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COMPARISON OF THE CLINICAL EFFICACY OF TRANSFORAMINAL AND INTERLAMINAR EPIDURAL STEROID INJECTIONS IN PATIENTS WITH LUMBAR DISC HERNIATION: A RETROSPECTIVE STUDY

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ABSTRACT

Objective: This study aimed to compare the effects of transforaminal epidural steroid injection (TFESI) and interlaminar epidural steroid injection (ILESI) techniques on pain management, functional improvement, and neuropathic pain in patients diagnosed with lumbar disc herniation (LDH).

Materials and Methods: This retrospective cohort included 124 patients who underwent epidural steroid injections between 2024 and 2025. Patients were divided into two groups according to the injection technique: TFESI and ILESI. Pain intensity was assessed using the visual analog scale (VAS), functional status with the Oswestry disability index (ODI), and neuropathic pain with the douleur neuropathique 4 (DN4) questionnaire. Patient satisfaction and injection-related complications were comprehensively reported. Assessments were performed at baseline and at the 1st, 2nd, 3rd, and 6th months post-injection.

Results: In the TFESI group, VAS, ODI, and DN4 scores demonstrated significant reductions at all follow-up points ($p<0.001$). Patient satisfaction was notably higher in the TFESI group. Complication rates remained low in both groups, with no statistically significant difference ($p=1.000$).

Conclusion: In patients with LDH, TFESI provides greater pain relief and functional improvement compared to the interlaminar approach. While both methods are safe, the transforaminal technique appears to be a more effective and targeted treatment option.

Keywords: Lumbar disc herniation, transforaminal injection, interlaminar injection, epidural steroid, pain management, VAS, ODI, DN4

INTRODUCTION

Lumbar disc herniation (LDH) is one of the most common causes of low back pain and significantly impairs quality of life. Extrusion of disc material through the intervertebral space can compress the nerve roots, leading to severe radicular pain and functional loss. In patients unresponsive to conservative treatments, invasive pain management strategies such as spinal injections have gained prominence[1,2].

Epidural steroid injections aim to reduce inflammation, thereby alleviating pain and improving functional recovery. Various anatomical approaches can be employed for these injections; however, the interlaminar and transforaminal routes are the most frequently utilized. While interlaminar injections provide a broader epidural spread, transforaminal injections offer a more targeted drug delivery[3].

Several reports in the literature have highlighted the clinical effectiveness of both techniques, yet the need for comparative evidence to guide clinical decision-making remains[4,5]. In this context, we designed a retrospective study to compare the effects of transforaminal epidural steroid injection (TFESI) and interlaminar epidural steroid injection (ILESI) on pain control, functional improvement, and patient satisfaction in patients with LDH.

Drug administration near the dorsal root ganglion makes TFESI more specific[6,7], and this method is particularly effective in patients with unilateral radicular pain[8,9]. Conversely, ILESI is preferred in cases with multiple disc pathologies due to its wider epidural distribution[10,11]. Randomized controlled trials

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(RCTs) have demonstrated the superior efficacy of TFESI over both methods for pain management[12-14].

MATERIALS AND METHODS

Study Design and Ethical Approval

In this single-center retrospective cohort study was conducted between 2024 and 2025 at a tertiary pain management clinic. Electronic medical records were reviewed to identify consecutive patients diagnosed with LDH who underwent either TFESI or ILESI. The study was carried out in accordance with the principles of the Declaration of Helsinki and approved by the University of Health Sciences Türkiye, Adana City Training and Research Hospital Local Ethics Committee (approval no: 584, date: 10.07.2025).

Inclusion and Exclusion Criteria

Inclusion criteria were: (I) age ⩾18 years, (II) LDH confirmed by magnetic resonance imaging, (III) treatment with TFESI or ILESI, (IV) availability of at least two follow-up visits among baseline, 1-, 2-, 3-, and 6-month assessments; and (V) documented symptom duration retrievable from medical records. Exclusion criteria included: marked spinal stenosis, spondylolisthesis, or previous lumbar surgery; active infection, coagulopathy, or progressive neurological deficits; occurrence of major post-injection complications (e.g., epidural hematoma, permanent neurological deficit); and critical missing data.

Patient Groups and Subgroups

Patients were divided into two main groups according to the injection technique: TFESI and ILESI. Symptom duration was calculated in months as the time from symptom onset to the injection date, based on patient statements, initial clinic notes, and discharge reports. It was analyzed both as a continuous variable and categorically: acute (<3 months), subacute (3-6 months), and chronic (>6 months). This classification was used in subgroup analyses to assess changes in primary outcomes visual analog scale (VAS), Oswestry disability index (ODI), douleur neuropathique 4 (DN4) according to symptom duration.

