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How effective are epidural steroid injections in patients with chronic low back pain?

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Abstract

This study aimed to evaluate the clinical effectiveness of transforaminal Epidural Steroid Injections (ESIs)in patients with chronic low back pain due to lumbar disc herniation who did not respond to conservative treatment. ESIs in this study resulted in a statistically significant reduction in pain and improvement in functional outcomes. Baseline Visual Analog Scale (VAS) scores (8.02±1.00) decreased to 3.80±2.53 at one month, 3.60±2.80 at three months, and 3.57±3.04 at six months ($p<0.001$). Similarly, Oswestry Disability Index (ODI) scores showed a mean reduction of 37.8 points following the intervention ($p<0.001$, Cohen's $d=1.610$), indicating substantial functional recovery. The most pronounced benefit was observed in patients with sequestrated disc herniations, where pain relief and functional gains were particularly evident. These findings demonstrate that transforaminal ESIs provide clinically meaningful and sustained outcomes in carefully selected patients with chronic low back pain. ESI provided a marked reduction in pain intensity and a clear improvement in daily functioning. Pain relief was evident within the first month and maintained throughout follow-up. Functional capacity improved substantially, with many patients reporting better mobility and quality of life. The benefit was observed across all Magnetic Resonance Imaging (MRI) levels, with particularly favorable outcomes in patients with sequestrated disc herniations. Transforaminal ESIs appear to be an effective and minimally invasive treatment for selected patients with lumbar disc herniation–related chronic low back pain. They can provide sustained pain relief, enhance functional status, and may reduce the need for surgical intervention when applied with appropriate patient selection and technique.

Keywords: Chronic low back pain, lumbar disc herniation, ESI, transforaminal approach, functional outcomes

Introduction

Almost 80% of adults worldwide will have low back pain at some point in their lives, making it one of the most prevalent musculoskeletal conditions [1]. According to the World Health Organization, back pain is one of the leading causes of lost work time and reduced quality of life. Its annual prevalence ranges from 15% to 45%, with the highest incidence seen in the 35–55 age group [2]. With age, an increase in disc degeneration and herniation is observed, which are among the important causes of mechanical low back pain [3]. In approximately 90% of patients with acute low back pain, symptoms subside within a few weeks, while only 10% experience pain lasting longer than 4–6 weeks [4]. Conservative treatments are the primary approach to managing low back pain. These treatments include passive methods such as rest, activity modification, and avoiding heavy lifting, as well as non-steroidal anti-inflammatory drugs, muscle relaxants, and antidepressants [5]. To reduce inflammation and alleviate pain, Epidural Steroid Injections (ESIs) are used as a minimally invasive option for patients who are not responding to conservative therapy. ESI use has significantly increased in recent years and is especially prevalent in cases of radicular pain brought on by lumbar disc herniation [6]. The efficiency of ESI has been the subject of conflicting findings in the literature since their introduction in 1953. According to available data, some patients may also benefit over the long run, even when they only temporarily experience pain relief [4-6]. This retrospective study

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set out to assess how ESIs affect the degree of pain and day-to-day functioning in lumbar disc herniation patients.

Material and Methods

This retrospective study was conducted by reviewing the medical files and electronic hospital records of patients who presented to the orthopedics and neurosurgery departments of our institution between 2019 and 2024 with chronic low back pain and who underwent ESIs. The study was carried out in accordance with the principles of the Declaration of Helsinki and received approval from the Ankara Etlik City Hospital ethics committee at 27.08.2025 and with Ref: AEŞH—BADEK1-2025-319.

Patient Selection

Between June 2019 and December 2024, a total of 150 patients who underwent ESIs for chronic low back pain were included in the study. Inclusion criteria were as follows:

- Chronic low back pain persisting for at least three months,
- Persistence of symptoms despite conservative treatment (analgesics, non-steroidal anti-inflammatory drugs, muscle relaxants, physical therapy),
- Presence of radicular symptoms on clinical examination (marked leg pain, dermatomal examination, positive straight leg raise test),
- Lumbar disc herniation or foraminal stenosis confirmed by Magnetic Resonance Imaging (MRI); consistent with clinical findings. Exclusion criteria were:
- History of previous lumbar surgery,
- Diagnosis of fibromyalgia or widespread chronic pain syndrome,
- Diabetic polyneuropathy or other neuropathic pain syndromes,
- History of prior ESI,
- Presence of severe coagulopathy, local or systemic infection,
- Pregnancy.

