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Original Article

Role of Transforaminal Injection in Non-Surgical Cases of Sciatica

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ABSTRACT

Background: Sciatica is a common lumbosacral radicular pain syndrome associated with pain, disability, and reduced functional capacity. Transforaminal epidural steroid injection is used as a targeted minimally invasive intervention in non-surgical cases, but local evidence regarding functional outcomes remains limited. Objective: To assess short-term functional improvement after transforaminal epidural steroid injection among non-surgical patients with sciatica and to identify clinical predictors of treatment efficacy. Methods: This descriptive case series was conducted at Punjab Institute of Neurosciences, Lahore, from March to September 2023. Eighty-five patients aged 25–65 years with clinically diagnosed sciatica received transforaminal epidural steroid injection using triamcinolone acetonide with levobupivacaine. Functional disability was assessed using the Oswestry Disability Index before treatment and at 12-week follow-up. Efficacy was defined as a reduction of more than 10 ODI points. Results: The mean age was 48.07 ± 4.71 years. ODI improved from 53.04 ± 0.72 before treatment to 31.65 ± 11.78 at 12 weeks, with a mean reduction of 21.35 ± 11.69 points ($p < 0.001$). Efficacy was achieved in 56 patients (65.9%). BMI ≤25 kg/m² (OR = 2.85, 95% CI: 1.12–7.21; $p = 0.028$) and symptom duration ≤14 days (OR = 3.45, 95% CI: 1.39–8.54; $p = 0.007$) independently predicted treatment response. Conclusion: Transforaminal epidural steroid injection was associated with significant short-term functional improvement in non-surgical sciatica, particularly among patients with lower BMI and shorter symptom duration. Keywords: Sciatica, Transforaminal Epidural Steroid Injection, Oswestry Disability Index, Functional Outcome, Non-Surgical Treatment

INTRODUCTION

Sciatica is a common lumbosacral radicular pain syndrome characterized by pain radiating from the lower back through the buttock and along the distribution of the sciatic nerve, often accompanied by sensory symptoms such as numbness, tingling, or paresthesia. It most frequently results from irritation or compression of the lumbar or sacral nerve roots, particularly L4–S1, with lumbar intervertebral disc herniation being one of the leading causes. Other clinically important contributors include lumbar spinal stenosis, degenerative disc disease, and spondylolisthesis. Because sciatica affects mobility, work capacity, sleep, and activities of daily living, it represents a substantial source of functional limitation and health-care utilization among adults with low back pain (1–3).

The reported lifetime or point prevalence of sciatica varies across populations and diagnostic definitions, but it commonly affects adults in the fourth and fifth decades of life and may become persistent or recurrent when radicular inflammation and mechanical nerve-root irritation are not adequately controlled. First-line management usually consists of conservative treatment, including nonsteroidal anti-inflammatory drugs, neuropathic pain medication, muscle relaxants where indicated, activity modification, and physiotherapy. Although many patients improve with conservative care, a clinically relevant subgroup continues to experience disabling radicular pain and functional restriction. Surgical management, including discectomy or decompression, is generally reserved for patients with severe, progressive, or refractory symptoms, but surgery is associated with higher cost, procedural risk, variable recovery, and the need for careful patient selection (4–8).

Transforaminal epidural steroid injection is a targeted minimally invasive intervention designed to deliver corticosteroid and local anesthetic close to the affected nerve root through the neural foramen. The rationale for this approach is based on the inflammatory component of radicular pain, in which corticosteroids may suppress local inflammatory mediators, reduce nerve-root edema, and provide pain relief that can facilitate functional recovery. Compared with less targeted epidural approaches, the transforaminal route may offer more direct delivery of medication to the symptomatic nerve root. Previous studies have reported short-term improvements in radicular pain and disability following transforaminal epidural steroid injection, although the magnitude and durability of benefit remain debated, particularly in patients managed without surgery (9–11).

