Research Article

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Comparative Efficacy of Caudal and Transforaminal Epidural Steroid Injections for Unilateral S1 Nerve Root Pain: A Randomized Controlled Trial

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Abstract

Unilateral S1 radiculopathy can cause persistent leg pain, functional limitations, and reduced quality of life despite conservative care. This manuscript compares the reported outcomes of caudal epidural steroid injection (CEI) and transforaminal epidural steroid injection (TFI) in patients with clinical and magnetic resonance imaging evidence of unilateral S1 nerve root compression. The submitted study describes a single-centre, parallel-group randomized trial of 120 adults aged 18–75 years with symptoms persisting for more than six weeks, allocated equally to CEI (n = 60) and TFI (n = 60). Pain was assessed by the Visual Analogue Scale (VAS), disability by the Oswestry Disability Index (ODI), quality of life by the Short Form-36 (SF-36), and satisfaction by a five-point Likert scale. Both groups showed improvements from their baseline values. Reported mean VAS scores favoured TFI at one month (3.0 $\pm$ 1.0 versus 4.3 $\pm$ 1.3), six months (3.1 $\pm$ 1.1 versus 4.0 $\pm$ 1.4), and twelve months (3.5 $\pm$ 1.3 versus 4.5 $\pm$ 1.6). The reported ODI score at six months was lower after TFI (28.5 $\pm$ 7.1 versus 37.9 $\pm$ 8.7). Satisfaction was higher in the TFI group, and the supplied tables record few adverse events. These results indicate greater reported pain relief and functional improvement with TFI in this sample. However, the study dates and completed twelve-month outcomes conflict with the publicly indexed record for the stated trial registration number, NCT07833553, and require source-record reconciliation before these findings can be considered verified results of a completed trial.

Keywords: Unilateral S1 radiculopathy; sciatica; caudal epidural steroid injection; transforaminal epidural steroid injection; randomized controlled trial; pain and disability

1. INTRODUCTION

Unilateral S1 nerve root pain is a manifestation of lumbosacral radiculopathy in which pain radiates from the lower back or buttock into the lower extremity along the distribution of the affected nerve. Lumbar disc herniation, degenerative changes, and spinal canal or foraminal narrowing may contribute to nerve root irritation through mechanical compression and inflammation. Patients can experience shooting or burning pain, paresthesia, sensory changes, or weakness, with associated restrictions in walking, work, and daily activities. These symptoms may persist despite initial treatment and can create an important personal and socioeconomic burden. Contemporary reviews describe the different approaches used to deliver lumbar epidural medication and their respective clinical considerations [1]. Randomized research specifically involving unilateral S1 radiculopathy has also compared the caudal and transforaminal routes [2], while broader research on sciatica documents its substantial impact on function and healthcare utilization [3].

Epidural steroid injection (ESI) is an established interventional option considered for selected patients with persistent radicular pain who have not responded adequately to conservative measures. Corticosteroids are administered into the epidural space with the aim of reducing inflammation in tissues surrounding the irritated nerve root. Treatment response may vary with the underlying condition, injection approach, medication, and technical accuracy. Comparative investigations have examined different injection routes and fluoroscopic or ultrasound-guided techniques, illustrating the importance of precise procedural description when interpreting outcomes [4]. A trial involving patients with recurrent pain following lumbar discectomy compared caudal delivery with an ultrasound-guided S1 transforaminal block, although that postoperative population differs from patients without prior spine surgery [5].

In the caudal approach, the needle enters the epidural space through the sacral hiatus and the injected solution may spread across multiple lumbosacral levels. In the transforaminal approach, the needle is advanced toward the affected neural foramen to deliver medication in closer proximity to the symptomatic nerve root. Each technique has practical advantages and limitations, including differences in local targeting, volume of injectate, anatomical accessibility, procedure time, and possible complications. Studies of modified transforaminal approaches combined with pulsed radiofrequency concern an additional intervention and cannot be treated as direct evidence of the effect of an isolated transforaminal steroid injection [6]. Likewise, comparisons of unilateral with bilateral transforaminal injections address a different procedural question from the comparison of caudal and transforaminal routes [7].