Demographic data, clinical characteristics and MRI findings of all patients were obtained from hospital records. Pain intensity was assessed before and after the injection using the Visual Analog Scale (VAS). Functional status was evaluated before and after the procedure through telephone interviews using the Oswestry Disability Index (ODI). All collected data were documented and used for statistical analysis.

Application Procedure

All ESIs were administered by two specialist physicians (orthopedic and neurosurgery specialists/with spinal surgery experience) with at least 5 years of experience, under local anesthesia and fluoroscopy guidance, in sterile operating room conditions. Patients were placed in the prone position. The level was determined under anteroposterior imaging with C-arm fluoroscopy according to MRI and clinical findings. Subsequently, the C-arm was positioned obliquely, the transforaminal approach was selected and the epidural space was reached using a 22G peripheral nerve block needle. In all patients, contrast medium (Iohexol/Omnipol®)was injected prior to the injection to ensure that the needle tip was positioned in the epidural space (Figure 1). All patients received a total of 5 ml injection consisting of 40 mg/1 ml methylprednisolone acetate (Depomedrol®)+ 40 mg/4 ml 1% prilocaine HCl (Citanest®) without the use of a nerve stimulator. After the procedure, patients were monitored for 4-6 hours for possible complications such as dura rupture, epidural hemorrhage, and headache, and were then discharged. After discharge, patients were advised to rest in bed for 2 days and to avoid heavy lifting and prolonged walking for 3 weeks. No physical therapy program was administered after the procedure.

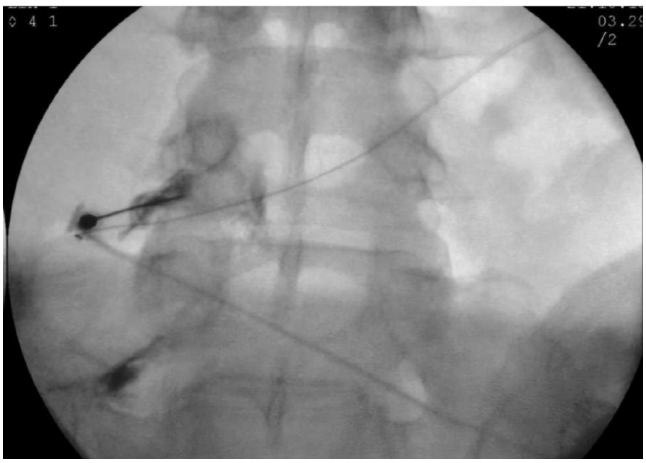

Figure 1. Contrast medium (Iohexol/Omnipol®) injection confirming correct needle tip position in the epidural space under fluoroscopy during transforaminal epidural steroid injection

Statistical Analysis

Data were analyzed using IBM SPSS Statistics v27 (SPSS Inc., Chicago, IL, USA) software. Continuous variables showing a normal distribution were summarized as mean±SD, while variables not showing a normal distribution were summarized as median (IQR); categorical data were summarized as percentages. Despite minor deviations from normal distribution, the sample size (n=150) was considered sufficient for parametric tests. VAS scores, collected at four time points (baseline, 1 month, 3 months, 6 months), were analyzed using repeated-measures Analysis of Variance (ANOVA) with MRI level as the between-subjects factor. Time effects, interaction effects (time × MRI level), and trend analyses (linear, quadratic, cubic) were reported. Bonferroni-adjusted pairwise comparisons were performed to compare VAS scores across time points. ODI scores, assessed pre and postoperatively, were analyzed using paired samples t-test. Effect sizes were calculated using Cohen's d. Additionally, a mixed ANOVA was conducted with MRI level as the between-subject factor and time (pre/post) as the within-subject factor to

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explore potential interaction effects. Between-group comparisons of pre- and postoperative ODI scores across MRI levels were also performed using one-way ANOVA. A two-tailed p value<0.05 was considered statistically significant for all tests. VAS scores were recorded at four time points (pre-intervention, 1st, 3rd, and 6th month) and were analyzed using repeated measures ANOVA in conjunction with the MRI level factor.