Concomitant Treatments

Use of analgesics (non-steroidal anti-inflammatory drugs, acetaminophen, weak/strong opioids), adjuvant medications (gabapentinoids, tricyclic anti-depressants, serotonin-norepinephrine reuptake inhibitors), and physical therapy/exercise programs during the 4 weeks prior to the procedure and the 6-month follow-up period were recorded as binary variables (yes/no). Dosage and treatment duration were noted when available. These variables were reported descriptively and included as covariates in multivariable models to minimize confounding effects.

Injection Level

The injection level was verified through procedure notes and fluoroscopic images, and recorded as L4-L5 or L5-S1. Selection was based on symptomatology and the predominant pathology confirmed by imaging. Injection level was used both descriptively and in subgroup analyses.

Interventional Techniques

All procedures were performed under sterile conditions and fluoroscopic guidance by experienced pain specialists at the same center. Hemodynamic parameters and oxygen saturation were monitored throughout the procedure. When not contraindicated, epidural placement was confirmed with non-ionic contrast. The injection solution in both techniques consisted of 40 mg triamcinolone mixed with 0.25% bupivacaine; the total volume was adjusted according to clinical judgment.

TFESI and Supraneural Technique

With the patient in prone position, the c-arm was rotated to provide an oblique view of the target foramen. Following skin anti-sepsis and local anesthesia, a 22G needle was advanced into the superior-anterior quadrant of the neural foramen, aligned with the inferior border of the pedicle and superior margin of the foramen, and positioned above the exiting nerve root (supraneural placement, commonly referred to as the "safe triangle" approach). After confirming negative aspiration, 1-2 mL of contrast was injected to verify radicular spread and exclude intravascular or intrathecal placement. The steroid-local anesthetic mixture was then administered slowly. This technique was designed to deliver the drug directly to the dorsal root ganglion and inflamed nerve root. Due to potential vascular and neurological risks, meticulous anatomical targeting was essential. Recent literature has compared supraneural and infraneural (retrodiskal/Kambin's triangle) approaches, discussing their safety and efficacy dimensions (e.g., SIAMESE protocol; interventional comparative studies)[15,16].

ILESI

With the patient in prone position, the target interlaminar space was centered under anteroposterior fluoroscopic view. Using either midline or paramedian entry, the epidural space was identified with the loss-of-resistance technique, followed by epidurogram confirmation with contrast. The same steroid-local anesthetic mixture was then injected into the epidural space. This approach is often preferred when a wider epidural distribution is desired.

Outcome Measures and Follow-up

Clinical assessments were conducted at baseline (pre-procedure) and at the 1st, 2nd, 3rd, and 6th months after injection.

- **Primary outcomes:** Pain intensity (VAS, 0-10), functional status (ODI, 0-100%), and neuropathic pain component (DN4).
- **Secondary outcomes:** Patient satisfaction at 6 months (rated on a three-point scale: good/fair/poor) and procedure-related complications (e.g., paresthesia, dural puncture, transient weakness, infection), collected from prospective complication forms and medical records.

Endpoints

The primary endpoint was ΔVAS (baseline to 6-month change) and the group×time interaction. Secondary endpoints included changes in ODI and DN4, 6-month satisfaction, and complication rates. Age, sex, and body mass index (BMI) balance between groups were reported descriptively. Symptom duration, injection level, and concomitant treatments were considered potential confounders and incorporated into analyses.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics v26.0. Distribution of continuous variables was evaluated with the Shapiro-Wilk test and visual methods. Normally distributed variables were expressed as mean ± standard deviation, and non-normally distributed variables as median (interquartile range). Categorical variables were summarized as numbers (%). Between-group comparisons at baseline were conducted using independent t-tests or Mann-Whitney U tests, and categorical variables with chi-square or Fisher's exact tests.

Time-course analyses were performed using two complementary approaches:

1. Linear mixed-effects models (LMM): Including group (TFESI/ILESI), time (baseline, 1, 2, 3, 6 months), and group×time interaction, with covariates age, sex, BMI, symptom duration (acute/subacute/chronic), injection level (L4-L5/L5-S1), and concomitant therapies. Random intercepts at the subject level were specified, and covariance structures [autoregressive model of order (1) vs. unstructured] were compared using akaike information criterion. Significant interactions were followed by Bonferroni-adjusted pairwise comparisons of marginal means.