Uncertainty remains concerning whether either route consistently offers superior pain relief, disability reduction, or treatment satisfaction for unilateral S1 radiculopathy. In the directly relevant trial published in 2023, treatment success was comparable between caudal and transforaminal injection groups over three months; this finding does not establish that their effectiveness must be identical under different treatment schedules or follow-up periods [2]. Other randomized work has examined combined caudal and transforaminal treatment against transforaminal treatment alone rather than the two isolated procedures [8]. A clearly reported comparative analysis should therefore distinguish the injection procedures, the outcomes measured, and the duration over which they were assessed.

The present manuscript evaluates the reported clinical outcomes of CEI and TFI in adults with unilateral S1 radicular pain. It addresses pain intensity, functional disability, durability of symptom improvement, health-related quality of life, patient satisfaction, and procedural complications. These objectives are relevant to selecting and evaluating interventional pain treatment, but any conclusions depend on accurate documentation of participant enrolment, trial registration, intervention details, and completed follow-up.

2. METHODS

The submitted study describes a single-centre, parallel-group randomized controlled trial involving 120 adults treated at a tertiary spine care centre. The dates supplied in the original manuscript were July 2025 to July 2026. The manuscript also cites trial registration number NCT07833553; however, the publicly indexed registry record assigns an estimated study start in January 2027 and estimated completion in February 2028. These conflicting dates require confirmation against contemporaneous institutional and registry records. Accordingly, the present editing preserves the study description and the supplied outcome values without treating the registry discrepancy as resolved.

The reported inclusion criteria were an age of 18–75 years, symptoms consistent with unilateral S1 radiculopathy, magnetic resonance imaging (MRI) evidence of unilateral S1 nerve root compression, and persistence of symptoms for more than six weeks despite conservative treatment. Exclusion criteria included an epidural steroid injection during the previous six months, neurological deficits requiring urgent surgery, coagulopathy or current anticoagulant therapy, and known hypersensitivity to corticosteroids or contrast agents. The supplied study description does not give the number screened, the number excluded, or the reasons for non-participation; these details should be reconciled with the original trial flow record.

Participants were reportedly assigned to two equal groups using computer-generated random numbers. Group A (n = 60) received a caudal epidural steroid injection, and Group B (n = 60) received a transforaminal epidural steroid injection.

The original description states that outcome assessment was performed by an assessor unaware of treatment allocation. The method of allocation concealment, the person responsible for randomization, and the extent of patient or clinician masking were not specified in the supplied materials and require confirmation before definitive reporting of the trial's risk of bias.

For CEI, patients were positioned prone. Under fluoroscopic guidance, the needle was advanced through the sacral hiatus into the caudal epidural space, and contrast was used to confirm the intended epidural distribution. A corticosteroid was then administered with approximately 1–2 mL of 0.25% bupivacaine, using aseptic technique. For TFI, the patient was placed prone or slightly oblique, and a spinal needle was advanced under fluoroscopic guidance toward the symptomatic S1 neural foramen. Contrast administration was used to assess the intended spread before a corticosteroid and local anaesthetic mixture was injected. The manuscript does not specify the corticosteroid formulation, exact steroid dose, total solution volume, number of injections per participant, or protocol for repeat procedures. These procedural details are important for meaningful comparison and should be entered from original records rather than reconstructed from other published studies.

The primary reported outcome was pain intensity, measured using the Visual Analogue Scale (VAS) at baseline, one week, one month, three months, six months, and twelve months following injection. Secondary outcomes were functional disability assessed with the Oswestry Disability Index (ODI), health-related quality of life assessed with the Short Form-36 (SF-36), satisfaction assessed on a five-point Likert scale, and procedural complications or adverse events. Follow-up duration was described as twelve months, but the date of each participant's final assessment and the denominator available at each visit were not reported. Without those records, the completeness of twelve-month follow-up cannot be independently established.

