

Original Research Article

Evaluation of functional outcome of epidural steroid injection in lumbar canal stenosis

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Received: 28 April 2026

Revised: 11 June 2026

Accepted: 27 August 2026

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ABSTRACT

Background: Low back ache is common complaint noted in orthopaedic OPDs. Low back pain accompanied by lumbosacral radiculopathy continues to be one of the most challenging musculoskeletal conditions to manage therapeutically. Stenosis manifests with two types of symptoms: neurogenic claudication, which may be unilateral or bilateral, and radiculopathy. The Management of Lumbar canal stenosis (LCS) is most debatable. Epidural injection by using steroid is commonly used treatment options used for chronic lower back pain. The present study evaluates the outcomes of Epidural steroid injection (ESI) in LCS and analyzes their effects on various outcome measures.

Methods: A prospective observational study was conducted on 50 patients diagnosed with LCS. The study was carried out in the Department of Orthopaedics at SBKS Medical Institute & Research Centre Piparia, Vadodara over a three-year period, March-2019 to March 2021. Patients underwent ESI and were followed up for clinical outcomes.

Results: In this study, the 51–60 years age group was most commonly affected, with a predominance of female patients. The L4–L5 levels were most commonly affected, with the majority of patients having a spinal canal diameter between 7–11 mm. The final results showed that 88% of patients had an excellent outcome, while 12% had a fair outcome.

Conclusions: ESI is a safe, cost-effective, and minimally invasive treatment for patients with subacute or chronic low back pain with radiculopathy, reducing the need for analgesics and facilitating an early return to work.

Keywords: Lumbar canal stenosis, Epidural steroid injection, MR

INTRODUCTION

Lumbar canal stenosis (LCS) is common degenerative disorders of the spine and a major cause of chronic low back pain with radiculopathy in the adult and elderly age group.¹⁻³ As life expectancy increases and the population ages, the prevalence of LCS is rising, creating a substantial socioeconomic and healthcare burden. Clinically, LCS presents with low back pain neurogenic claudication, and/or radicular symptoms that are aggravated by standing and walking and are typically relieved by lumbar flexion.⁴⁻⁶ The pathophysiology of lumbar canal stenosis is multifactorial, involving degenerative changes such as

intervertebral disc bulging, facet joint hypertrophy, ligamentum flavum thickening, and degenerative spondylolisthesis, all of which lead to narrowing of the central canal, lateral recess, or neural foramina.^{5,7} While mechanical compression of neural elements plays a central role, growing evidence indicates that inflammatory mediators released around the affected nerve roots also significantly contribute to pain and radiculopathy.⁸

The management of lumbar canal stenosis remains controversial, with treatment options broadly classified into conservative, interventional, and surgical approaches. Although surgical decompression can be effective in

selected patients, it carries higher morbidity, increased costs, and greater perioperative risks, particularly in elderly individuals and those with comorbid conditions.^{9,10} As a result, minimally invasive interventional modalities have become increasingly popular as intermediate treatment options. Epidural steroid injections (ESIs) are commonly utilized in the management of chronic low back pain and radiculopathy associated with lumbar canal stenosis.^{11,12} Corticosteroids produce their therapeutic effects by inhibiting inflammatory mediators such as phospholipase A2, prostaglandins, and cytokines, stabilizing nerve membranes, and reducing neural edema.¹³ When delivered into the epidural space, steroids provide targeted anti-inflammatory effects at the site of nerve root irritation, thereby alleviating pain and enhancing functional capacity. Despite its widespread use, the efficacy of epidural steroid injections in lumbar canal stenosis remains controversial, with studies reporting variable outcomes.^{11,14-16} Variations in patient selection, severity of stenosis, injection techniques, outcome measures, and duration of follow-up result in variable findings across studies.¹⁴⁻¹⁸ Therefore, there remains a need for prospective clinical studies to evaluate both pain relief and functional outcomes following epidural steroid injections in patients with lumbar canal stenosis. This study aims to evaluate the functional outcomes of epidural steroid injections in patients with lumbar canal stenosis using standardized outcome measures such as the Japanese Orthopaedic Association (JOA) score, Visual Analog Scale (VAS), and Verbal Rating Scale (VRS), and to determine their effectiveness as a safe, cost-effective, and minimally invasive treatment modality.^{11,14,15}

