RESEARCH PAPER

Efficacy of Epidural Steroid Injection in Lumbar Radicular Pain: A Prospective Clinical Study

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Abstract

Background: Lumbar radicular pain is a major contributor to disability worldwide. Epidural steroid injections (ESIs) are widely used for symptom control, yet their clinical value remains controversial due to inconsistent long-term outcomes.
Objective: To evaluate the efficacy of epidural steroid injections in terms of pain relief, functional improvement, and patient **satisfaction in lumbar radicular pain.**
Methods: A prospective observational study was conducted on patients with lumbar radicular pain persisting for more than three months and refractory to conservative treatment. Outcomes were assessed using Numeric Rating Scale (NRS), Oswestry Disability Index (ODI), Roland-Morris Disability Questionnaire (RMDQ), and finger-to-floor distance (FTF). Follow-up was conducted up to 12 months.
Results: Significant short-term improvement in pain and functional scores was observed following ESI. Peak benefit was noted within the early follow-up period, with gradual decline in some patients over time. Long-term outcomes showed variability, with a subset requiring further intervention.
Conclusion: ESIs provide meaningful short-term relief in lumbar radicular pain but demonstrate inconsistent long-term benefits. Their role is best defined as an adjunct in non-operative management rather than a definitive treatment.

Keywords: Lumbar radiculopathy, Epidural steroid injection, Sciatica, Disc prolapse, Pain management
How to cite this article: Mahesh S, Gowtham S, John L, Khan A. Efficacy of Epidural Steroid Injection in Lumbar Radicular Pain: A Prospective Clinical Study. Int J Drug Deliv Technol. 2026;16(33s):400-413. DOI: 10.25258/ijddt.16.33s.48

Introduction

Low back pain remains one of the most significant contributors to global disability, ranking among the leading causes of years lived with disability worldwide [1]. Lumbar radicular pain, commonly presenting as sciatica, represents a clinically important subset characterized by radiating pain along the distribution of affected nerve roots.

Historically, the pathogenesis of radicular pain was attributed primarily to mechanical compression of nerve roots by herniated intervertebral discs. However, emerging evidence has challenged this simplistic model. Studies have demonstrated that mechanical compression alone is insufficient to explain symptom severity, as patients with significant radiological compression may remain asymptomatic, whereas others with minimal compression experience severe pain [2,3].

Contemporary understanding emphasizes the role of inflammatory and immunological mechanisms, with mediators such as phospholipase A2, interleukins, and tumor necrosis factor-alpha contributing to nerve root sensitization and ectopic neural discharge [4]. This paradigm shift has provided the biological rationale for the use of corticosteroids in epidural injections.

Epidural steroid injections (ESIs) have been used for over six decades as a minimally invasive intervention targeting inflammation within the epidural space. Despite widespread clinical adoption, their efficacy remains controversial. While numerous studies report short-term pain relief, systematic reviews and randomized trials have demonstrated inconsistent long-term benefits and, in some cases, outcomes comparable to placebo [5–7].

Furthermore, ESIs do not address the underlying structural pathology, raising questions about their role in altering disease progression. Concerns regarding safety, including rare but serious neurological complications, have also prompted regulatory scrutiny [8].

Given these uncertainties, there is a need for well-structured prospective studies to evaluate both the magnitude and durability of clinical improvement following ESIs. The present study aims to assess their efficacy in terms of pain relief, functional recovery, and

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patient satisfaction, while critically examining their role in contemporary spine care.

Materials and Methods

Study Design

Prospective observational study conducted in a tertiary care orthopaedic center.

Inclusion Criteria

Patients aged >18 years
Lumbar radicular pain >3 months
Failure of conservative management
Radiological evidence of disc pathology

Exclusion Criteria

Progressive neurological deficit
Spinal infection or malignancyPrevious spinal surgery
Coagulopathy or contraindications to steroid use

Intervention

Epidural steroid injection was administered under strict aseptic precautions. A corticosteroid preparation combined with local anesthetic was delivered into the epidural space using standard technique.

Outcome Measures

Numeric Rating Scale (NRS)
Oswestry Disability Index (ODI)
Roland-Morris Disability Questionnaire (RMDQ)
Finger-to-floor distance (FTF)
Patient satisfaction score

Follow-Up

Patients were evaluated at baseline, early post-procedure, and periodically up to 12 months.

RESULTS

A total of 50 patients with lumbar radicular pain were included in this prospective

study.

Demographic Profile

Age Group (years)	Number of Patients	Percentage (%)
21–30	13	26
31–40	11	22
41–50	13	26
51–60	9	18
61–70	4	8
Total	50	100

The majority of patients were in the 21–30 years and 41–50 years age groups (26% each), followed by 31–40 years (22%) and 51–60 years (18%). Only 8% were above 60 years, indicating a predominance of disease in the economically active age group.

Gender	Number of Patients	Percentage (%)
Male	39	78
Female	11	22
Total	50	100

Male patients constituted 78% (n=39), while females accounted for 22% (n=11), demonstrating a clear male predominance.

Etiology	Number of Patients	Percentage (%)
Intervertebral Disc Prolapse	43	86
Lumbar Canal Stenosis	7	14
Total	50	100

Intervertebral disc prolapse was the most common etiology (86%), while lumbar canal stenosis accounted for 14%.