2. Repeated-measures analysis of variance (RM-ANOVA): With a two-factor (group×time) design. Greenhouse-Geisser correction was applied when Mauchly's sphericity test was violated. Bonferroni correction was used for multiple comparisons.

Patient satisfaction was analyzed with ordinal logistic regression (proportional odds assumption checked). Complications were analyzed with chi-square/Fisher tests, with risk ratios, 95% confidence interval (CI) reported. Missing follow-up data were primarily handled with LMM under the missing at random assumption. Complementary RM-ANOVA analyses were conducted using complete cases, and in scenarios where missingness exceeded 10%, multiple imputation (m=20; predictive mean matching) was performed for sensitivity analyses.

All tests were two-tailed, with $p<0.05$ considered statistically significant. Effect sizes (partial η^2, Cohen's d, odds ratio with 95% CI) were systematically reported. Table footnotes explicitly described statistical adjustments (Bonferroni, Greenhouse-Geisser, etc.).

Note (TFESI supraneural): Recent comparative studies and safety/efficacy discussions regarding supraneural versus infraneural approaches were referenced (e.g., BMJ Open SIAMESE protocol, 2023; Interventional Pain Medicine, 2024).

RESULTS

A total of 124 patients were included in the study, with 64 undergoing TFESI and 60 receiving ILESI. The groups were comparable in terms of age, sex, and BMI (Table 1). The distribution of injection levels was also similar (L4-L5≈64-66%, L5-S1≈34-36%). Use of concomitant therapies during baseline and follow-up was comparable between groups (analgesics: TFESI 82.8%, ILESI 88.3%; adjuvants: 37.5% vs. 36.7%; physical therapy: 32.8% vs. 30.0%) (Table 2).

Pain (VAS)

Baseline VAS values did not differ significantly between groups (TFESI: 7.22±1.08, ILESI: 7.47±1.09; $p>0.05$). At 6 months, VAS scores were 1.81±1.49 in TFESI and 4.35±1.33 in ILESI, with a statistically significant intergroup difference (Welch $t=-10.04$, $p<0.001$). The baseline-to-6-month change (ΔVAS) was -5.41±1.23 for TFESI and -3.12±1.20 for ILESI. The between-group ΔVAS difference (TFESI-ILESI) was -2.29 (95% CI: -2.63 to -1.95), $t=-13.24$, $p<0.001$, with a large effect size (Cohen's d=-2.39).

Table 1. Baseline demographic and clinical characteristics of patients

Variable	TFESI (n=64)	ILESI (n=60)	p-value
Age (years, mean ± SD)	47.8±13.8	50.8±15.7	>0.05
Sex (male/female)	0/64	52/8	>0.05
BMI (kg/m^2, mean ± SD)	27.95±6.42	27.44±7.48	>0.05
Baseline VAS	7.22±1.08	7.47±1.09	>0.05
Baseline ODI	64.52±8.94	64.33±8.86	>0.05
Baseline DN4	6.34±1.12	6.50±1.21	>0.05
Symptom duration (months)	Median (IQR)	Median (IQR)	>0.05
Injection level L4–L5	41 (64.1%)	40 (66.7%)	>0.05
Injection level L5–S1	23 (35.9%)	20 (33.3%)	

Baseline demographic and clinical characteristics of patients in TFESI and ILESI groups. TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, VAS: Visual analog scale, ODI: Oswestry disability index, DN4: Douleur Neuropathique 4, IQR: Interquartile range, SD: Standard deviation, BMI: Body mass index

Table 2. Concomitant treatments

Variable	TFESI (n=64)	ILESI (n=60)	p-value
Analgesic use	53 (82.8%)	53 (88.3%)	>0.05
Adjuvant use	24 (37.5%)	22 (36.7%)	>0.05
Physical therapy/exercise	21 (32.8%)	18 (30.0%)	>0.05

Concomitant use of analgesics, adjuvants, and physical therapy before and after the procedure. TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection

Table 3. Temporal changes in VAS, ODI, and DN4

Outcome	Baseline (Mean ± SD)	1 month	2 months	3 months	6 months	Group×time interaction (p-value)
VAS (TFESI)	7.22±1.08	↓	↓	↓	1.81±1.49	<0.001
VAS (ILESI)	7.47±1.09	↓	↓	↓	4.35±1.33	
ODI (TFESI)	64.52±8.94	↓	↓	↓	25.41±9.74	<0.001
ODI (ILESI)	64.33±8.86	↓	↓	↓	40.67±8.88	
DN4 (TFESI)	6.34±1.12	↓	↓	↓	3.34±1.49	0.37 (NS)
DN4 (ILESI)	6.50±1.21	↓	↓	↓	5.05±1.77	