Time and interaction effects were evaluated; pairwise comparisons were performed with Bonferroni correction. ODI scores were compared using a paired t-test in the pre- and postoperative periods, and the effect size was calculated using Cohen's d coefficient. Additionally, mixed ANOVA was applied for MRI levels and one-way ANOVA for between-group comparisons. All analyses were considered statistically significant at p<0.05.

Result

Patient Characteristics

A total of 150 patients (mean age: 58.0±14.9 years; 54.7% male) underwent lumbar ESI. The most common MRI levels involved were L4–L5 (34.0%) and L2–L3 (24.7%). Sequestrated disc herniation was observed in 17.3% of patients. Baseline demographics and clinical features did not significantly differ across MRI levels. (Table1.)

Table 1. Descriptive statistics

Demographic and Clinical Variables	Total (n=150)	L1–L2 (n=12)	L2–L3 (n=37)	L3–L4 (n=24)	L4–L5 (n=51)	L5–S1 (n=26)	p
Age	58.0±14.9	62.9±15.1	59.6±14.1	59.1±12.9	57.6±14.5	53.1±17.7	0.326
Gender (male), n (%)	82 (54.7%)	9 (75.0%)	20 (54.1%)	13 (54.2%)	23 (45.1%)	17 (65.4%)	0.277
Sequestrated Disc, n (%)	26 (17.3%)	2 (16.7%)	8 (21.6%)	3 (12.5%)	9 (17.6%)	4 (15.4%)	0.918
VAS pre	8.02±1.00	8.08±1.38	8.19±1.00	8.04±0.91	7.84±1.05	8.08±1.02	0.628
VAS 1 mo	3.80±2.53	3.83±2.17	3.14±2.46	3.83±2.78	4.04±2.34	3.83±2.88	0.382
VAS 3 mo	3.60±2.80	3.33±2.61	3.08±2.60	4.04±2.76	3.84±2.87	4.04±3.09	0.582
VAS 6 mo	3.57±3.04	3.08±2.84	3.19±2.85	4.04±2.90	3.49±3.19	4.04±3.33	0.720
ODI pre	55.2±12.4	56.6±16.1	57.8±11.8	54.2±12.5	51.8±13.4	58.5±7.8	0.104
ODI post	17.4±20.2	12.5±17.6	15.1±20.2	22.9±20.5	16.3±19.9	20±21.7	0.477

[a]: Mann- Whitney U Testi, [b]: Student-t test, Mean±SD: Mean±Standard Deviation, n: Frequency, %: Percent

Change in Pain Scores (VAS)

The mean VAS score significantly improved over time (F (3.435)=190.34, p<0.001, partial η^2=0.568), indicating a significant reduction in pain following intervention (Table 2). The average VAS score decreased from 8.02±1.00 at baseline to 3.80±2.53 at 1 month, 3.60±2.80 at 3 months, and 3.57±3.04 at 6 months. Trend analysis revealed significant linear (p<0.001, η^2=.562), quadratic (p<0.001, η^2=.604), and cubic (p<0.001, η^2=.468) effects over time. The quadratic trend, with the strongest effect size, suggests a steep initial reduction in pain followed by a plateau at later time points. Bonferroni-adjusted pairwise comparisons showed statistically significant reductions in VAS scores from baseline to all follow-up points: Pre vs. 1 Month: MD=4.21, SE=0.245, p<0.001, 95% CI [3.55, 4.87], Pre vs. 3 Months: MD=4.38, SE=0.283, p<0.001, 95% CI [3.62, 5.14], Pre vs. 6 Months: MD=4.48, SE=0.309, p<0.001, 95% CI [3.65, 5.30]. In contrast, no significant differences were found between any of the follow-up time points (1 vs. 3 months, 1 vs. 6 months, 3 vs. 6 months; all p> 0.05). The interaction effect of time × MRI Level is not significant (F=0.894, p=0.553, partial η^2=0.024). This means the pattern of VAS score improvement over time was similar across all MRI levels (no interaction) (Figure 2). Similarly, between-subjects analysis showed no significant differences in overall VAS scores across MRI levels (F (4.145)=0.633, p=0.640, partial η^2=0.017) (Table 1).

