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Functional outcomes following surgical decompression for lumbar canal stenosis - A prospective study

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Abstract
Introduction: Low back pain is a common cause of morbidity and disability, with a prevalence of 28.5%. Among the causes of chronic low back pain, lumbar spinal stenosis is most common. Symptomatic canal stenosis causes neurogenic claudication, back and radicular leg pain. The aim of decompressive surgery is to relieve radicular leg pain and improve walking distance.
Objectives: To study the clinical presentation of patients with lumbar spinal stenosis. To evaluate functional outcome and complications associated with surgical decompression of lumbar canal stenosis. To assess the rate of recovery postoperatively.
Materials & Methods: A prospective analytical study was conducted on 30 patients at SSIMS & RC, Davangere, Karnataka. Materials & Methods: A prospective analytical study was conducted on 30 patients with surgical decompression of lumbar canal stenosis between February 2023 to February 2025 at SSIMS & RC, Davangere, Karnataka. Patient underwent decompressive laminectomy of the selected levels of stenosis. Patients followed up at 4 weeks, 8 weeks,3 months, 6 months and 1 year postoperatively. Patients were assessed with Oswestry disability index score and Visual analogue scale at each follow-up.
Observation: Degenerative Lumbar canal stenosis, observed more commonly in the adult age group. Pathology including loss of disc space height, telescoping of the facets, bulge of the posterior anulus and the posterior longitudinal ligament and the hypertrophy of the Ligamentum flavum eventually leads to the narrowing of the spinal canal dimension. Spinal decompression reduces leg pain, which in turn improves walking distance and gait.
Results: The mean age of patients was 58.6 years, with a male predominance (56.7%). The most affected level was L4-L5 (66.7%). Significant improvement was seen in VAS and ODI scores postoperatively ($p<0.001$). Most patients (80%) showed good clinical outcome. Neurological recovery was gradual and complete in most cases within 6–12 months. Complication rate was low (13.3%), including dura tears and superficial infections.
Conclusion: In patients undergoing surgical decompression for lumbar spinal stenosis, radicular symptoms were relieved in majority of the patients at 4 weeks follow up. However Sensory deficits and motor deficits improved over 6-12 month's duration.
There were improvements in ODI and VAS and functional outcome of patients after the surgery.

Keywords: Lumbar spinal stenosis, decompressive laminectomy, functional outcome, ODI, VAS

Introduction

Low back pain is a common cause of morbidity and disability, with a prevalence of 28.5%. Among the causes of chronic low back pain, lumbar spinal stenosis is most common cause.[10] Lumbar spinal stenosis is a pathological condition originating from decreased space available for the neural elements resulting in compressive forces on the conus medullaris, cauda equina, or individual lumbar nerve roots.[10,11]Degenerative LSS is defined as narrowing of the spinal canal, the lateral nerve root canals or the intervertebral neural foramina due to progressive hypertrophy of any of the surrounding osteocartilaginous and ligamentous elements.[5]

Incidence increases with age and hence a large proportion of sufferers are adults with a peak at the age of 65· Symptomatic lumbar canal stenosis causes neurogenic claudication, back and radicular leg pain [5,12.]

Management of Lumbar spinal stenosis is accomplished through conservative or invasive measures. surgical decompression is indicated when pain is refractory to non-invasive treatment and any compression of neural elements results in profound neurological deficits. [15] Spinal decompression surgery has long been considered the gold standard surgical treatment for symptomatic lumbar spinal stenosis. The aim of surgery is to relieve radicular leg pain and improve walking distance. [15]

Lumbar decompressive laminectomy has a beneficial effect on bladder function in a significant number of patients with advanced degenerative lumbar spinal stenosis. [4] The functional outcome can be adequately assessed by using statistical parameters such as

Oswestry Disability Index [7] to compare the preoperative and postoperative functional status of the patients.

Materials and Methods

Study Design

This was a prospective analytical study conducted at the Department of Orthopaedics, S. S. Institute of Medical Sciences and Research Centre (SSIMS & RC), Davangere, Karnataka. The study was carried out over a 24-month period, from February 2023 to February 2025, after obtaining Institutional Ethical Committee clearance and written informed consent from all participants.

Study Population

The study included **30 patients**, all diagnosed with lumbar canal stenosis, who underwent surgical decompression via standard posterior approach laminectomy.