Type of Pain Distribution	Number of Patients	Percentage (%)
Bilateral	18	36
Unilateral (Right)	15	30
Unilateral (Left)	17	34
Total	50	100

Radiating pain was bilateral in 36%, right-sided in 30%, and left-sided in 34%, showing near-equal distribution.

Duration (months)	Number of Patients	Percentage (%)
3–6	20	40
7–12	21	42
13–18	6	12
19–24	2	4
>24	1	2
Total	50	100

The majority of patients had symptom duration between 3–12 months (82%), indicating a predominantly subacute to chronic presentation.

Level	Number of Patients	Percentage (%)
L3–L4	5	10
L4–L5	30	60
L5–S1	15	30
Total	50	100

The most commonly involved level was L4–L5 (60%), followed by L5–S1 (30%) and L3–L4 (10%).

Functional and Clinical Outcomes

Time Point	Mean Score	Standard Deviation	P value
Pre-injection	16.46	1.88	<0.001
1 Week	11.58	—	<0.001
1 Month	11.58	2.58	<0.001
3 Months	11.14	2.58	<0.001
6 Months	10.58	2.41	<0.001
12 Months	9.28	2.38	<0.001

RMDQ Score

The mean RMDQ score improved significantly from 16.46 ± 1.88 pre-injection to:

11.58 at 1 week

~11.14 at 3 months

9.28 ± 2.38 at 12 months

This reduction was statistically highly significant ($p < 0.001$) across all follow-ups, indicating sustained improvement in functional disability.

Finger-to-Floor Distance (FTF)

Time Point	Mean (cm)	Standard Deviation	P value
Pre-injection	63.12	7.90	<0.001
1 Week	36.16	—	<0.001
1 Month	37.92	14.92	<0.001
3 Months	37.92	14.77	<0.001
6 Months	39.60	14.77	<0.001
12 Months	41.74	16.06	<0.001

The mean FTF distance improved from 63.12 ± 7.90 cm pre-injection to:
36.16 cm at 1 week
~37–39 cm during mid follow-up
41.74 ± 16.06 cm at 12 months

This improvement was statistically significant ($p < 0.001$), demonstrating enhanced spinal flexibility.

Patient Satisfaction Score

Time Point	Mean Score	Standard Deviation	P value
Pre-injection	0.14	0.35	0.068
1 Week	2.68	1.23	<0.001
1 Month	2.38	1.15	<0.001
3 Months	2.26	1.19	<0.001
6 Months	2.18	1.17	<0.001
12 Months	2.08	1.15	<0.001

The mean satisfaction score increased from 0.14 ± 0.35 pre-injection to:
2.68 ± 1.23 at 1 week
Gradually declining to 2.08 ± 1.15 at 12 months
This change was statistically significant ($p < 0.001$), indicating high early satisfaction with slight decline over time.

VAS Score (Pain)

Time Point	Mean Score	Standard Deviation	P value
Pre-injection	8.58	0.83	<0.001
1 Week	3.56	2.18	<0.001
1 Month	3.56	2.19	<0.001
3 Months	4.00	2.35	<0.001

6 Months	4.26	2.46	<0.001
12 Months	4.48	2.45	<0.001

The mean VAS score reduced significantly from 8.58 ± 0.83 pre-injection to:
3.56 ± 2.18 at 1 week
3.56 ± 2.19 at 1 month
Gradually increasing to 4.48 ± 2.45 at 12 months
This reduction remained statistically significant ($p < 0.001$) throughout follow-up.

Oswestry Disability Index (ODI)

Time Point	Mean Score	Standard Deviation	P value
Pre-injection	57.4	8.42	<0.001
1 Week	46.36	9.09	<0.001
1 Month	49.2	8.91	<0.001
3 Months	31.4	11.02	<0.001
6 Months	30.6	13.47	<0.001
12 Months	32.2	12.90	<0.001

The mean ODI improved from 57.4 ± 8.42 pre-injection to:
46.36 ± 9.09 at 1 week
31.4 ± 11.02 at 3 months
30.6 ± 13.47 at 6 months
32.2 ± 12.90 at 12 months

This improvement was statistically significant ($p < 0.001$), with maximum functional gain observed at 3–6 months.
FIGURE LEGENDS