Continuous variables were summarized as means and standard deviations when their distributions permitted, with medians and interquartile ranges intended for skewed observations. Between-group comparisons were described as independent-samples t-tests or Mann–Whitney U tests, as appropriate. Categorical outcomes were compared using chi-square or Fisher exact tests, and repeated measures were reportedly assessed with repeated-measures analysis of variance where appropriate. The stated significance threshold was $p < 0.05$. The supplied tables provide group means, standard deviations, and selected p-values but do not include the participant-level observations, missing-data handling, repeated-measures model specification, or complete statistical output. Consequently, the inferential results are transcribed as reported and require checking against the original analysis files.

3. RESULTS

The submitted results describe 120 participants, with 60 allocated to CEI and 60 to TFI. Baseline demographic variables and initial pain and disability scores were described as broadly similar in the two groups, although a complete baseline characteristics table was not included in the supplied manuscript. The reported mean baseline VAS values were 8.2 ± 1.0 for CEI and 8.3 ± 0.9 for TFI. Table 1 presents pain scores at all reported assessment times.

Table 1. *Visual Analogue Scale Scores at Baseline and Follow-up by Injection Approach*

Time Point	CEI Group (Mean ± SD)	TFI Group (Mean ± SD)	Reported p-Value
Baseline	8.2 ± 1.0	8.3 ± 0.9	0.63
1 Week	5.1 ± 1.5	3.8 ± 1.2	< 0.001
1 Month	4.3 ± 1.3	3.0 ± 1.0	< 0.001
3 Months	3.9 ± 1.2	2.8 ± 0.9	< 0.001
6 Months	4.0 ± 1.4	3.1 ± 1.1	0.002
12 Months	4.5 ± 1.6	3.5 ± 1.3	< 0.001

Both groups showed lower mean pain scores at the reported follow-up visits than at baseline. Scores were consistently lower in the TFI group, with a numerical between-group difference of 1.3 points at one month, 0.9 points at six months, and 1.0 point at twelve months. The table reports statistically significant differences at each post-baseline visit. Nevertheless, a participant-level longitudinal analysis would be needed to account adequately for within-person correlation, attrition, and any additional treatment during follow-up. The reported p-value at six months should also be checked against the original statistical output because a conventional independent-groups calculation from the displayed summary values would yield a smaller value.

Table 2 presents the reported ODI values. Baseline mean scores were $54.2 \pm 10.3\%$ for CEI and $55.0 \pm 9.8\%$ for TFI, whereas at six months the corresponding values were $37.9 \pm 8.7\%$ and $28.5 \pm 7.1\%$. At twelve months, scores were $39.8 \pm 9.2\%$ and $30.0 \pm 7.8\%$, respectively. These findings describe greater reported improvement in functional disability following TFI, although the exact longitudinal model and the completeness of follow-up remain unverified.

In addition to disability scores, the manuscript reports higher SF-36 scores in the physical functioning, bodily pain, and

general health domains following TFI at six and twelve months. However, no domain-level means, standard deviations, denominators, or statistical test results were provided for these SF-36 comparisons. Accordingly, these quality-of-life findings remain descriptive claims pending confirmation of the corresponding results tables and analysis records.

Table 2. *Oswestry Disability Index Scores by Injection Approach*

Time Point	CEI Group (ODI, Mean ± SD)	TFI Group (ODI, Mean ± SD)	Reported p-Value
Baseline	54.2 ± 10.3	55.0 ± 9.8	0.72
3 Months	38.5 ± 8.9	30.7 ± 7.5	< 0.001
6 Months	37.9 ± 8.7	28.5 ± 7.1	< 0.001
12 Months	39.8 ± 9.2	30.0 ± 7.8	< 0.001

The reported proportion of patients who were very satisfied at one month was 75% following TFI compared with 52% following CEI. At twelve months, the corresponding proportions were 62% and 40%, respectively. These comparisons suggest higher reported satisfaction in the TFI group, although the manuscript does not provide the complete five-category frequency distribution or an inferential test. Because the original percentages may have been rounded, they should not be converted into exact numbers of patients without checking the underlying responses.

Table 3 summarizes the recorded complications. Transient headache occurred in two CEI participants and one TFI participant. Increased post-procedural pain was reported in five and seven patients, respectively. One dural puncture and one vascular injury were listed in the TFI group; neither complication was listed in the CEI group. No infections were recorded in either group. These counts are too small to support definitive claims of equivalent safety, and the nature, severity, management, and outcome of the reported vascular event require clarification.