Inclusion Criteria

- Patients with lumbar canal stenosis with radicular symptoms and sensory disturbances [12]
- Patients with neurogenic claudication [1]
- Patients with symptomatic degenerative lumbar spinal stenosis
- Patients with motor and sensory deficits with lumbar canal stenosis.
- Patients of age above 30 years
- Patients with Single level canal stenosis

Exclusion Criteria

- Patients with prior lumbar surgery
- Patients with developmental spinal anomalies
- Patients with traumatic lumbar canal stenosis
- Patients with spinal stenosis due to tumours and infection
- Patients with spinal instability and spondylolisthesis
- Patients unwilling to be included in study
- Patients with two or more level of Lumbar canal stenosis

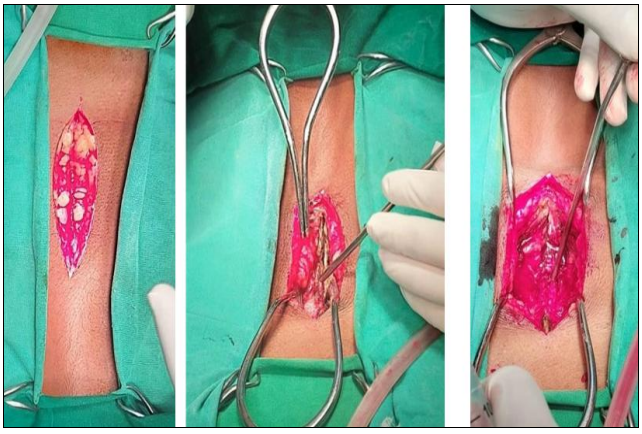
Preoperative Evaluation

All patients underwent complete clinical and neurological examination. Investigations included:

- **Radiological Assessment:** X-rays (AP, lateral, flexion/extension views), MRI
- **Functional Scores:** ODI and VAS recorded preoperatively
- **Neurological Tests:** SLRT, muscle power (MRC grading), sensory mapping
- **Routine Blood Investigations:** CBC, RFT, LFT, Coagulation profile, Urine R/M

Operative procedure

- Patient made to lie in prone position under endotracheal general anaesthesia
- Incision is given along the midline, targeting the area of stenosis. Intraoperative radiograph is taken to confirm the surgical level. Incision continued through the midline until reaching the fascia.
- The fascia and muscle is stripped subperiosteally from the spinous processes and laminae to the facet joints to expose the pars interarticularis. Avoiding damage to facet joints.
- The spinous processes is identified and removed at the levels to be decompressed. Soft tissue is cleared with a sharp curet.
- The ligamentum flavum is detached from the lamina with a curet.
- The lamina is then removed with a Kerrison rongeur up to the insertion of the ligamentum flavum. The lamina is removed until the pedicles is felt.
- Using the pedicle as a guide, the nerve root is identified and traced to the foramen.
- Using a rongeur, the medial portion of the superior facet is removed which forms the upper portion of the lateral recess.
- An angled dural elevator is used to check the foramen patency
- The disc is inspected and gross herniations removed unilaterally
- At all symptomatic levels' dissection is completed and confirmed
- Decompression is from the caudal aspect of the most proximal pedicle to the cephalad aspect of the most distal pedicle, allowing observation of the lateral margins of the dura in the lateral recesses
- Hemostasis is acheived with bipolar cautery and the temporary use of thrombinsoaked absorbable gelatin sponge (Gelfoam). Cerebrospinal fluid (CSF) leakage is inspected.
- A ⅛-inch diameter drain can be placed deep in the wound, exiting through a separate stab incision. The wound is closed in layers.

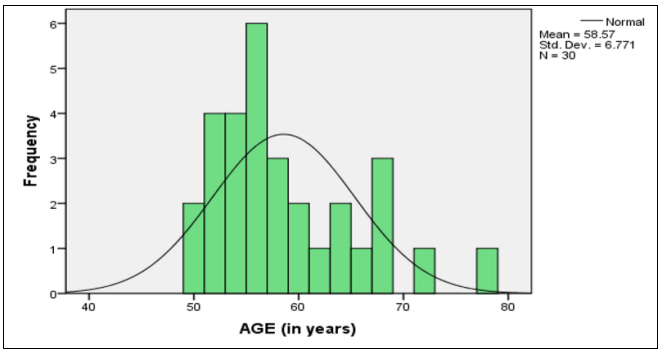


Postoperative protocol

The drain was removed after 48 hours and patients were allowed to turn in bed and were allowed to ambulate after drain removal with lumbosacral belt, the sutures were removed on 10th day and the patients were discharged with lumbosacral belt.