Outcome Measures: baseline evaluation was conducted prior to the injection procedure. Pain intensity was measured using the Visual analog scale (VAS), while functional outcome was assessed with the Japanese orthopaedic association (JOA) score. Functional ability was further evaluated in terms of walking distance and standing duration. All parameters were documented at baseline and at subsequent follow-up visits.

METHODS

This prospective observational study was carried out in the Department of Orthopaedics at SBKS Medical Institute & Research Centre Piparia, Vadodara over a three-year period, March-2019 to March 2021. Patients presenting with clinical signs suggestive of lumbar canal stenosis, such as low back pain and neurogenic claudication, were assessed and included in the study after obtaining informed consent.

Sample sizes and study population

Fifty patients satisfying the inclusion criteria were included in the study.

Patients presenting with low back pain, with or without neurogenic claudication, and suspected lumbar canal

stenosis were evaluated. The diagnosis was confirmed through radiological investigations, specifically MRI of the lumbar spine.

Inclusion criteria

Patients older than 18 years with clinically and radiologically confirmed lumbar canal stenosis, persistent symptoms refractory to conservative treatment, and willingness to participate in the study were included.

Exclusion criteria

Patients with a history of prior lumbar spine surgery, spinal infection, tumors, fractures, severe neurological deficits requiring urgent surgical intervention, or contraindications to epidural steroid injection (including uncontrolled diabetes mellitus, coagulopathy, or local infection at the injection site) were excluded.

Statistical analysis

Data were analyzed using statistical software. mean $\pm$ standard deviation is used to present Continuous variables. Comparisons between pre- and post-intervention values were performed using the paired t-test, while repeated measures ANOVA was applied for comparisons across multiple follow-up time points. A p-value of less than 0.05 was considered statistically significant.

Patients older than 18 years with confirmed clinical and radiological diagnosis of lumbar canal stenosis who did not respond to conservative treatment were included in the study. Patients with prior lumbar spine surgery, spinal infections, tumors, fractures, severe neurological deficits necessitating urgent surgical intervention, or contraindications to steroid injection including uncontrolled diabetes, coagulopathy, or local infection were excluded from the study.

All patients received epidural steroid injections with strict aseptic conditions. The injection was given via interlaminar or caudal approach, depend on the clinical indication. A mixture of a corticosteroid such as methylprednisolone or triamcinolone and a local anesthetic was administered (Figure 1).

Outcome assessment was conducted using the Visual Analog Scale (VAS) for pain and the Japanese Orthopaedic Association (JOA) score for functional evaluation. Functional capacity was assessed in form of walking distance and standing duration. Baseline “pre-injection” measurements were recorded and subsequently compared with “post-injection” values in follow-up. after procedure patients followed up at 1, 3 and 6 months. Outcome measures were compared before and after intervention, and statistical analysis was performed to evaluate the significance of the improvement. All patients given epidural steroid injection with strict aseptic precautions. The procedure was done with the patient in

the prone position (Figure 2) and monitoring including non-invasive blood pressure, pulse oximetry, and electrocardiography was used during whole procedure.

After confirming level injection of local anesthetic given (Figure 3). After finding epidural space, a single-shot epidural injection was given containing 80 mg of triamcinolone acetonide (2 ml) combined with 2% lignocaine (8 ml) and normal saline (10 ml) (Figure 4). The injection was given slowly after negative aspiration to avoid intrathecal or intravascular delivery.