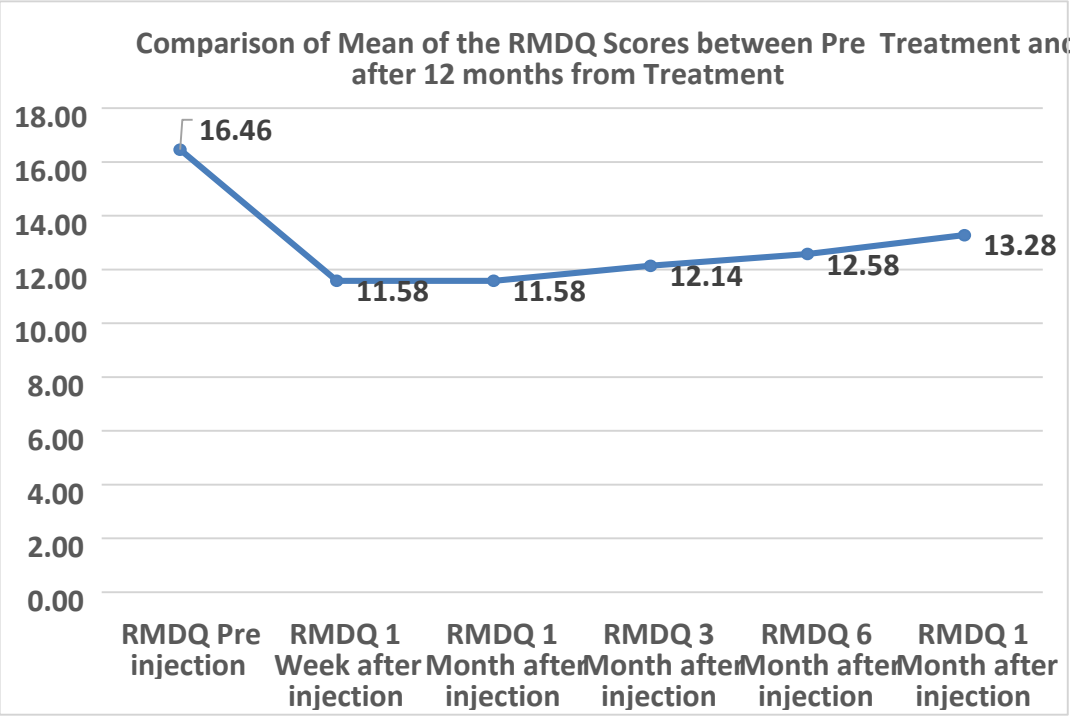

Figure 1: Trend of RMDQ Scores Over Time

Shows progressive reduction in disability scores with maximum improvement at 12 months

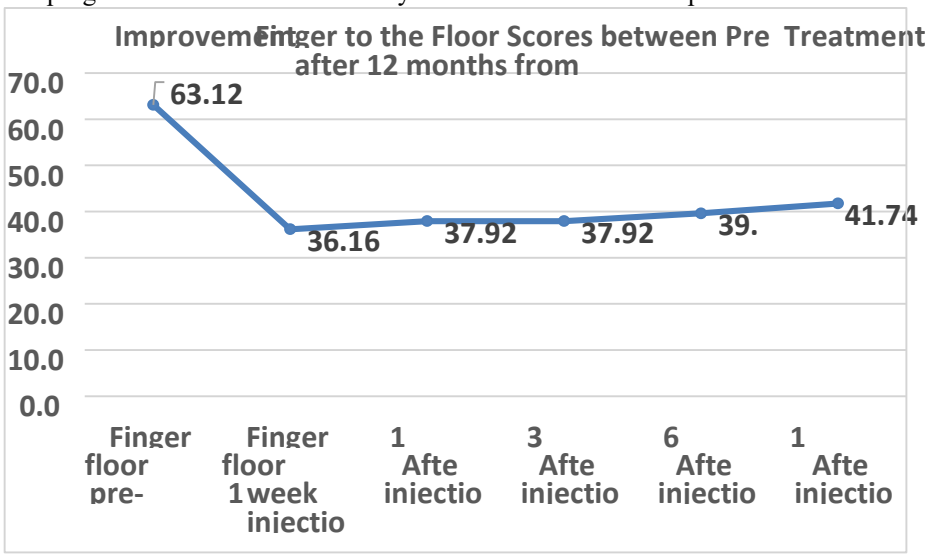

Figure 2: Improvement in Finger-to-Floor Distance

Demonstrates significant early improvement in spinal mobility with partial decline over time.