Despite the increasing use of transforaminal epidural steroid injection, important evidence gaps remain. Much of the available evidence has been generated in Western populations or in heterogeneous groups that include different causes and durations of radiculopathy. Local data from Pakistan and comparable developing health-care settings remain limited, and fewer studies have evaluated functional improvement using validated disability instruments such as the Oswestry Disability Index. In addition, clinical factors that may influence response, including body mass index and duration of symptoms, require further evaluation to support better patient selection. Therefore, the present study was conducted to assess short-term functional improvement after transforaminal epidural steroid injection among non-surgical patients with sciatica, using change in Oswestry Disability Index score at 12 weeks as the primary outcome. The study also aimed to determine whether baseline clinical factors, particularly body mass index and symptom duration, were associated with treatment efficacy.

MATERIALS AND METHODS

This descriptive case series was conducted to evaluate functional outcomes after transforaminal epidural steroid injection among patients with non-surgical sciatica. The study was carried out in Unit I of the Department of Neurosurgery, Punjab Institute of Neurosciences, Lahore, Pakistan, over a six-month period from March 2023 to September 2023. The design was selected because the objective was to assess short-term functional change after the intervention in a defined clinical cohort rather than to compare transforaminal epidural steroid injection with another treatment arm.

Patients of either sex aged 25 to 65 years who presented with clinically diagnosed sciatica were considered eligible for inclusion. Sciatica was defined as radiating pain along the distribution of the sciatic nerve, extending from the lower back to the buttock and lower limb, with or without associated numbness, tingling, or paresthesia. Patients were managed as non-surgical cases at the time of enrollment. Patients with a history of previous lumbar spine surgery, known cardiac disease, psychiatric illness, major musculoskeletal disorder affecting functional assessment, or refusal to provide informed consent were excluded. Eligible participants were recruited using non-probability consecutive sampling until the required sample size was achieved.

The sample size was calculated using the World Health Organization sample size method for estimating a single population proportion. The anticipated efficacy proportion of transforaminal epidural steroid injection was taken as 68% from previously published evidence, with a 95% confidence level and 10% absolute precision. Using the formula $n = Z^2p(1-p)/d^2$, where $Z = 1.96$, $p = 0.68$, and $d = 0.10$, the required sample size was approximately 84 patients. A total of 85 patients were enrolled and completed follow-up.

After institutional ethical approval, written informed consent was obtained from all participants. Baseline demographic and clinical information was recorded, including age, sex, body mass index, duration of symptoms, occupational status, working hours, lifestyle status, and relevant family history. Functional disability was assessed before intervention using the Oswestry Disability Index, a validated instrument for disability related to low back pain and radicular symptoms. The primary outcome was change in Oswestry Disability Index score from baseline to 12 weeks after intervention. Treatment efficacy was operationally defined as a reduction of more than 10 points in Oswestry Disability Index score at 12-week follow-up.

All patients received transforaminal epidural steroid injection under standard aseptic conditions. The injected medication consisted of triamcinolone acetonide in a dose range of 20–60 mg combined with 0.25% levobupivacaine, with a total injectate volume of 2 mL. The transforaminal approach was used to target the clinically affected nerve root. Patients were followed in the outpatient department for 12 weeks after the procedure, and Oswestry Disability Index scores were reassessed at the end of follow-up. The difference between pre-treatment and post-treatment Oswestry Disability Index scores was calculated for each patient.

Potential confounding was addressed analytically by stratifying outcomes according to clinically relevant baseline variables, including age group, sex, body mass index category, duration of symptoms, lifestyle, and occupational status. Body mass index was categorized as ≤ 25 kg/m² and >25 kg/m², while symptom duration was categorized as ≤ 14 days and >14 days. These subgroup analyses were used to explore whether baseline clinical characteristics influenced the likelihood of achieving treatment efficacy. To improve data integrity, information was collected using a structured data collection form, entered into SPSS, and reviewed for completeness before analysis.

Data were analyzed using SPSS version 26. Quantitative variables, including age, body mass index, symptom duration, working hours, and Oswestry Disability Index scores, were summarized as mean and standard deviation. Qualitative variables, including sex, lifestyle, occupation, family history, and efficacy status, were presented as frequencies and percentages. Pre-treatment and post-treatment Oswestry Disability Index scores were compared using the paired-sample t-test. Associations between categorical baseline variables and efficacy status were assessed using the chi-square test. Mean change in Oswestry Disability Index score between two groups was compared using the independent-sample t-test, while one-way analysis of variance was used for comparisons across more than two groups where applicable. The Mann–Whitney U test was applied for non-normally distributed subgroup comparisons. Multivariate logistic regression was performed to identify independent predictors of treatment efficacy, with results reported as odds ratios and 95% confidence intervals. A p-value of ≤ 0.05 was considered statistically significant.