Figure 1: (A) Vial Containing 2% lignocaine, (B) syringe with needle filled with 80 mg (2 ml) of triamcinolone and 8 ml 2% lignocaine with 10 ml of normal saline and (C) pack of 80 mg (2 ml) of triamcinolone.

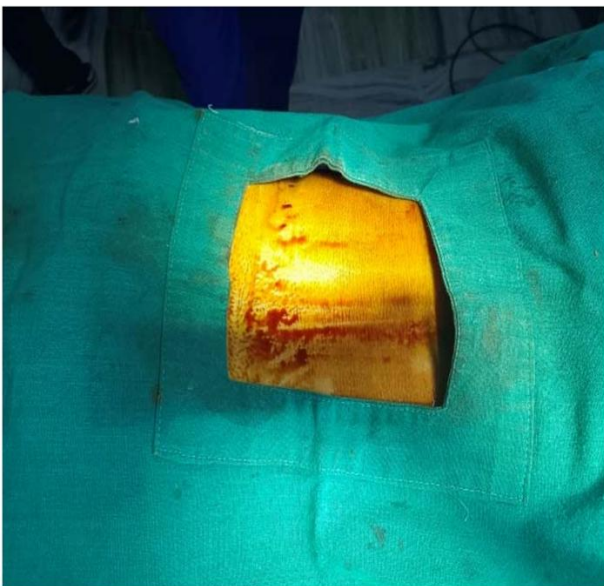


Figure 2: Position and draping of patient for procedure.



Figure 3: Injection of local anesthetic after confirmation of level.



Figure 4: Single-shot epidural injection of prepared solution.

After the procedure, patients were monitored for at least 15 minutes to detect any immediate adverse effects and were discharged once clinically stable. All patients were instructed regarding routine post-procedure care and scheduled follow-up in accordance with the study protocol. Patients were followed up at 1, 3 and 6 months post-procedure. At each follow-up visit, clinical assessment and outcome measures are recorded.

RESULTS

In this study, the 51-60 years age group was most commonly affected, with a female predominance. The L4-L5 level was the most frequently involved, and most patients had a canal diameter ranging from 7-11 mm. The final results demonstrated excellent outcomes in 88% of patients, while 12% had fair outcomes. The majority of patients (48%) were in the 51-60 years age group. The

condition is more prevalent in the later part of middle age, as individuals in this stage of life remain active while degenerative spinal changes begin to appear (Table 1).

In this study, females outnumbered males. Of the total 50 patients, 30 (60%) were females and 20 (40%) were males. This predominance may be attributed to engagement in household activities involving odd postures and poor ergonomics. Additional contributing factors include obesity, laxity of the anterior abdominal muscles, and lack of regular exercise (Table 1).

Table 1: Demographic and clinical characteristics.

Variables	Category	Number	Percentage
Age (years)	31–40	5	12
	41–50	18	36
	51–60	24	48
	≥61	3	6
Sex	Male	20	40
	Female	30	60
Duration of symptoms	<6 months	5	10
	6 months–1 year	21	42
	>1 year	24	48

In this study, the majority of patients had symptoms for more than one year, accounting for 24 (48%) out of 50 cases. Among the total 50 patients, only 5 had previously undergone treatment (Table 1).

Table 2: Baseline functional and radiological assessment.

Variables	Category	Number	Percentage
Walking distance	>500 m	9	18
	100–500 m	34	68
	<100 m	7	14
Standing time	>30 min	4	8
	10–30 min	41	82
	<10 min	5	10
MRI level	L2–L3	8	16
	L3–L4	7	14
	L4–L5	25	50
	L5–S1	10	20
Canal AP diameter	<7 mm	9	18
	7–11 mm	36	72
	>11 mm	5	10

Most patients were able to ambulate within and around their homes without significant difficulty at the time of presentation. A total of 43 (86%) patients out of 50 were able to walk 100 meters or more, while 7 (14%) had a walking distance of less than 100 meters, indicating a markedly reduced claudication distance (Table 2).