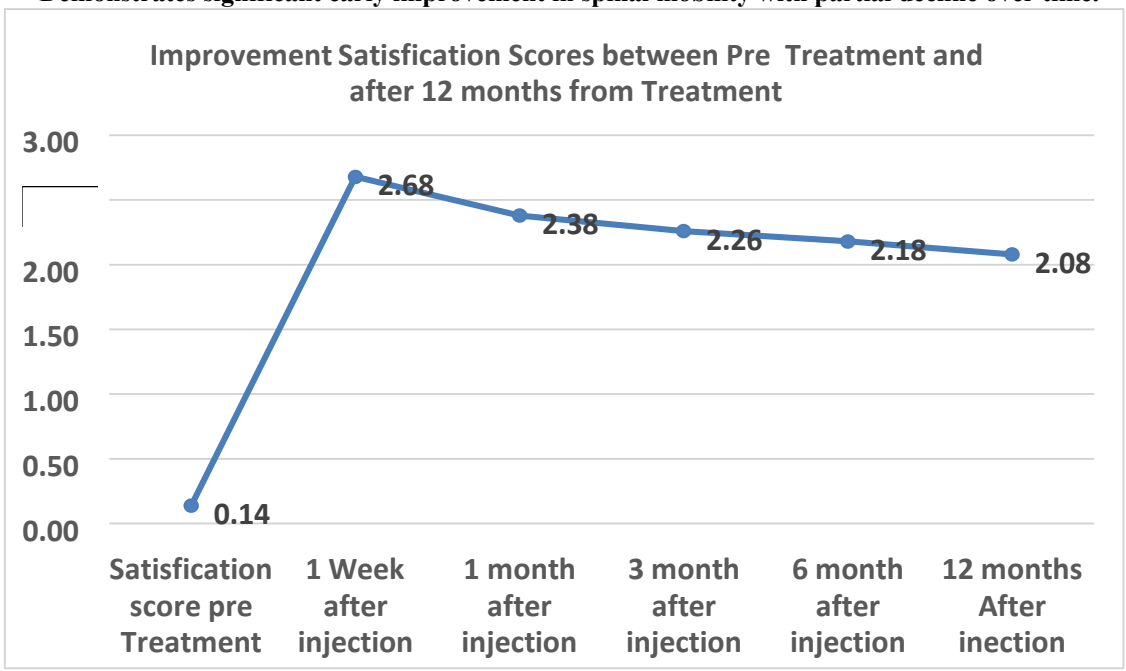

Figure 3: Patient Satisfaction Trends

Depicts peak satisfaction at 1 week followed by gradual decline.

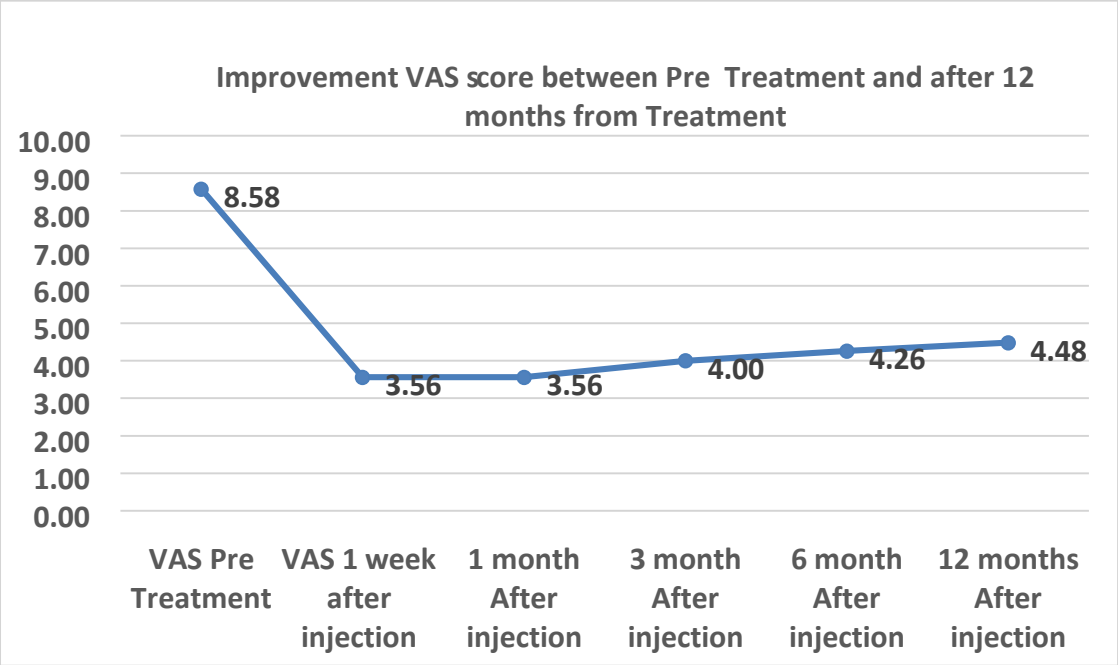

Figure 4: VAS Score Reduction

Illustrates sharp early reduction in pain with mild increase at long-term follow-up.