The study was conducted in accordance with ethical principles for human-subject research. Institutional review board approval was obtained before data collection. Written informed consent was taken from all participants, confidentiality of patient information was maintained, and all clinical procedures were performed according to standard institutional practice.

RESULTS

A total of 85 patients with non-surgical sciatica were enrolled and completed the 12-week follow-up assessment. The mean age of the participants was 48.07 ± 4.71 years, and 54 patients (63.5%) were aged 25–50 years. The study population included 41 males (48.2%) and 44 females (51.8%). The mean body mass index was 25.91 ± 3.55 kg/m², while the mean duration of symptoms before intervention was 13.42 ± 4.28 days. Most participants had a sedentary lifestyle (76.5%) and were employed (80.0%). Family history of sciatica and osteoarthritis was reported in 12.9% and 15.3% of patients, respectively.

Table 1. Baseline Demographic and Clinical Characteristics of Patients with Sciatica (n = 85)

Variable	Mean ± SD or n (%)
Age, years	48.07 ± 4.71
Body mass index, kg/m²	25.91 ± 3.55
Duration of symptoms, days	13.42 ± 4.28
Working hours per day	8.57 ± 1.49
Age 25–50 years	54 (63.5)
Age 51–65 years	31 (36.5)
Male sex	41 (48.2)
Female sex	44 (51.8)
Sedentary lifestyle	65 (76.5)
Active lifestyle	20 (23.5)
Employed	68 (80.0)
Unemployed	17 (20.0)
Family history of sciatica	11 (12.9)
Family history of osteoarthritis	13 (15.3)

Functional disability improved significantly after transforaminal epidural steroid injection. The mean pre-treatment Oswestry Disability Index score was 53.04 ± 0.72, which decreased to 31.65 ± 11.78 at 12 weeks. The mean reduction in Oswestry Disability Index score was 21.35 ± 11.69 points, with a 95% confidence interval of 18.83 to 23.87 points. This change was statistically significant on paired-sample t-test ($t = 16.82$, $p < 0.001$) and represented a large within-patient treatment effect.

Table 2. Pre- and Post-Treatment Oswestry Disability Index Scores at 12 Weeks

Outcome	Mean ± SD	Mean Difference	95% CI for Mean Difference	t-value	p-value
Pre-treatment ODI score	53.04 ± 0.72	—	—	—	—
Post-treatment ODI score	31.65 ± 11.78	21.35 ± 11.69	18.83–23.87	16.82	<0.001

Treatment efficacy, defined as a reduction of more than 10 points in Oswestry Disability Index score, was achieved in 56 patients (65.9%), while 29 patients (34.1%) did not meet the predefined efficacy threshold. This indicates that nearly two-thirds of patients experienced clinically meaningful short-term functional improvement after the procedure.

Table 3. Frequency of Treatment Efficacy at 12 Weeks

Treatment Response	Frequency	Percentage
Effective response	56	65.9
Not effective response	29	34.1
Total	85	100.0

On subgroup analysis, efficacy was significantly associated with body mass index and duration of symptoms. Patients with body mass index ≤25 kg/m² had a higher efficacy rate than those with body mass index >25 kg/m² (83.3% vs. 56.4%, $\chi^2 = 5.82$, $p = 0.016$). Similarly, patients with symptom duration ≤14 days had a higher efficacy rate than those with symptoms lasting more than 14 days (75.9% vs. 44.4%, $\chi^2 = 7.24$, $p = 0.007$). Age group, sex, and lifestyle were not significantly associated with treatment efficacy.