Results

A total of **30 patients** were included in the study. The demographic data, clinical presentations, surgical findings, and outcome measures are presented below.



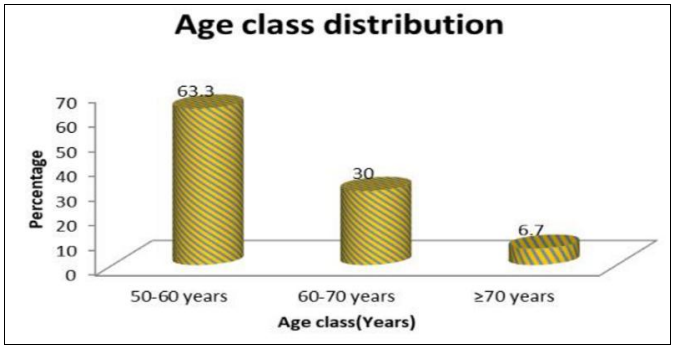


Fig 1: Distribution of age

Table 1: Distribution of duration of symptoms (in months)

Duration of symptoms (in months)	Frequency	Percent
<6	4	13.3
7-12	16	53.3
>12	10	33.3

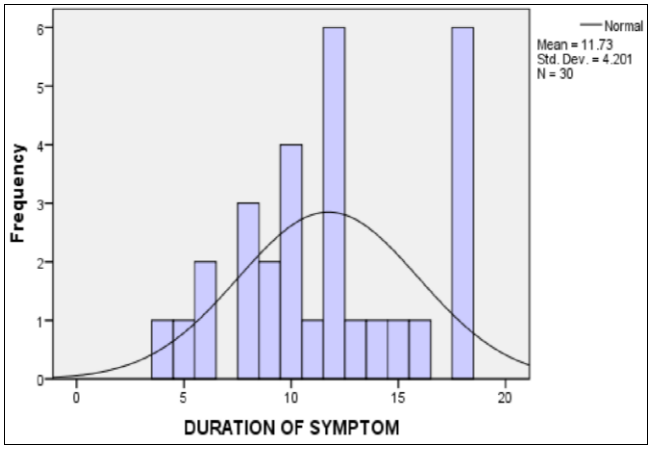


Fig 2

Table 2: Distribution of Level of stenosis

Level of stenosis	Frequency	Percent
L2-L3	1	3.3
L3-L4	4	13.3
L4-L5	20	66.7
L5-S1	5	16.6.7

The table presents data on the levels of spinal stenosis observed in patients. The most commonly affected level is L4-L5, found in 20 patients (66.7%), indicating that this region is the primary site of stenosis for most individuals.

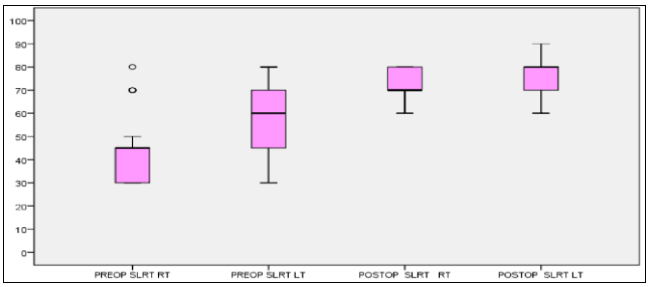


Fig 3

Table 3: Comparison of Straight Leg Raise Test (SLRT) on right and left side of leg between preop and postop findings

Side	Straight Leg Raise Test (SLRT)		p value
	Preoperative Median(Q1-Q3)	Postoperative Median (Q1-Q3)	
Right side	45(30-46.3)	70(70-80)	<0.001
Left side	60(45-70)	80(70-80)	<0.001

Wilcoxon Signed rank test, A p value <0.05 considered as statistically significant