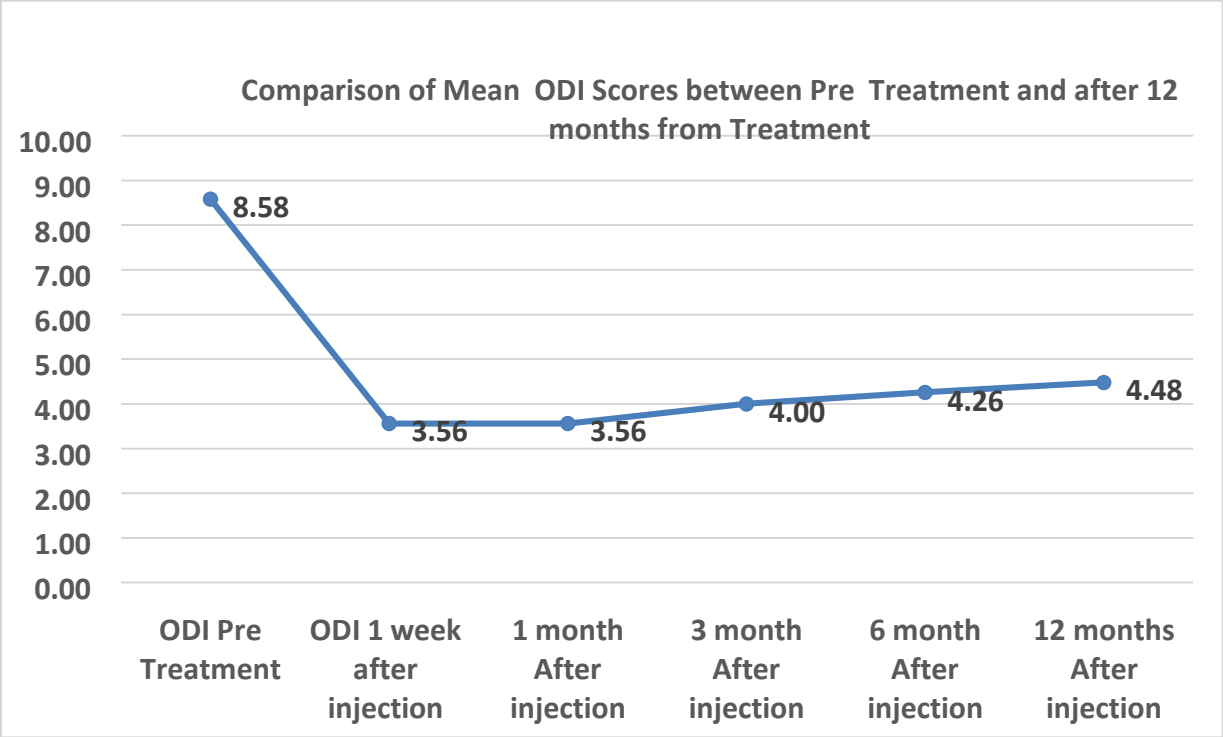

Figure 5: ODI Score Improvement

Shows maximum functional improvement at 3–6 months with sustained benefit at 12 months.
CASE ILLUSTRATION 1