Group×time interactions for VAS, ODI, and DN4. DN4 interaction not consistently significant; however, 6-month differences were significant. TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, VAS: Visual analog scale, ODI: Oswestry disability index, DN4: Douleur Neuropathique 4, NS: Not significant, SD: Standard deviation

In LMM, the group×time interaction for VAS was significant (all time-point p<0.001, Bonferroni-corrected), with trajectories illustrated in Figure 1 (Table 3).

Function (ODI)

Baseline ODI values were comparable (TFESI: 64.52±8.94, ILESI: 64.33±8.86; p>0.05). At 6 months, ODI was 25.41±9.74 for TFESI and 40.67±8.88 for ILESI (Welch t=-9.13, p<0.001). ΔODI was -39.11±8.09 in TFESI and -23.67±7.12 in ILESI, with a between-group difference of -15.44 (95% CI: -16.96 to -13.93), t=-20.24, p<0.001. The effect size was very large (Cohen's d=-3.58). The group×time interaction was also significant for ODI (p<0.001, Bonferroni-corrected), with time-series results shown in Figure 2 (Table 3).

Neuropathic Component (DN4)

Baseline DN4 values were similar between groups (TFESI: 6.34±1.12, ILESI: 6.50±1.21; p>0.05). At 6 months, DN4 scores were 3.34±1.49 for TFESI and 5.05±1.77 for ILESI (Welch t=-5.78, p<0.001). ΔDN4 was -3.00±0.79 in TFESI and -1.45±1.00 in ILESI, with a between-group difference of -1.55 (95% CI: -1.86 to -1.24), t=-9.89, p<0.001, Cohen's d=-1.80. In mixed-effects models, the group×time interaction for DN4 was not consistently significant across all time points (p≈0.37). However, both the 6-month difference and ΔDN4 comparisons were statistically significant in favor of TFESI (all p<0.001). Temporal changes are illustrated in Figure 3 (Table 3).

Symptom Duration Subgroups (Acute vs. Chronic)

As requested by reviewers, additional analyses were conducted for acute (<3 months) and chronic (>6 months) subgroups (Table 4).

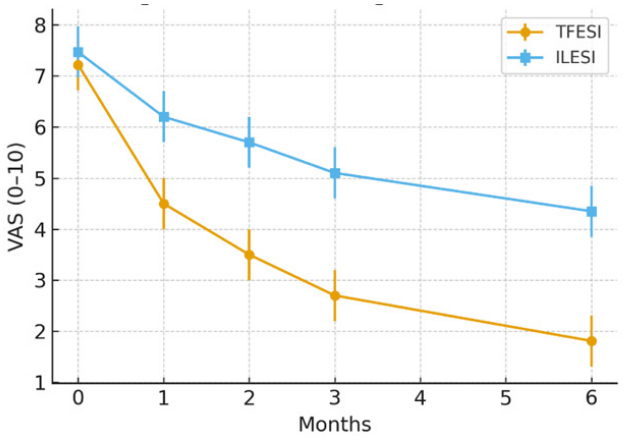

Figure 1. VAS change over time. Dots represent group means; error bars show 95% confidence intervals. Group×time interaction was significant in mixed-effects models (p<0.001). TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, VAS: Visual analog scale

- For ΔVAS, TFESI superiority was evident in both acute (-5.54±0.98 vs. -3.09±1.20; Δ=-2.45, 95% CI: -3.10 to -1.81; t=-7.66, p<0.001) and chronic (-5.35±0.80 vs. -3.29±0.94; Δ=-2.06, 95% CI: -2.52 to -1.60; t=-8.95, p<0.001) subgroups.
- For ΔODI, between-group differences were also significant in acute (Δ=-14.88, 95% CI: -17.10 to -12.65; t=-13.48, p<0.001) and chronic (Δ=-16.52, 95% CI: -19.06 to -13.97; t=-13.16, p<0.001) subgroups.
- For ΔDN4, differences were significant in acute (Δ=-1.22, 95% CI: -1.71 to -0.73; t=-4.99, p<0.001) and chronic (Δ=-1.62, 95% CI: -2.08 to -1.16; t=-7.04, p<0.001) subgroups.