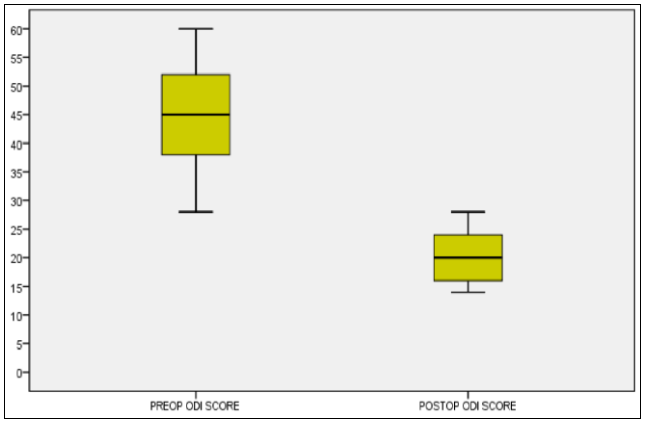


Fig 4

The median (Q1-Q3) of preoperative ODI score was 45(38-52) and it decreased to 20(16-24) postoperatively. The results showed statistically significant change (p value<0.001).

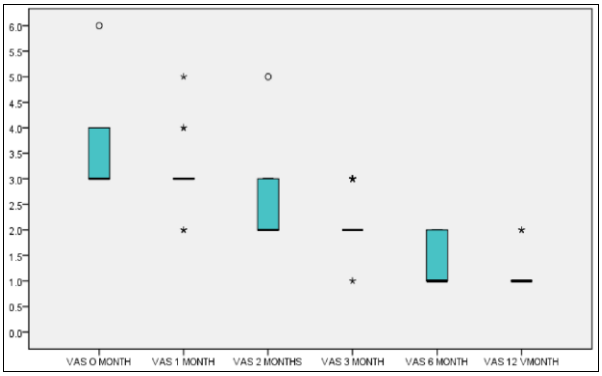
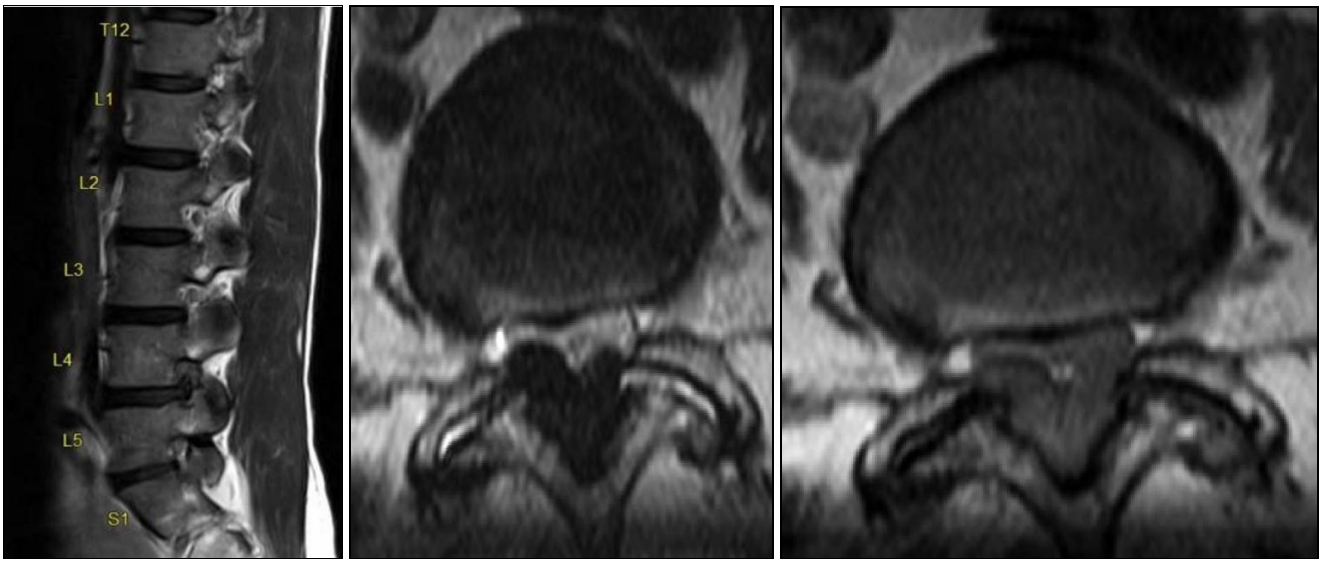