Table 4. Association of Baseline Clinical Variables with Treatment Efficacy

Variable	Category	Effective, n/N (%)	Not Effective, n/N (%)	χ² value	p-value
Age group	25–50 years	36/54 (66.7)	18/54 (33.3)	0.000	1.000
	51–65 years	20/31 (64.5)	11/31 (35.5)		
Sex	Male	26/41 (63.4)	15/41 (36.6)	0.200	0.655
	Female	30/44 (68.2)	14/44 (31.8)		
Body mass index	≤25 kg/m²	25/30 (83.3)	5/30 (16.7)	5.82	0.016
	>25 kg/m²	31/55 (56.4)	24/55 (43.6)		
Duration of symptoms	≤14 days	44/58 (75.9)	14/58 (24.1)	7.24	0.007
	>14 days	12/27 (44.4)	15/27 (55.6)		
Lifestyle	Active	12/20 (60.0)	8/20 (40.0)	0.28	0.593
	Sedentary	44/65 (67.7)	21/65 (32.3)		

Patients with lower body mass index and shorter symptom duration also showed greater mean improvement in Oswestry Disability Index scores. The mean ODI reduction was 25.70 ± 9.18 points among patients with body mass index ≤25 kg/m^2 compared with 18.98 ± 12.29 points among those with body mass index >25 kg/m^2. The mean between-group difference was 6.72 points, with a 95% confidence interval of 2.02 to 11.42 points ($p = 0.011$). Patients with symptom duration ≤14 days showed a mean ODI reduction of 23.87 ± 10.39 points compared with 15.92 ± 12.64 points among those with symptoms lasting more than 14 days. The mean difference was 7.95 points, with a 95% confidence interval of 2.33 to 13.57 points ($p = 0.003$).

Table 5. Comparison of Mean Oswestry Disability Index Change Across Clinically Relevant Subgroups

Variable	Category	n	Mean ODI Change ± SD	Mean Difference	95% CI for Difference	t-value	p-value
Body mass index	<25 kg/m^2	30	25.70 ± 9.18	6.72	2.02–11.42	2.62	0.011
	>25 kg/m^2	55	18.98 ± 12.29				
Duration of symptoms	<14 days	58	23.87 ± 10.39	7.95	2.33–13.57	3.05	0.003
	>14 days	27	15.92 ± 12.64				

One-way analysis of variance showed no statistically significant difference in mean ODI improvement across age subgroups. Mean ODI change was 21.9 ± 11.5 points in patients aged 25–40 years, 21.2 ± 11.7 points in those aged 41–50 years, and 21.1 ± 11.7 points in those aged 51–65 years ($F = 0.12$, $p = 0.885$). This indicates that functional improvement after treatment was broadly comparable across age categories.

Table 6. One-Way Analysis of Variance for Mean Oswestry Disability Index Change Across Age Groups

Variable	Group	Mean ODI Change ± SD	F-value	p-value
Age group	25–40 years	21.9 ± 11.5	0.12	0.885
	41–50 years	21.2 ± 11.7		
	51–65 years	21.1 ± 11.7		

Because symptom-duration-related improvement may not have followed a normal distribution, the Mann–Whitney U test was also applied. Median ODI improvement was higher among patients with symptom duration ≤14 days than among those with duration >14 days (24 vs. 16 points), and this difference remained statistically significant ($U = 412$, $p = 0.005$). This finding supported the parametric subgroup analysis and reinforced the association between earlier intervention and greater functional improvement.

Table 7. Mann–Whitney U Test for Oswestry Disability Index Change by Symptom Duration

Variable	Group	Median ODI Change	U-value	p-value
Duration of symptoms	< 14 days	24	412	0.005
	> 14 days	16		

Multivariate logistic regression identified body mass index ≤25 kg/m^2 and symptom duration ≤14 days as independent predictors of treatment efficacy. Patients with body mass index ≤25 kg/m^2 had 2.85 times higher odds of achieving efficacy than those with body mass index >25 kg/m^2 (OR = 2.85, 95% CI: 1.12–7.21, $p = 0.028$). Patients with symptom duration ≤14 days had 3.45 times higher odds of achieving efficacy than those with longer symptom duration (OR = 3.45, 95% CI: 1.39–8.54, $p = 0.007$). Age and sex were not independently associated with efficacy.

