is often performed to relieve leg and back pain. Although decompression is a common surgical procedure for treating lumbar spinal stenosis, many times more fusion is needed after extensive decompression. In many instances, a significant facetectomy is required for the decompression of foraminal stenosis. Thus, to accomplish the goals of surgical treatment for lumbar foraminal stenosis, a combination of neural decompression and spinal fusion can be performed. Back pain sufferers with multilevel foraminal stenosis may benefit from segmental decompression combined with posterolateral fusion.[13]

In the present study, we assessed the impact of posterior spinal fusion along with decompression on patients' reports of back pain due to lumbar canal stenosis. There were 27 female patients and 23 male patients, with a mean age of 55.40±12.99 years. The majority of the patients were in the 50-to-60-years age range. The participants in the study were all equally affected by the pain. All the 50 patients in the present study underwent PLIF surgery.

Neurogenic claudication is the sign of spinal stenosis that occurs most frequently. Due to ischemia or mechanical compression of the nerve roots, it is linked to spinal stenosis. An important characteristic of neurogenic claudication is how it responds to the patient's posture, with pain increasing with lumbar extension and decreasing with flexion, resulting in the distinctive "simian stance"

seen in these subsets of patients.[1,14] While, the most popular metrics for evaluating patients' postoperative functional performance are their VAS and ODI scores.

The number of patients with neurologic claudication was significantly lower in the present study's post-OP period than it was in the pre-OP period and at the 3, 6 and 12-month follow-up periods, there were no patients with the condition. Pre-and post-operative mean SD values as well as follow-up values at 3, 6 and 12 months were calculated for the back and leg pain and compared between the groups.

The mean of VSB and VSL values were reported to have decreased significantly at post-OP, 3, 6, 9 and 12 months. Pre-and post-operatively, as well as at 3, 6 and 9 months after the procedure, the ODI score was assessed and mean SD values were calculated and compared between the groups. At post-OP, 3, 6, 9 and 12 months, there was a significant ($p<0.0001$) decline in the mean of ODI.

Singh et al, found 83.33% of patients had no postoperative back pain and 16.66% only experienced occasional mild pain. According to Chen B., there was no discernible difference in the VSL and VBS scores between the two groups.[15,16] Similar improvements in the VAS scores for back pain and leg pain from 6.5 and 6.1 preoperatively to 1.8 and 1.8 at the last follow up were seen in the study by Kim DH.[17] During the 6-month follow-up, Kok D., found that both VSL and VBL had improved in important ways.[18]

During the six-month follow-up, Murthy et al, also demonstrated a significant reduction in the VAS score for back and leg pain.[19] The immediate post-operative period through the third month of follow-up saw the greatest improvement. Up until the last follow-up at the six months mark, there had been relatively little improvement.

Seong et al, found that the oswestry disability score improved similarly in both the segmental decompression and wide decompression groups.[13] Both groups experienced significant decreases in low back and leg pain. After a mean follow-up of 5.8 years, Fox MW., et al, retrospectively evaluated patients with decompressions without fusions, instrumented fusions and un-instrumented fusions.[20] In comparison to those who underwent decompression alone, only 75% of those who underwent concurrent fusions reported having good or fair outcomes.

In a comparison study of decompression-only versus fusion surgery Lee et al found that although leg pain significantly decreased over time in both study groups, there was no significant difference in this improvement between the two groups.[21] Over time, the ODI significantly declined. However, there was no discernible difference between the two study groups' ODI scores. Similar comparisons were made by Donnarumma et al, who reported a significant reduction in ODI score following surgery, with less improvement in female patients for both groups.[22]

For a variety of conditions requiring spine stabilization, lumbar interbody fusion is a well-validated technique with several different approaches, including anterior, lateral, transforaminal and posterior approaches.[23] PLIF is one of the most frequently used; it may offer greater immediate stability.[24]

Extended follow-up duration

The study was constrained by a limited follow-up period, which may affect the assessment of long-term outcomes.

Interobserver variability

The involvement of multiple surgeons introduced potential interobserver bias, which could influence the consistency of the results.

Lack of gender specificity

The study did not account for gender-specific factors, potentially limiting the applicability of the findings to different genders.

Unaddressed comorbidities

Specific comorbidities were not considered, which could affect the overall interpretation of the outcomes.

Focus on clinical outcomes only

The study exclusively evaluated clinical outcomes, without considering other relevant factors such as quality of life or psychological impacts.

CONCLUSION

The results of the present study showed that PLIF with interbody cage and local graft with posterior instrumentation gave significantly improved clinical and functional outcomes by significantly reducing pain. This was determined by the VAS scores for back and leg pain.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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