These subgroup findings confirm the superiority of TFESI over ILESI in improving pain, function, and neuropathic components in both acute and chronic cases. Considering that DN4 may not always be a strong indicator in acute LDH, DN4 changes were interpreted in conjunction with VAS/ODI outcomes across subgroups.

Patient Satisfaction (6 Months)

Satisfaction was assessed at 6 months using a three-level scale (good/fair/poor) (Table 5). In exploratory dichotomous analysis (good/fair vs. poor), group differences were significant across all cases (Fisher p=0.016). Subgroup analyses showed:

- Acute: ILESI 52.2% (12/23) vs. TFESI 20.8% (5/24), p=0.036.
- Chronic: ILESI 48.4% (15/31) vs. TFESI 30.8% (8/26), p=0.278.

In ordinal logistic regression, however, group effect was not consistently retained as an independent determinant (adjusted p>0.05). These findings suggest that satisfaction is a subjective, multifactorial outcome.

Safety

Procedure-related complication rates were 14.10% (9/64) in TFESI and 13.33% (8/60) in ILESI, with no significant difference (Fisher p=1.000). The most common events were transient paresthesia or needle trauma. No major complications were observed.

Covariates and Effect of BMI

In multivariable linear models adjusted for group, baseline values, symptom duration, injection level, and concomitant treatments, BMI did not significantly affect ΔVAS (p=0.387), ΔODI (p=0.431), or ΔDN4 (p=0.400). Thus, treatment response was independent of BMI.

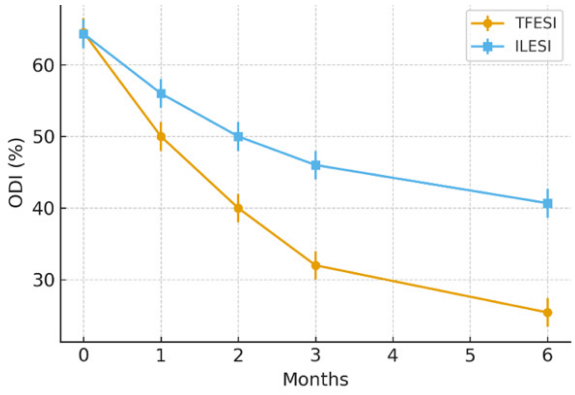

Figure 2. ODI change over time. TFESI consistently showed significantly lower ODI scores compared with ILESI at all follow-up points (Bonferroni-corrected p<0.001). TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, ODI: Oswestry disability index

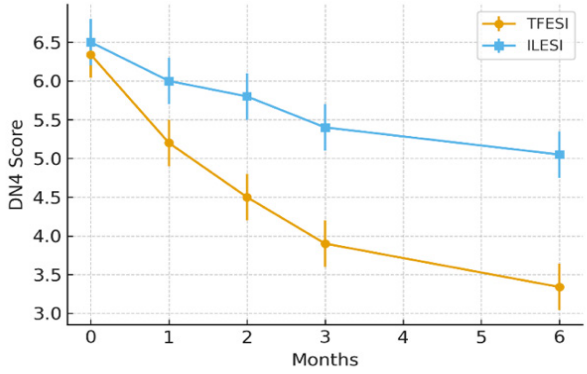

Figure 3. DN4 change over time. DN4 reductions were more pronounced in the TFESI group, particularly in the chronic subgroup. Although the group×time interaction was not consistently significant (mixed model p≈0.37), the 6-month difference was significant (p<0.001). TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, DN4: Douleur Neuropathique 4

Table 4. Subgroup analyses by symptom duration (acute vs. chronic)

Outcome	Subgroup	TFESI (Mean ± SD)	ILESI (Mean ± SD)	Δ Difference (95% CI)	t-value	p-value
ΔVAS	Acute	-5.54±0.98	-3.09±1.20	-2.45 (-3.10 to -1.81)	-7.66	<0.001
ΔVAS	Chronic	-5.35±0.80	-3.29±0.94	-2.06 (-2.52 to -1.60)	-8.95	<0.001
ΔODI	Acute	-39.88±6.50	-24.99±7.10	-14.88 (-17.10 to -12.65)	-13.48	<0.001
ΔODI	Chronic	-40.35±6.20	-23.83±6.90	-16.52 (-19.06 to -13.97)	-13.16	<0.001
ΔDN4	Acute	-3.00±0.85	-1.78±0.66	-1.22 (-1.71 to -0.73)	-4.99	<0.001
ΔDN4	Chronic	-3.01±0.88	-1.39±0.70	-1.62 (-2.08 to -1.16)	-7.04	<0.001