Change in Disability Scores

ODI also showed significant improvement (Figure 3). A paired-samples t-test showed that mean ODI decreased from pre- to post-intervention by 37.8 points (t (149)=19.71, p<0.001, 95% CI [34.01, 41.59]) with large effect size Cohen's d=1.610 (95% CI [1.366, 1.851]). Repeated-measures ANOVA confirmed a significant main effect of time (F (1.145)=320.32, p<0.001, partial η^2=0.688), supporting robust improvement in ODI scores following treatment. No significant interaction was found between time and MRI level (F (4.145)=1.226, p=0.302, partial η^2=0.033), suggesting that the magnitude of improvement in ODI was consistent across all levels. Repeated-measures ANOVA confirmed a significant main effect of time (F (1.145)=320.32, p<0.001, partial η^2=0.688), supporting robust improvement in ODI scores following treatment. No significant interaction was found between time and MRI level (F (4.145)=1.226, p=0.302, partial η^2=0.033), suggesting that the magnitude of improvement in ODI was consistent across all levels.

Similarly, there was no significant difference in overall ODI scores between MRI levels (F (4.145)=1.119, p=0.350, partial η^2=0.030), and Bonferroni-adjusted pairwise comparisons did not identify any significant between-group differences (all p>.05) (Table 3).

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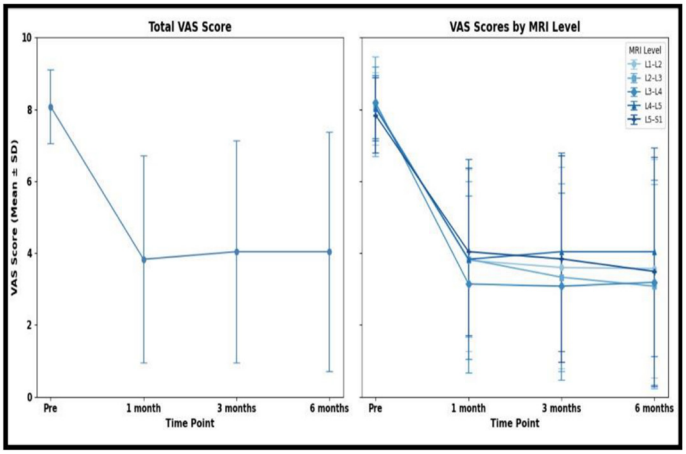

Figure 2. Change in VAS scores over time following lumbar epidural injection: Total cohort vs. MRI- level subgroups

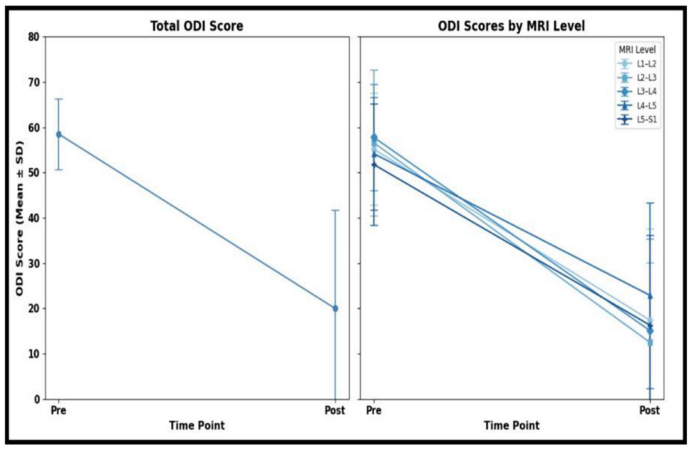

Figure 3. Change in ODI scores over time following lumbar epidural injection:Total cohort vs. MRI- level subgroups

Table 2. Mixed ANOVA (Analysis of Variance) results

Effect	F	p	Partial n2
VAS score			
Time	190.34	<0.001	0.568
Time*MRI level	0.894	0.553	0.024
MRI level (between subjects)	0.633	0.640	0.017
ODI score			
Time	320.32	<0.001	0.688
Time*MRI level	1.226	0.302	0.033
MRI level (between subjects)	1.119	0.350	0.030

VAS: Visual Analog Scale, ODI: Oswestry Disability Index, MRI: Magnetic Resonance Imaging

Table 3. Bonferroni-adjusted pairwise comparisons of VAS and ODI scores over time