Table 3. *Reported Procedure-Related Complications by Treatment Group*

Complication	CEI Group ($n = 60$)	TFI Group ($n = 60$)
Transient headache	2	1
Increased post-procedure pain	5	7
Dural puncture	0	1
Infection	0	0
Vascular injury	0	1

4. DISCUSSION

The reported findings indicate that patients in both groups experienced lower pain scores and disability levels after epidural injection than before treatment. The TFI group consistently had lower mean VAS values at the recorded follow-up points and lower ODI scores at three, six, and twelve months. The apparent between-group differences may be relevant to clinical decision-making, particularly for patients with symptoms localized to the S1 nerve root. However, these findings should be interpreted in light of the inconsistent registration timeline, incomplete procedural specifications, and absence of source-level follow-up and statistical records.

The literature does not establish a uniform superiority of TFI over CEI. In a prospective randomized trial specifically involving unilateral S1 radiculopathy from paracentral L5–S1 disc herniation, Ozturk and colleagues reported improvement with both approaches and similar rates of treatment success at three months [2]. Their study also found shorter fluoroscopy time and lower radiation exposure with the caudal route. These findings differ from the magnitude and direction of the differences described in the present manuscript. Differences in selection criteria, injection protocol, outcome measurement, duration of observation, and sample composition may contribute to differing results, but they cannot be used to explain a discrepancy without patient-level evidence. Another randomized comparison involving targeted caudal-catheter delivery and transforaminal injection provides relevant evidence that injection design and targeting may influence how procedures are compared [9].

Studies of postoperative radicular pain also deserve careful interpretation. Hashemi and colleagues compared caudal treatment with an ultrasound-guided S1 transforaminal block among individuals with symptoms following lumbar discectomy [5]. Song and colleagues directly compared fluoroscopy-guided caudal and transforaminal injections in a retrospective analysis of chronic pain after spinal surgery [10]. Both studies provide useful procedural context, but their participants' postoperative histories may differ materially from the population described here. Therefore, their effect estimates should not be assumed to apply unchanged to patients with uncomplicated unilateral S1 radiculopathy.

Other commonly cited injection studies address different comparisons. Choi and colleagues evaluated the oblique interlaminar and transforaminal routes, and they did not directly compare caudal with transforaminal delivery; their findings suggested similar pain and functional outcomes over twelve weeks [11]. Ahmed and colleagues compared ultrasound

guidance with fluoroscopic guidance rather than comparing the caudal and transforaminal routes themselves [12]. Work comparing a conventional transforaminal approach with an injection administered through Kambin's triangle is also relevant to technique refinement but cannot establish comparative efficacy against CEI [13]. These distinctions are important because inaccurately describing study interventions can create a misleading impression that the available evidence consistently favours one route.

The outcomes described in the present manuscript should also be evaluated in relation to their timing. Rabanal Llevot and colleagues assessed epidural infiltration for acute and subacute lumbosacral radiculopathy, a clinical setting in which symptom duration may influence treatment response [14]. The present manuscript includes persistent symptoms of more than six weeks and reports long-term assessments, but does not provide the individual follow-up schedule or the number of participants available at each visit. Furthermore, the published trial record associated with the stated registration number specifies estimated dates extending into 2028. A claim of complete twelve-month outcomes from all 120 participants cannot be substantiated without dated source records showing that the required observation period had elapsed for each participant.

Mechanistically, TFI may allow medication to reach the symptomatic neural foramen more directly, while CEI may provide broader epidural spread. This anatomical distinction does not automatically translate into superior clinical outcomes, particularly when local inflammatory response, severity of compression, steroid formulation, injection volume, and ancillary treatments vary. Reports of transforaminal techniques combined with pulsed radiofrequency introduce additional treatment components that must not be conflated with an injection-only trial [6]. Similarly, trials comparing unilateral and bilateral transforaminal administration address an aspect of drug delivery within the transforaminal category rather than the choice between CEI and TFI [7]. Research on combined caudal and transforaminal injections further highlights the importance of specifying whether participants received one route, both routes, or repeated treatments [8].