Four patients (8%) had a standing time of more than 30 minutes, 41 patients (82%) stood for 10-30 minutes, and 5

patients (10%) had a standing time of less than 10 minutes. Overall, the majority of patients were able to stand for more than 10 minutes without pain (Table 2).

The majority of patients, 25 (50%) out of 50, had involvement at the L4-L5 level. Ten patients (20%) showed L5-S1 involvement, while 15 (30%) had involvement at L4 or higher levels (Table 2).

All 50 patients underwent MRI evaluation. Among them, 36 (72%) had a spinal canal diameter between 7-11 mm, 5 (10%) had a diameter greater than 11 mm, and 9 patients had a diameter less than 7 mm but were either unfit for surgery or unwilling to undergo surgical intervention (Table 2).

Table 3: Functional outcome following treatment.

Outcomes	Present	Absent	Worsened
Improvement in standing time	43 (84%)	6 (12%)	1 (2%)
Improvement in walking distance	43 (86%)	6 (12%)	1 (2%)

It was observed that 43 (86%) patients showed marked improvement in standing time following treatment. One patient (2%) experienced worsening of symptoms, while 6 patients (12%) showed no change after treatment (Table 3).

It was observed that 43 (86%) patients showed marked improvement in both walking distance and standing time after treatment. One patient (2%) experienced worsening of symptoms, while 6 patients (12%) showed no change following treatment. Overall, 43 out of 50 patients demonstrated improvement in both standing time and walking distance, 6 patients showed no improvement in either parameter, and 1 patient had a deterioration in walking distance as well as standing capacity (Table 3).

Table 4: Pain relief and patient satisfaction.

Variables	Category	Number	Percentage
Relief in radicular pain	None	2	4
	Mild	19	38
	Moderate	6	12
	Significant	23	46
Patient satisfaction	Yes	46	92
	No	4	8

Twenty-three patients (46%) experienced significant pain relief, while 25 patients (50%) reported mild to moderate relief. Only 2 patients (4%) out of 50 showed no improvement in pain (Table 4).

Eighteen patients (36%) had a visual analog scale (VAS) score between 6-8 prior to treatment. Thirty patients (60%)

had a score ranging from 4-6, while 2 patients (4%) had a score between 2-4 before treatment.

Forty-seven patients (94%) had a verbal rating score of 6-8 prior to treatment, while 3 patients (6%) had a score ranging from 4-6 before treatment.

Table 5: JOA score assessment.

JOA Score	Pre-treatment n(%)	Post-treatment n (%)
6–10	1 (2)	0
11–15	5 (10)	0
16–20	41 (82)	0
21–25	3 (6)	4 (8)
26–29	0	46 (92)

The majority of patients, 41 (82%) out of 50, had a pre-treatment JOA score between 16–20. Following treatment, 46 (92%) patients improved to a score range of 26–29. Overall, a 100% improvement in JOA scores was observed among all patients. At presentation, 46 patients had scores between 11–20, while after treatment, 46 (92%) patients achieved scores above 25 (Table 5).

Forty-four patients (88%) out of 50 achieved excellent results, while the remaining 6 patients (12%) had good outcomes.

All patients noted a visual analog scale (VAS) score between 0-4 after intervention. Post-treatment, 48 patients (96%) showed improvement, with 23 patients (46%) scoring between 0-2 and 25 patients (50%) scoring between 2-4. At the end of 6 months, almost all patients demonstrated significant improvement in pain levels (Table 6).

After treatment, 46 patients (92%) had a verbal rating score between 0-4, while 4 patients (8%) had a score between 4-6. Overall, all patients showed improvement in the verbal rating scale.

Approximately 46 patients (92%) out of 50 reported good patient satisfaction following epidural steroid injection, while 4 patients (8%) did not express satisfaction with the treatment outcome.

Table 6: Changes in pain scores during follow-up.