Fig 5

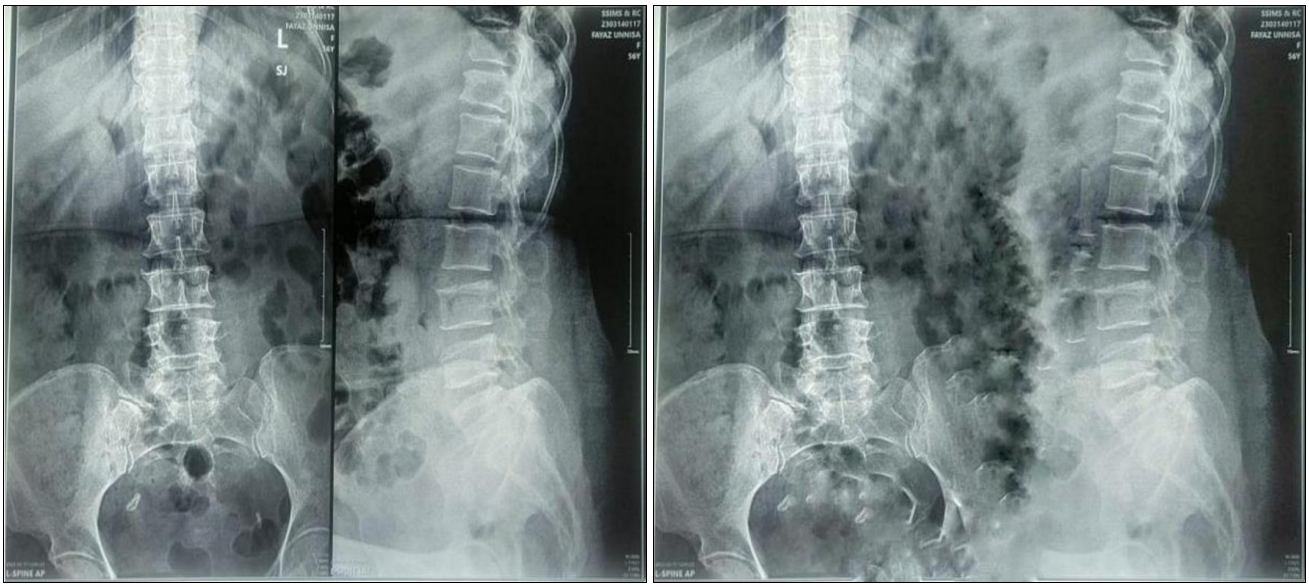
The median (Q1-Q3) of postoperative VAS score was 3(3-4), one 1 month it was 3(3-3), on 2 month it was2(2-3), on 3 months it was 2(2-2), on 6 months it was 1(1-2) and on 12 months it was 1(1-1). The median VAS score was decreased from baseline to different time points. The results showed statistically significant change (p value<0.001).

Pre-Op Ap & Lateral Flexion & Extension Views

Fig: 6 Clinical pictures and Radiographs



Preoperative Ls Spine Mri Sagittal and Axial View



Postop Radiograph Ap & Lateral View **3 Months Followup**

Fig 7: Preoperative Clinical Assessment

12 Months Clinical Assessment

Discussion

Low back pain is a common cause of morbidity and disability, with a prevalence of 28.5%.

Among the causes of chronic low back pain, lumbar spinal stenosis is most common cause. [10] Lumbar spinal stenosis is a pathological condition originating from decreased space available for the neural elements resulting in compressive forces on the conus medullaris, cauda equina, or individual lumbar nerve roots. [10, 12]

Incidence increases with age and hence a large proportion of sufferers are late adulthood or elderly age with a peak at the age of 65. Symptomatic lumbar canal stenosis causes neurogenic claudication, back and radicular leg pain [5, 12]

Management of Lumbar spinal stenosis is accomplished through conservative or invasive measures. surgical decompression is indicated when pain is refractory to non-invasive treatment and any compression of neural elements results in profound neurological deficits. [15] Spinal decompression surgery has long been considered the gold standard surgical treatment for symptomatic lumbar spinal

stenosis. The aim of surgery is to relieve radicular leg pain and improve walking distance. [5]

Present study included total of 30 patients fulfilling inclusion criteria with mean age of 58.6±6.8yrs, among them 56.7% were male and 43.3% were female. Preoperatively patients presented with LBP with left sided radiculopathy in 20%, 46.7% with LBP with right sided radiculopathy and 33.3% with LBP with bilateral radiculopathy. There was presence of neurological claudication in 58.1% patients. There was improvement in SLRT during post operative period, with mean of 70 degrees in right side and 80 degrees on left side.