Pairwise Time Comparison	Mean Difference(MD)	Std. Error	p-value (Bonferroni)	%95 CI
Pre vs 1 Month VAS	4.209	0.245	<0.001	3.554-4.865
Pre vs 3 Months VAS	4.379	0.283	<0.001	3.622-5.137
Pre vs 6 Months VAS	4.478	0.309	<0.001	3.652-5.304
1 Month vs 3 Months VAS	0.170	0.128	1.000	-0.172-0.512
1 Month vs 6 Months VAS	0.269	0.184	0.873	-0.223-0.760
3 Months vs 6 Months VAS	0.099	0.119	1.000	-0.220-0.418
Pre vs Post ODI	37.8	2.15	<0.001	34.17-42.66

VAS: Visual analog scale, ODI: Oswestry disability index

Discussion

ESIs, which have been used since 1953 in the treatment of chronic low back pain and radicular pain, have reported varying results in the literature in terms of efficacy. In our study, we evaluated the effect of ESI on alleviating back pain with an average follow-up period of 22 months. The most important finding we obtained was that no change in pain was observed in 26% of our patients, even for a short period. Looking at previous studies examining the effectiveness of ESI applications, transforaminal ESI achieved an 84% success rate compared to saline injections applied to trigger points [7]. Similarly, a 60% success rate was observed in another study [8,9]. However, this retrospective study included only 30 patients, 20 of whom had lumbar disc herniation and 10 of whom had foraminal stenosis, and all patients required surgical decompression. Rapid improvement was achieved in 87% of patients within the first four days, and permanent relief was observed in 60%. Thus, it was demonstrated that surgery was not required during the average 16-month follow-up period. The 74% success rate obtained in our study was demonstrated by a significant decrease in VAS scores in patients over a minimum 6-month period. Additionally, ODI scores at final follow-up

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showed a significant decrease compared to pre-treatment levels in 60% of patients.

According to a comprehensive analysis, ESIs only slightly and very briefly improved outcomes when compared to a placebo, at a level that both doctors and patients considered clinically inconsequential [10]. However, when compared to the results of our study, we do not find Oliveira and colleagues' review sufficient for our practice. We believe that ESI applications, with appropriate patient selection, correct technique, and experienced hands, are effective in delaying surgery and reducing the patient's pain level. The combination of transforaminal ESIs and Mechanical Diagnostic Treatment (MDT) was found to offer further advantages in terms of lowering the number of impacted discs and enhancing clinical results [11]. Even though our trial only used transforaminal ESIs, we were nevertheless able to reduce pain with a high success rate. This result emphasizes the necessity of more studies assessing combined therapy regimens. Other studies underlined the significance of customized treatment approaches and examined predictive criteria for identifying individuals most likely to benefit from transforaminal ESIs [12]. Our cohort's notable clinical and radiological improvement, especially in patients with sequestered disc herniations, supports these findings and emphasizes how important patient selection is to treatment results. It has been reported that ESIs given during the recovery phase after Percutaneous Endoscopic Lumbar Discectomy (PELD) may improve functional outcomes and lessen leg and back discomfort [13]. ESIs were found to be better than a placebo for short-term (≤3 months) and mid-term (≤6 months) pain control in a meta-analysis [14]; however, no discernible increase in functional outcomes was noted. Despite this, the survey highlighted a significant decline in opioid use. On the other hand, our research showed notable gains in both ODI and VAS scores. This disparity might be explained by our cohort's more uniform patient selection and method uniformity The remarkable success rate seen in our study, especially among patients with sequestered disc herniations, firmly supports the efficacy of transforaminal ESIs when used on the right patient population, especially in light of the literature from the previous five years. However, the absence of integrated treatment protocols and the disregard for psychological factors are drawbacks that need to be addressed in future prospective studies. The decrease in pain perception observed in the VAS scores in our study and the change in ODI scores showing a significant improvement in patients' daily activities support this view. The literature also reports that the success of ESI applications is influenced by both patient-related and technique-related factors. Although the transforaminal approach carries more risk than other interlaminar and caudal applications, it is known to be more effective in radiculopathy because it allows direct drug application to the affected nerve root [15]. Furthermore, when evaluated based on the patient's body mass index, the use of longer needles increases the chance of success in obese patients [16]. Considering the relationship between pain and psychosocial factors, previous reviews emphasized the need to include psychosocial factors when evaluating the success of ESI applications [17]. Therefore, unlike the review by Oliveira and colleagues, our study demonstrates that ESI, when performed with the appropriate technique, is an effective method that can be applied before surgery in patients with lumbar disc herniation. One of the most important things we learned from our study was that ESIs worked 100% of the time to relieve pain in individuals with large or sequestered disc herniations. Also, follow-up MRI scans done an average of 6 months (range, 3–14 months) following the surgery showed that the herniated nucleus pulposus or sequestered fragment had gotten much smaller in 70% of instances (Figure 4). It has been reported that ESI reduced symptoms but did not cause a significant change in lesion size [17]. However, in our study, it is noteworthy that the lesions of cases with shrinkage or resorption observed on MRI images had more avascular components. Sequestrated fragments are defined as radiological findings in lumbar disc herniations that are not connected to the main fragment [18]. A review study published in 2014 reported that when subtypes of lumbar disc herniations were compared, sequestrations had the highest likelihood of developing the fastest spontaneous regression [19]. It has been suggested that this mechanism may be related to the regression of the avascular fragment through inflammatory processes [20]. Furthermore, another review published in 2015 reported spontaneous regression rates of 96% in sequestration, 70% in extrusion, 41% in protrusion, and 13% in bulging [21].