Follow-up	VAS 0–2	VAS 2–4	VPS 0–2	VPS 2–4
Before treatment	0	2	0	0
48 hours	50	0	50	0
2 weeks	44	6	37	13
4 weeks	44	6	37	13
8 weeks	23	27	20	26
24 weeks	23 (46%)	27 (54%)	20 (40%)	26 (52%)

DISCUSSION

Lumbar canal stenosis is a common degenerative disorder that typically presents with chronic low back pain, radiculopathy, and neurogenic claudication, especially in middle-aged and elderly individuals.^{1,2} Its management is often challenging, with treatment options varying from conservative therapy to surgical decompression.^{9,10} Epidural steroid injections have become increasingly popular as a minimally invasive treatment option for reducing inflammation and relieving radicular pain.^{11,13} This study assessed the functional outcomes of epidural steroid injections in patients with lumbar canal stenosis over a six-month follow-up period. In this study, a statistically significant decrease in pain scores was noted as early as 48 hours after the injection, with continued improvement observed at later follow-up visits. This early clinical response may be attributed to the synergistic action of the local anesthetic and corticosteroid, which helps reduce neural inflammation, nerve root edema, and ectopic neural activity. The sustained improvement seen throughout the follow-up period indicates that epidural steroid injections can offer effective short- to mid-term symptomatic relief in patients with lumbar canal stenosis.¹⁴⁻¹⁸ Functional outcomes, as measured by the Japanese Orthopaedic Association (JOA) score, showed significant improvement following the intervention. Most patients demonstrated increased walking tolerance along with a reduction in radicular symptoms. These results emphasize that epidural steroid injections are beneficial not only for pain relief but also for enhancing functional ability and quality of life, especially in patients who are unfit for surgery or prefer to postpone surgical intervention. The findings of the present study are in agreement with previously published literature reporting favorable outcomes following epidural steroid injections in degenerative lumbar spine disorders.^{17,19} Similar benefits have been reported in radicular pain conditions also. Systematic reviews have demonstrated effectiveness of epidural injections in lumbar radicular pain. Several studies have shown significant short-term pain relief along with functional improvement, although the extent and duration of benefit have varied across studies.^{14,15,20-24} Variations in patient selection, degree of stenosis, injection techniques, and outcome assessment methods may explain the differences in reported results. The present study supports epidural steroid injections as an effective intermediate treatment option in suitably selected patients. Importantly, no major procedure-related complications were noted in this study. Any minor, transient adverse effects resolved on their own, indicating that epidural steroid injections are relatively safe when performed under strict aseptic conditions.^{12,13,25} This strong safety profile further supports their use as a minimally invasive alternative to surgery, especially in elderly patients with multiple comorbidities. Despite the positive outcomes, this study has several limitations. The small sample size and absence of a control group limit the generalizability of the findings. In addition, the follow-up period was restricted to six months, which did not allow evaluation of long-term

results. Further studies with larger sample sizes, randomized controlled designs, and longer follow-up durations are necessary to better determine the long-term effectiveness and ideal role of epidural steroid injections in the management of lumbar canal stenosis.²⁶⁻³⁰

CONCLUSION

Epidural steroid injection is a safe and effective minimally invasive treatment option for patients with lumbar canal stenosis. It leads to significant pain relief and improved functional status, with early symptom improvement that is sustained over a six-month follow-up period. This procedure can be regarded as an effective intermediate option in the treatment algorithm, especially for patients who are not suitable for surgery or wish to postpone surgical intervention.

ACKNOWLEDGEMENTS

The authors acknowledge the support of the Head of the Department and institutional authorities, technical staff for their assistance during the study and all the patients for their cooperation.

Funding: No funding sources

Conflict of interest: None declared

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

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Cite this article as: Doshi S, Parmar H, Gamit VR, Rawat SK. Evaluation of functional outcome of epidural steroid injection in lumbar canal stenosis. *Int J Res Orthop* 2026;12:1767-73.