Age: 32
L4-L5 Intervertebral disc protrusion
MSU grade: 1-A

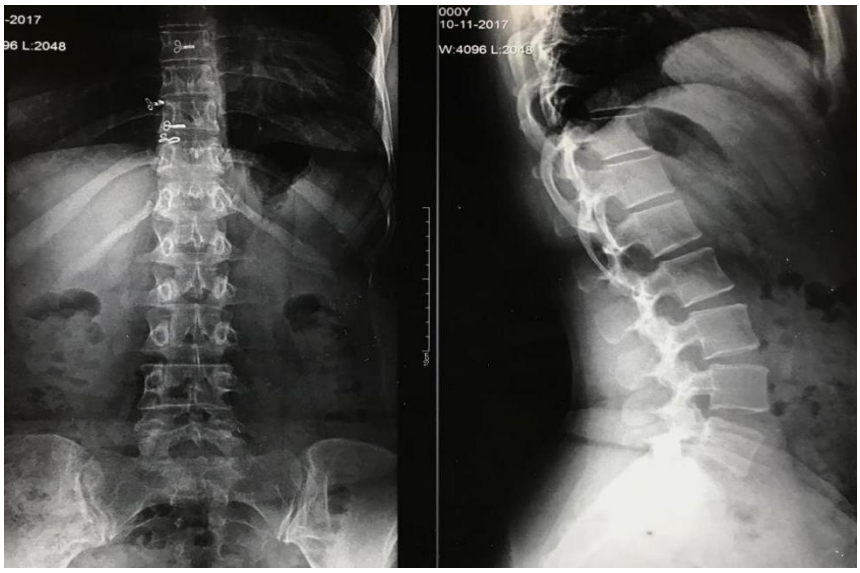

Fig 33: X-ray LS Spine AP and lateral view shows no bony abnormality

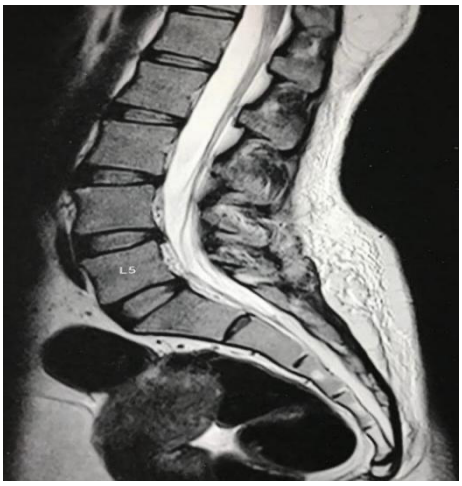

Fig 34: MRI Sagittal view of lumbosacral spine shows diffuse disc bulge

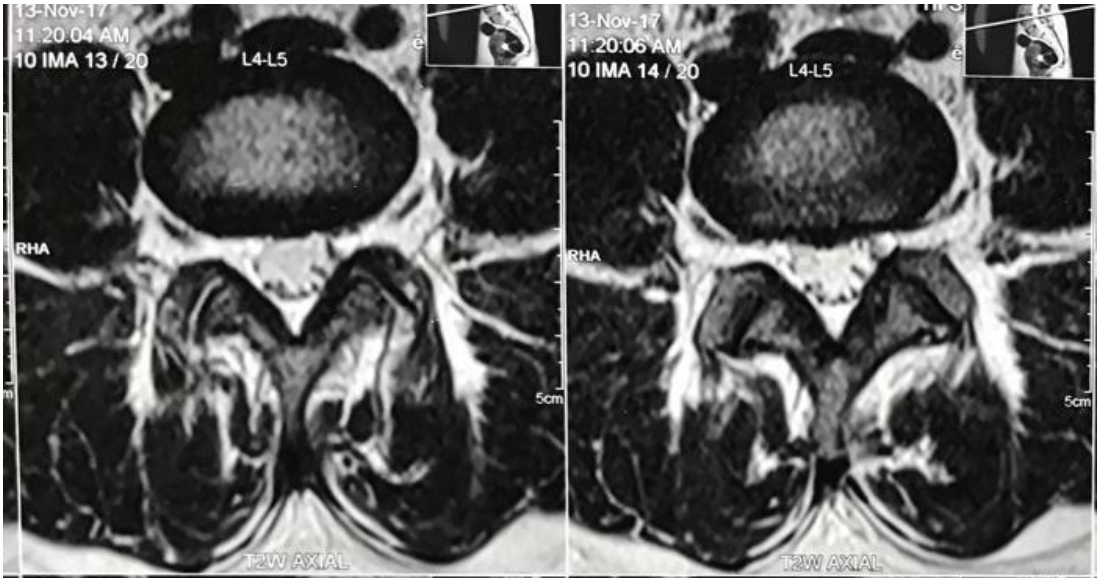

Fig 35: MRI Axial view of L4-L5 shows central bulge (MSU grade 1-A)

CASE ILLUSTRATION 2
Age: 46
Multiple level disc bulge at L3-L4, L4-L5 and L5-S1 disc protrusion
MSU grade: 1-B

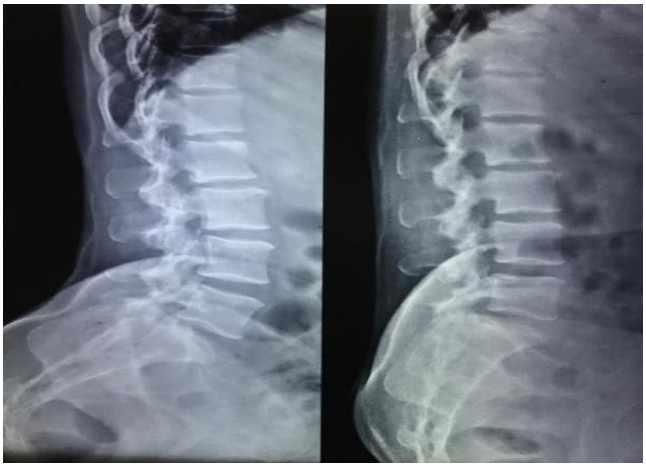

Fig 36: X-ray LS Spine AP and lateral view shows no bony abnormality

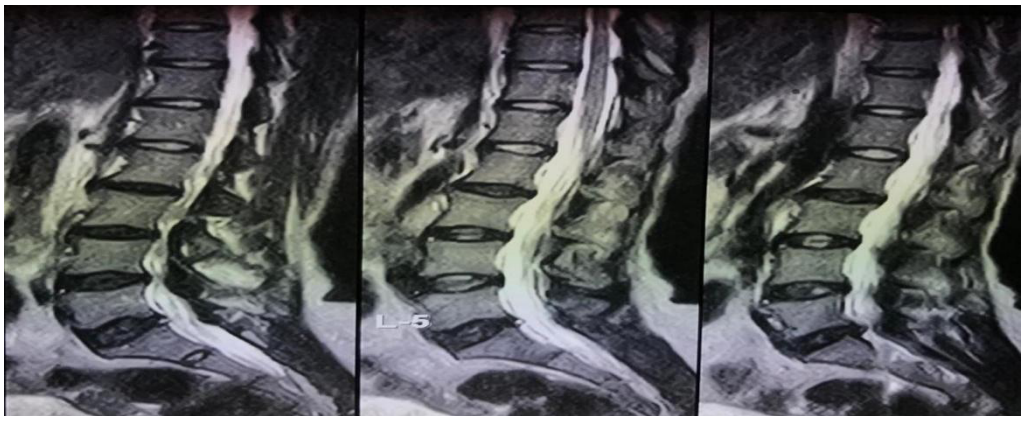

Fig 37: MRI Sagittal view of lumbosacral spine shows multiple level disc-bulge at L3-L4, L4-L5 and L5-S1 disc protrusion.