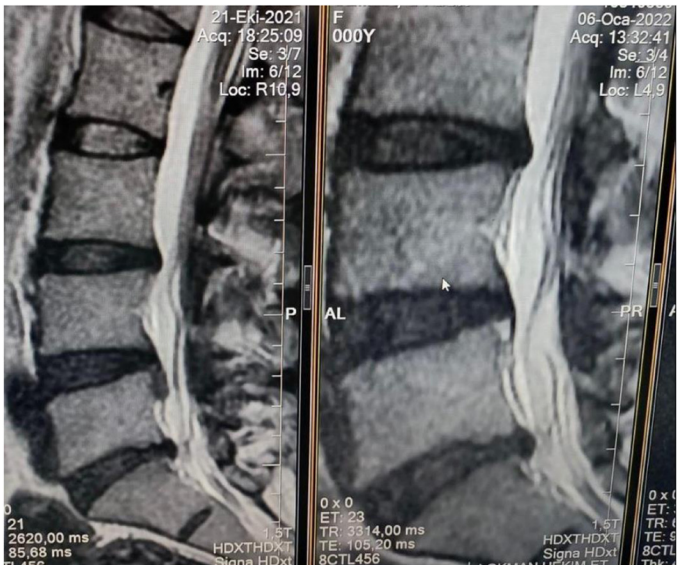

Figure 4. Sagittal lumbar MRI imajes of a 30-year-old female patient at the L4 - L5 level. (A) Pre- injection: sequestrated disc herniation causing compression. (B) Threee months post- injection: marked regression of the sequestrated fragment and decompression of neural structures

The literature identifies three primary mechanisms for spontaneous disc regression: The first mechanism is dehydration of the herniated disc [22]. The second is retraction of the herniated fragment into the intervertebral space, and the third is inflammatory resorption and lysis after herniation into

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the epidural vascular space [20-23]. We concluded that the regressions observed in our study were consistent with the timeframes reported in the literature, but that thanks to steroid administration, patients experienced this process without pain. Therefore, we argue that ESI applications should be considered as a priority in cases of sequestrated lumbar disc herniation, provided there are no findings such as neurological deficit, motor strength loss, hypoesthesia or cauda equina syndrome. A review of the literature indicates that ESI is reported to be 50% successful in its effect on activities of daily living [24]. In line with this, a retrospective review of our patients revealed a considerable reduction in ODI scores at the last follow-up, along with a marked enhancement in daily activity levels.

Conclusion

According to the results of our retrospective study, epidural transforaminal steroid injections in patients with lumbar disc herniation were effective both in reducing the need for surgery and in achieving pain control. However, the retrospective design of the study, along with the lack of consideration of patients' physical characteristics and psychosocial factors in pain assessment, represent important limitations. We believe that future prospective studies, in which these factors are taken into account and patients are appropriately categorized, will provide stronger contributions to the literature on epidural steroid interventions.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study received ethical approval from the Ankara Etlik City Hospital Clinical Research Ethics Committee (decision number: AEŞH-BADEK1-2025-319, date: 27.08.2025).

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