Table 8. Multivariate Logistic Regression Analysis for Independent Predictors of Treatment Efficacy

Predictor	Reference Category	Odds Ratio	95% CI	p-value
Body mass index ≤25 kg/m^2	>25 kg/m^2	2.85	1.12–7.21	0.028
Duration of symptoms ≤14 days	>14 days	3.45	1.39–8.54	0.007
Age	Per unit increase	1.02	0.94–1.10	0.621
Female sex	Male sex	1.21	0.48–3.01	0.678

Overall, the results showed a statistically significant and clinically meaningful reduction in disability 12 weeks after transforaminal epidural steroid injection. The greatest improvement was observed among patients with lower body mass index and shorter symptom duration, while age, sex, and lifestyle did not show significant associations with treatment response.

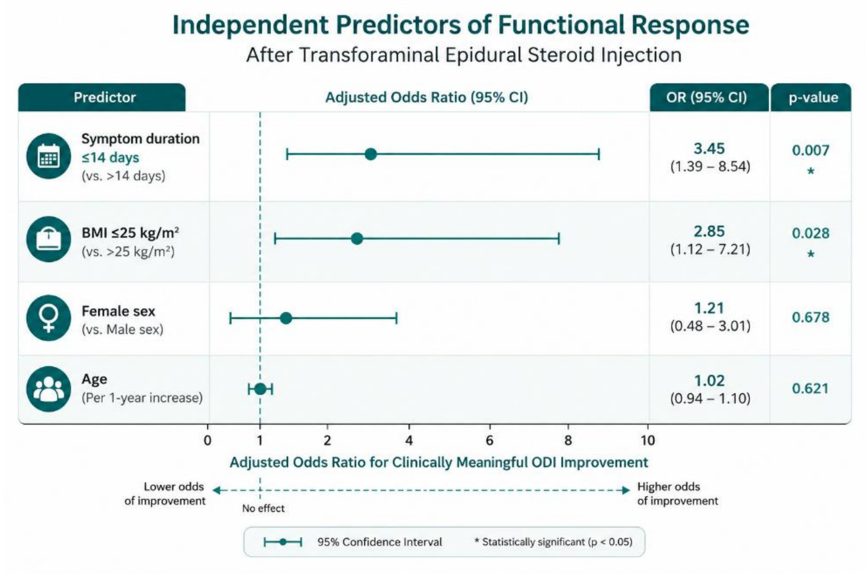

Figure 1 Figure 1. Independent Predictors of Clinically Meaningful Functional Improvement Following Transforaminal Epidural Steroid Injection Forest plot illustrating adjusted odds ratios (ORs) with 95% confidence intervals (CIs) from multivariable logistic regression analysis evaluating predictors of achieving a clinically meaningful improvement in Oswestry Disability Index (ODI) score at 12-week follow-up. Symptom duration ≤14 days and body mass index (BMI) ≤25 kg/m² were independently associated with significantly greater odds of treatment success. The vertical dashed line represents the null effect (OR = 1.0). Predictors with confidence intervals that do not cross the null line are considered statistically significant.

Multivariable logistic regression analysis demonstrated that shorter symptom duration was the strongest independent predictor of treatment efficacy. Patients presenting within 14 days of symptom onset had a 3.45-fold greater likelihood of achieving clinically meaningful functional improvement compared with those experiencing symptoms for more than 14 days (OR = 3.45, 95% CI: 1.39–8.54; p = 0.007). Similarly, patients with a BMI ≤25 kg/m² exhibited significantly higher odds of treatment success than those with BMI >25 kg/m² (OR = 2.85, 95% CI: 1.12–7.21; p = 0.028). In contrast, sex and age were not significantly associated with treatment response, as evidenced by confidence intervals crossing the null value of 1.0 (female sex: OR = 1.21, 95% CI: 0.48–3.01; p = 0.678; age: OR = 1.02, 95% CI: 0.94–1.10; p = 0.621). Overall, the figure highlights that earlier intervention and lower BMI were the principal determinants of favorable functional outcomes following transforaminal epidural steroid injection in patients with non-surgical sciatica.