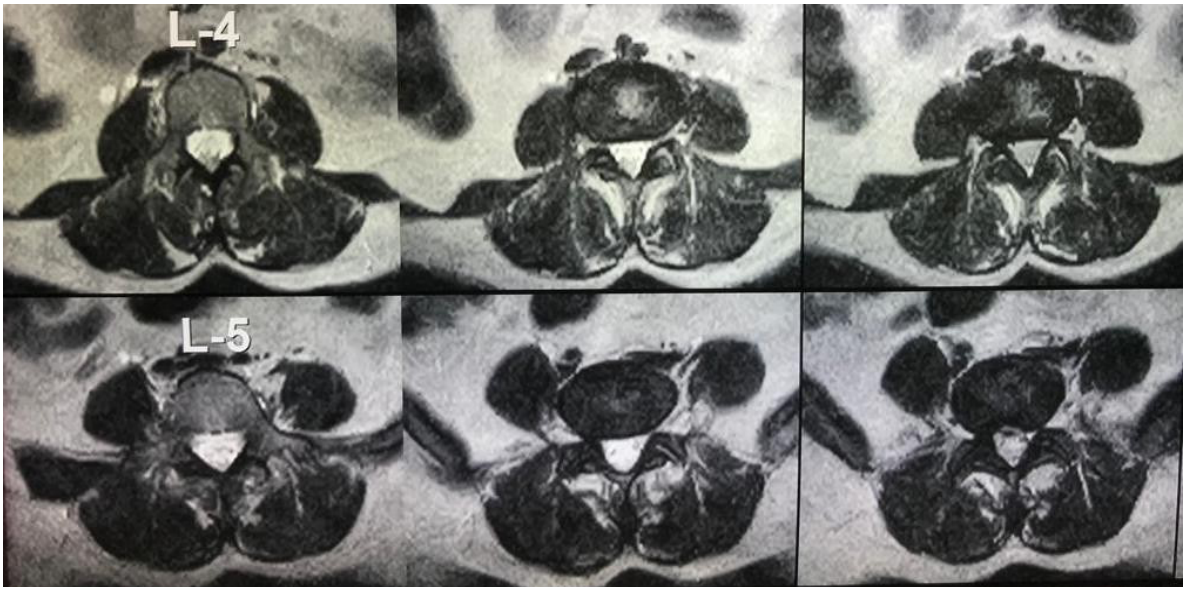

Fig 38: MRI Axial view of L4-L5 shows disc protrusion (MSU grade 1-B)