Patient satisfaction and health-related quality of life are clinically meaningful alongside pain intensity and functional scores. The higher reported satisfaction proportions after TFI may be consistent with the direction of the VAS and ODI differences. Nevertheless, these satisfaction percentages were not accompanied by complete counts, confidence intervals, or statistical comparisons, and the SF-36 results were summarized without detailed scores. Claims about superiority in these outcomes should therefore remain provisional. Likewise, the recorded complications cannot establish that one technique is safer because the number of events is limited. The vascular injury and dural puncture listed in the TFI arm warrant description of their clinical consequences and management.

Clinical application should be guided by patient characteristics, imaging findings, operator experience, contraindications, procedural risks, and patient preferences. Reviews of injection approaches identify strengths and limitations of caudal, interlaminar, and transforaminal delivery rather than recommending a single approach for every patient [1]. Smaller clinical studies of transforaminal injection have reported symptom improvement, but those observations should not be interpreted as proof of superiority over caudal administration without a direct comparator [15]. For this reason, the data in this manuscript do not justify an unconditional recommendation to use TFI as the first-line injection approach in every case of unilateral S1 pain.

The analysis has several important limitations. The study was described as single-centre, and its enrollment and follow-up records were not supplied for independent inspection. The registration record conflicts with the stated trial dates, the twelve-month dataset cannot be reconciled from the available material, and the type and dose of corticosteroid were not documented. The statistical output required to verify repeated-measures estimates, selected p-values, and missing-data handling was not provided. In addition, no complete baseline table, SF-36 output, patient flow diagram, allocation-concealment description, or ethics committee approval identifier was supplied. These issues affect confidence in the reported findings and require clarification before submission of the work as a completed randomized trial.

5. CONCLUSION

In the supplied results, both caudal and transforaminal epidural steroid injections were associated with improvements in pain and disability scores among patients described as having unilateral S1 radiculopathy. The transforaminal group showed lower reported mean pain scores and ODI values at the available follow-up times, together with higher descriptive satisfaction percentages. However, the trial's reported conduct dates and twelve-month outcomes conflict with the publicly indexed registration timeline, and the underlying follow-up and statistical records were not available for verification. The results must therefore be regarded as provisional until their provenance, chronological feasibility, and completeness are confirmed. Subject to that verification, adequately documented randomized research with standardized dosing, transparent adverse-event reporting, and complete long-term follow-up could clarify the comparative effectiveness and safety of these approaches.

Author Contributions

All authors contributed to the manuscript preparation. All authors reviewed and approved the final manuscript and accept accountability for their respective contributions.

Conflicts of Interest

The authors declare no competing interests.

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Ethics Approval and Informed Consent

The study have received institutional ethical approval, and informed consent was obtained from participants.

Data Availability

The de-identified participant-level data and supporting analysis files can be obtained from the corresponding author.

REFERENCES

[1] Li, Tommy, et al. "Understanding the Landscape of Lumbar Epidural Steroid Injections: A Review of Interlaminar, Transforaminal, and Caudal Approaches." *Orthopedic Reviews*, vol. 17, 2025, article 138210. https://doi.org/10.52965/001c.138210.

[2] Ozturk, Ekim Can, et al. "Caudal Epidural Steroid Injection versus Transforaminal ESI for Unilateral S1 Radiculopathy: A Prospective, Randomized Trial." *Pain Medicine*, vol. 24, no. 8, 2023, pp. 957–62. https://doi.org/10.1093/pm/pnad041.

[3] Foster, Nadine E., et al. "Stratified versus Usual Care for the Management of Primary Care Patients with Sciatica: The SCOPiC RCT." *Health Technology Assessment*, vol. 24, no. 49, 2020, pp. 1–130. https://doi.org/10.3310/hta24490.

[4] Khojasteh, Narges, et al. "Comparison of Epidural Space Contrast Flow and Clinical Outcomes in Parasagittal versus Transforaminal Epidural Steroid Injection." *Scientific Reports*, vol. 16, no. 1, 2026, article 7127. https://doi.org/10.1038/s41598-026-36056-6.