DISCUSSION

The present study demonstrated a statistically significant and clinically meaningful short-term improvement in functional disability among patients with non-surgical sciatica treated with transforaminal epidural steroid injection. The mean Oswestry Disability Index score decreased from 53.04 ± 0.72 before treatment to 31.65 ± 11.78 at 12-week follow-up, with a mean reduction of 21.35 ± 11.69 points. Since treatment efficacy was defined as a reduction of more than 10 points in ODI score, the observed mean change suggests that the intervention was associated with meaningful functional recovery in a substantial proportion of patients. Overall, 65.9% of patients achieved the predefined efficacy threshold, supporting the short-term clinical usefulness of this targeted minimally invasive approach in carefully selected non-surgical sciatica cases.

The functional improvement observed in this study is consistent with previous literature suggesting that epidural and selective nerve-root approaches may reduce radicular symptoms by delivering corticosteroid close to the affected nerve root. The transforaminal route is anatomically suited to radicular pain because it allows targeted medication delivery near the inflamed nerve root and dorsal root ganglion, where inflammatory mediators contribute to pain generation and disability. Similar studies have reported short-term improvement in pain and disability after transforaminal epidural steroid injection, although the magnitude and durability of benefit vary across populations, diagnostic criteria, injection technique, and follow-up duration (12–15).

A clinically important finding of this study was that shorter symptom duration was independently associated with better treatment response. Patients with symptoms lasting ≤14 days had significantly higher efficacy than those with symptoms persisting for more than 14 days, and multivariate analysis showed that early presentation increased the odds of achieving clinically meaningful improvement by more than threefold. This finding supports the concept that early radicular symptoms may be more responsive to anti-inflammatory intervention before prolonged nerve irritation, central sensitization, or chronic disability patterns become established. Previous guidance and clinical evidence also emphasize that recent-onset lumbar radiculopathy may respond better to structured non-surgical and interventional approaches when patients are appropriately selected (16,17).

Body mass index was another significant predictor of treatment efficacy. Patients with BMI ≤25 kg/m² had higher response rates and greater mean ODI improvement than those with BMI >25 kg/m². This association may reflect the influence of mechanical loading, systemic inflammation, reduced spinal mobility, and obesity-related functional limitation on recovery after radicular pain interventions. Although TESI targets inflammatory nerve-root pain, persistent biomechanical stress may reduce the extent of functional improvement in patients with higher BMI. These findings suggest that BMI should be considered during counselling and patient selection, and that weight management and rehabilitation may be useful adjuncts in overweight patients undergoing interventional treatment for sciatica (18,19).

Age and sex were not significantly associated with treatment efficacy in either subgroup analysis or multivariate regression. This suggests that functional response to TESI in the present cohort was more strongly related to modifiable or clinically time-sensitive factors, particularly symptom duration and BMI, than to demographic characteristics. However, these findings should be interpreted cautiously because the sample size was modest and the study was not primarily powered for subgroup comparisons. Larger controlled studies are needed to determine whether demographic variables influence response in more heterogeneous populations.

The findings should be interpreted within the methodological limitations of a descriptive case series. Since no control group was included, improvement cannot be attributed solely to the injection, and natural recovery, regression to the mean, placebo effects, concurrent medication, physiotherapy, or activity modification may have contributed to the observed outcome. The follow-up period was limited to 12 weeks, so durability of benefit, recurrence, subsequent need for surgery, and long-term functional outcomes could not be assessed. In addition, imaging severity, level of disc involvement, injection level, number of injections, procedural guidance details, and adverse-event surveillance were not reported in sufficient detail, which limits reproducibility and interpretation of safety. Future randomized controlled trials with larger multicenter cohorts, standardized procedural protocols, imaging-based stratification, longer follow-up, and predefined adverse-event monitoring are required to confirm the effectiveness and safety profile of transforaminal epidural steroid injection in non-surgical sciatica (20–23).

CONCLUSION

Transforaminal epidural steroid injection was associated with significant short-term improvement in functional disability among patients with non-surgical sciatica, with nearly two-thirds of participants achieving a clinically meaningful reduction in Oswestry Disability Index score at 12 weeks. Better outcomes were independently associated with symptom duration ≤14 days and BMI ≤25 kg/m², suggesting that earlier intervention and lower mechanical or metabolic burden may improve the likelihood of treatment response. However, because this was an uncontrolled descriptive case series with short follow-up, the findings should be interpreted as evidence of short-term association rather than definitive proof of treatment superiority or surgery prevention.

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