CASE ILLUSTRATION 3

Age: 39
L4-L5 disc protrusion
MSU grade: 2-A

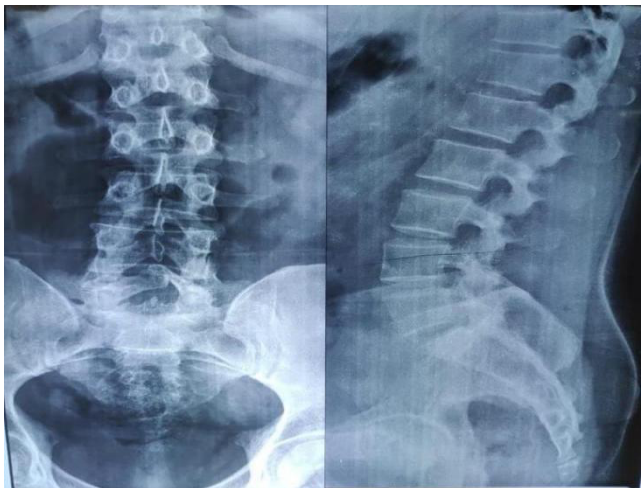

Fig 39: X-ray LS Spine AP and lateral view shows no bony abnormality

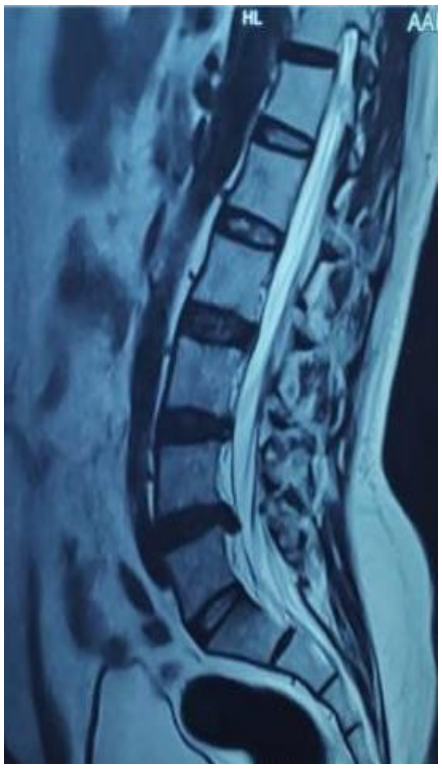

Fig 40: MRI Sagittal view of lumbosacral spine shows
L4-L5 disc protrusion

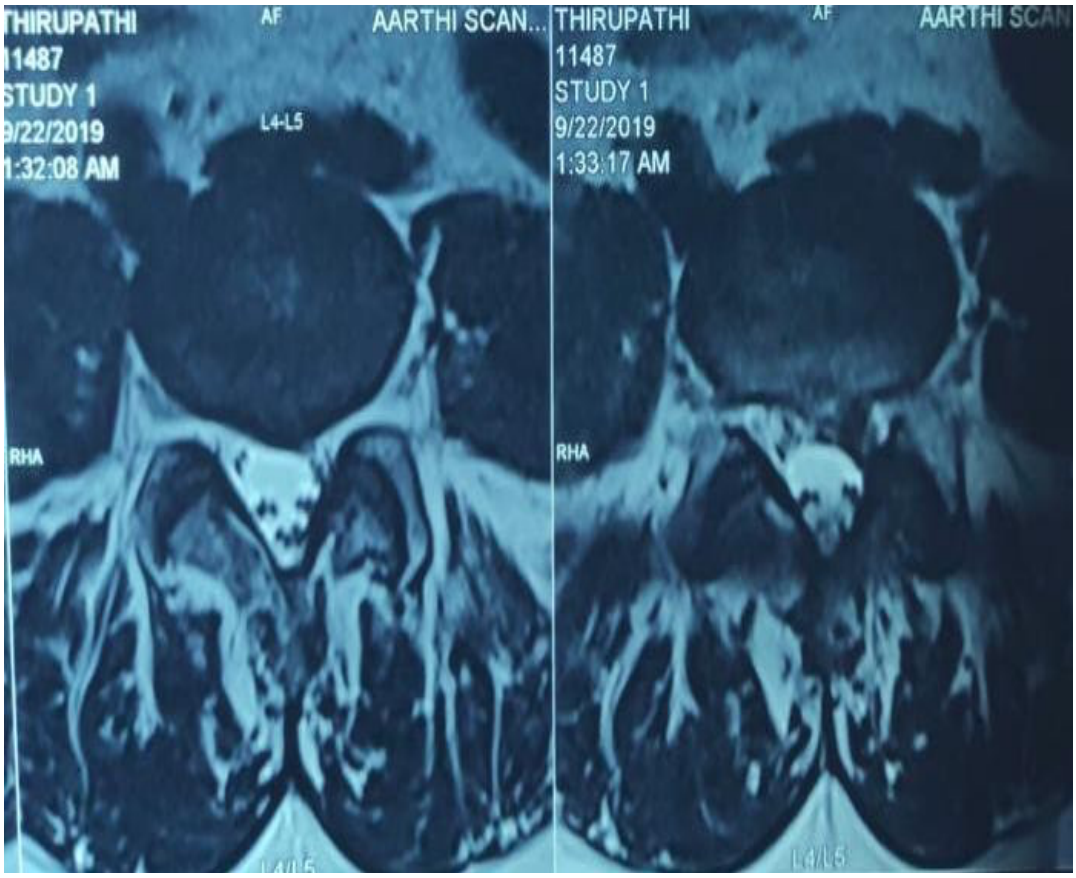

Fig 41: MRI Axial view of L4-L5 shows central disc protrusion (MSU grade 2-A)

DISCUSSION

The present study demonstrates that epidural steroid injections result in statistically significant improvement in pain and functional outcomes in patients with lumbar radicular pain. The mean VAS score showed a marked reduction from 8.58 ± 0.83 pre-injection to 3.56 ± 2.18 at 1 week ($p < 0.001$), indicating a substantial early analgesic effect. This improvement remained significant at 12 months (4.48 ± 2.45, $p < 0.001$), although a gradual increase in pain scores suggests partial loss of efficacy over time. These findings are consistent with previous studies demonstrating strong short-term benefit of epidural steroid injections [5,7].

Functional outcomes showed parallel improvement. The RMDQ score decreased significantly from 16.46 ± 1.88 to 9.28 ± 2.38 at 12 months ($p < 0.001$), indicating sustained improvement in disability. Similarly, ODI improved from 57.4 ± 8.42 to 30.6 ± 13.47 at 6 months, with slight worsening to 32.2 ± 12.90 at 12 months, suggesting that functional gains peak at mid-term follow-up and are partially maintained thereafter. These improvements exceed the minimal clinically important difference thresholds described in literature [8], confirming both statistical and clinical relevance.

The temporal pattern of response observed in this study is particularly important. Maximum benefit was observed in the early post-injection period, with significant improvements in pain, disability, and patient satisfaction. The mean satisfaction score increased from 0.14 to 2.68 at 1 week, followed by gradual decline to 2.08 at 12 months, reflecting a strong early response with diminishing long-term benefit. This trend is consistent with systematic reviews and randomized controlled trials that have shown diminishing efficacy of epidural steroid injections over time [9,10].

The improvement in finger-to-floor distance from 63.12 ± 7.90 cm to 36.16 cm at 1 week ($p < 0.001$) further supports the role of epidural steroids in improving spinal mobility. However, the gradual increase to 41.74 cm at 12 months suggests partial loss of flexibility over time, likely due to persistent structural pathology.

These findings reinforce the concept that epidural steroid injections primarily target the inflammatory component of radicular pain. The early and significant reduction in pain can be attributed to suppression of inflammatory mediators such as cytokines and phospholipase A2 [4]. However, the inability to sustain long-term benefit highlights a key limitation—epidural steroid injections do not address underlying mechanical compression or degenerative changes [2,3].

The variability in long-term outcomes observed in this study may be explained by differences in disease severity, duration of symptoms, and degree of nerve root compression. Patients with predominantly inflammatory pathology are likely to benefit more than those with significant structural abnormalities. This emphasizes the importance of careful patient selection.

When compared with existing literature, the findings of this study are consistent with previous reports demonstrating significant short-term efficacy but limited long-term benefit of epidural steroid injections [5,6]. High-quality trials such as those by Friedly et al. have shown no sustained long-term superiority over placebo [10], supporting the view that epidural steroid injections serve as an adjunct rather than definitive treatment.

Although no major complications were observed in this study, potential risks such as neurological injury and infection must be considered [12,13]. Proper technique and patient selection remain essential to minimize adverse events.

In summary, this study confirms that epidural steroid injections provide statistically significant and clinically meaningful short-term improvement in lumbar radicular pain, with partial decline in efficacy over time. These findings support their use as a component of multimodal management rather than a standalone definitive therapy.

CONCLUSION

Epidural steroid injections provide significant short-term symptomatic relief in lumbar radicular pain, with meaningful improvement in functional outcomes. However, their long-term efficacy remains inconsistent, and they do not modify underlying pathology.

They should be used judiciously within a multimodal treatment strategy, with appropriate patient selection and expectation management.

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