In similar to present study Jones *et al* documented among 119 patients with central or lateral recess LSS. 49 men and 70 women completed 6 weeks and 1-year follow-up assessments, generating data for statistical analysis. The average age of the study population was 68.2 with a range of 31–89. Fifteen patients had right sided, 10 had left-sided and 94 had bilateral radiculopathy. [10]

Present study shows the mean change in ODI scores among the patients from baseline to the 12 months follow-up. There is decreasing trend in the mean level of the ODI during follow-up period. There is significant improvement in the SLRT in both right and left side among the patients($p<0.001$). There was significant reduction in the ODI score in postoperative period

16(16-18) compared to preoperative period 45(38-52) among the patients($p<0.001$). There was significant reduction in the Pain score, during the follow-up period compared to the pain score with baseline($p<0.001$). During follow-up, there is significant reduction in the ODI score at various interval of time compared to the baseline ODI scores($p<0.001$).

In similar to present study Mobbs *et al*., documented with Oswestry scoring index preoperatively 46.6±18.9 improved to 17.8±15.4. The visual analogue scale score preoperatively 7.9±1.4 improved to 3.9±2.9. [9]

In similar to present study the Gelalis *et al*., documented with improvement in the ODI score and visual analogue scale rating among the patients with follow-up period compared to the baseline. [5]

In present study post operative neurological claudication was present in 12.9% of the cases. The surgical complication was dural tear in 6.7% and superficial infection in 6.7% of the cases. At 1-year follow-up, clinical outcome was found to be good in 80% and fair in 20% of the cases.

In similar to present study the Jones *et al* documented among 119 patients with central or lateral recess LSS. Spinal decompression reduces leg pain, which in turn improves walking distance and gait significantly. [10]

This prospective study on functional outcome in the surgical decompression of lumbar canal stenosis included 30 patients with a mean age of 58.6±6.8 years, consisting of 56.7% males and 43.3% females, with 23.3% having diabetes mellitus and 33.3% hypertension. Preoperatively, the mean duration of symptoms was 11.7±4.2 months, with LBP with radiculopathy presentations on the left side in 20% of patients, right side in 46.7%, and bilaterally in 33.3%. Neurological claudication was present in cases, with the severe canal stenosis and the most common level of stenosis being L4-L5 (67.7%).

The improvement of LBP following decompression surgery is the improvement in nutrient supply to ischaemic nerves and the recovery of blood flow, and hence improving the claudication pain originating from muscles supplied by the dorsal rami at the stenotic level [1].

Postoperatively, there was a significant improvement in SLRT, with mean degrees increasing to 70 degrees on the right side and 80 degrees on the left side. Neurological claudication reduced to 16.7%, and the majority of patients improved. The median preoperative ODI score of 45(38-52) significantly reduced to 16(16-18) postoperatively ($p<0.001$). Additionally, the study observed a decrease in pain scores and improvement in clinical outcomes, with 80% of patients achieving good results and 20% fair results. Complications included a dural tear in

6.7% of cases and superficial infection in 6.7% of cases.

Surgical Complications

A majority of patients (86.7%) experienced no complications (NIL) post-surgery, indicating a generally safe surgical outcome. However, 2 patients (6.7%) developed Dura tear and another 2 patients (6.7%) experienced superficial infection, though the exact nature of these complications is unspecified. The relatively low incidence of complications suggests that the procedure was largely successful, with only a small percentage of patients encountering postoperative issues.

Study Limitations

- The sample size was relatively small.
- No comparator group was there in our study.
- The study was limited to a single geographic area and conducted withina restricted teaching institution.

Conclusion

In conclusion, decompressive laminectomy demonstrates significant efficacy in reducing low back pain, radiculopathy, neurological claudication and improving functional outcomes in patients with lumbar canal stenosis. The procedure not only alleviates radiculopathy, neurological deficit and neurological claudication but also enhances the overall quality of life for patients, as evidenced by the significant reduction in ODI scores and pain levels (VAS) during the follow-up period. These findings underscore the value of decompressive laminectomy as a reliable surgical intervention for managing lumbar canal stenosis.

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