[5] Hashemi, Masoud, et al. "Comparative Evaluation of Caudal Epidural Method to Ultrasound-Guided S1 Transforamen Block in Patient's Lumbar Discectomy with Failed Back Syndrome Symptoms: A Double-Blind Clinical Trial." *Anesthesiology and Pain Medicine*, vol. 13, no. 6, 2023, article e137325. https://doi.org/10.5812/aapm-137325.

[6] Yan, Qi, et al. "Modified Transforaminal Epidural Steroid Injection Combined with Pulsed Radiofrequency: An Effective Treatment Measure for Lumbar Radiculopathy." *Frontiers in Surgery*, vol. 12, 2025, article 1566661. https://doi.org/10.3389/fsurg.2025.1566661.

[7] Ünal, Hanzade Aybüke, et al. "Comparison of Unilateral and Bilateral Transforaminal Epidural Steroid Injections in Unilateral Lumbar Disc Herniation: A Randomized Controlled Trial." *Journal of Clinical Medicine*, vol. 14, no. 1, 2025, article 147. https://doi.org/10.3390/jcm14010147.

[8] Munjupong, Sithapan, and Wipoo Kumnerddee. "Effect of Supraneural Transforaminal Epidural Steroid Injection Combined with Caudal Epidural Steroid Injection with Catheter in Chronic Radicular Pain Management: Double Blinded Randomized Controlled Trial." *F1000Research*, version 2, vol. 9, 2020, article 634. https://doi.org/10.12688/f1000research.23188.2.

[9] Imani, Farnad, et al. "Comparison of Clinical Effects and Physical Examination of Transforaminal and Caudal Steroid Injection With Targeted Catheter in Lumbar Radiculopathy: A Single-Blind Randomized Clinical Trial." *Brain and Behavior*, vol. 14, no. 10, 2024, article e70067. https://doi.org/10.1002/brb3.70067.

[10] Song, Jun Hyeong, et al. "Fluoroscopy-Guided Transforaminal versus Caudal Epidural Steroid Injection for Chronic Pain after Spinal Surgery: A Retrospective Mid-Term Comparative Study." *Journal of Pain Research*, vol. 14, 2021, pp. 2129–38. https://doi.org/10.2147/JPR.S314044.

[11] Choi, Eun-Ji, et al. "Comparison of the Oblique Interlaminar and Transforaminal Lumbar Epidural Steroid Injections for Treatment of Low Back and Lumbosacral Radicular Pain." *Journal of Pain Research*, vol. 14, 2021, pp. 407–14. https://doi.org/10.2147/JPR.S293166.

[12] Ahmed, Mansoor, et al. "Ultrasound-Guided versus Conventional Fluoroscopy-Guided Epidural Injection for Radiculopathy. A Meta-Analysis of Randomized Controlled Trials." *World Neurosurgery*, vol. 180, 2023, pp. 203–212.e4. https://doi.org/10.1016/j.wneu.2023.09.088.

[13] Singh, Gauresh, et al. "A Comparative Study of the Effectiveness of Lumbar Steroid Injection in Kambin's Triangle versus Conventional Transforaminal Approach for the Treatment of Lumbar Radicular Pain: A Prospective Randomised Study." *Journal of Anesthesiology and Reanimation Specialists' Society*, vol. 30, no. 3, 2022, pp. 199–206. https://doi.org/10.54875/jarss.2022.28199.

[14] Rabanal Llevot, Jose Manuel, et al. "Efficacy of Epidural Infiltration in the Management of Pain and Disability Due to Acute and Subacute Lumbosacral Radiculopathy." *Neurocirugía (English Edition)*, vol. 35, no. 2, 2024, pp. 64–70. https://doi.org/10.1016/j.neucie.2023.07.008.

[15] Bhatti, Mohd Javed, et al. "To Study the Efficacy of Transforaminal Epidural Steroid Injection in Relieving Lumbosacral Radiculopathy." *Journal of Bone and Joint Diseases*, vol. 36, no. 3, 2021, pp. 80–83. https://doi.org/10.4103/jbjd.jbjd_16_21.