Subgroup analyses of pain (VAS), function (ODI), and neuropathic component (DN4) by symptom duration (acute vs. chronic). TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection, VAS: Visual analog scale, ODI: Oswestry disability index, DN4: Douleur Neuropathique 4, SD: Standard deviation, CI: Confidence interval

Table 5. Patient satisfaction (6th month)

Symptom Group	Intervention	Poor	Fair	Good
Acute	ILESI	6	12	5
Acute	TFESI	0	5	19
Chronic	ILESI	3	15	13
Chronic	TFESI	0	8	18
Subacute	ILESI	2	0	4
Subacute	TFESI	0	4	10

Patient satisfaction assessed at the 6th month using a three-point scale (good/fair/poor). Analyses were performed with Fisher's exact test. TFESI: Transforaminal epidural steroid injection, ILESI: Interlaminar epidural steroid injection

Reporting Notes

All multiple comparisons were Bonferroni-corrected, and Greenhouse-Geisser correction was applied in RM-ANOVA when sphericity was violated. Temporal trajectories with 95% CIs are presented in Figures 1-3. Detailed numerical summaries are provided in Tables 3-4, and satisfaction distributions in Table 5.

DISCUSSION

In this single-center retrospective cohort, TFESI demonstrated superiority over ILESI in terms of pain (VAS), function (ODI), and neuropathic component (DN4) outcomes up to 6 months. This superiority remained consistent across both acute and chronic subgroups. Safety profiles were comparable, and patient satisfaction was found to be sensitive to non-technical and contextual factors. Multivariable models indicated that treatment response was independent of BMI.

Our findings, when considered alongside RCTs reporting similar outcomes between TFESI and ILESI in chronic unilateral radiculopathy (n=64)[17], a meta-analysis indicating TFESI's short-term advantage in pain control (9 RCTs+4 observational studies; total n=931)[18], and registry cohort data showing TFESI was more likely to achieve ≥50% reduction in leg pain (n=73)[19], support the clinical advantage of target-specific distribution in radicular phenotypes.

The supraneural (subpedicular/safe triangle) approach of TFESI facilitates ventral epidural delivery of the injectate to the dorsal root ganglion and adjacent nerve root. However, meticulous planning is required due to foraminal anatomy and potential variations of radiculomedullary arteries (anatomical and safety reviews)[20]. In this context, prospective non-inferiority protocols comparing supraneural and infraneural approaches aim to provide high-quality evidence regarding safety and efficacy balance[21].

Although DN4 was originally developed as a screening and stratification tool, it may reflect longitudinal changes in neuropathic symptom burden. In a post-breast surgery pain cohort (n=163), DN4 successfully stratified probable versus definite neuropathic pain[22]. Furthermore, a multicenter validation study (n=291) confirmed its accuracy in daily clinical practice[23]. In our study, reductions in DN4 scores were significant in favor of TFESI, and these changes paralleled improvements in VAS and ODI. This suggests that DN4, while secondary, may serve as a meaningful follow-up measure when interpreted alongside pain and function outcomes.

Large single-center series (n=290) have shown that Press-Ganey-based satisfaction scores do not correspond directly with pain reduction and are influenced by contextual variables such as age and insurance type[24]. Similarly, an earlier series (n=35) reported 83% satisfaction at 3 months, emphasizing the role of psychosocial factors in patient perception of outcomes[25]. In our data, although exploratory subgroup analysis suggested differences in acute cases, ordinal models did not confirm technique as an independent predictor. Thus, satisfaction should be interpreted as a secondary, multidimensional outcome, adjusted for confounders.

A comparative study (n=343) found no significant differences in 3-month VAS, ODI, or patient-reported outcomes measurement information system changes across BMI categories[26]. Likewise, in a single-level TFESI series (n=162), short-term success was similar between obese and non-obese patients[27]. In line with these results, our multivariable models confirmed that BMI had no independent effect on TFESI or ILESI efficacy.

This study contributes to the literature by (I) demonstrating the consistent superiority of TFESI across acute and chronic subgroups, (II) reporting DN4 as a longitudinal outcome alongside VAS and ODI, and (III) analyzing patient satisfaction within the framework of contextual determinants using multivariable statistical models. Strengths include the use of LMM and RM-ANOVA to test group×time interactions, and the incorporation of symptom duration and injection level into analytic models. Limitations are its single-center retrospective design and the contextual sensitivity of satisfaction measurement. These findings warrant confirmation through prospective, multicenter, protocol-driven trials.

CONCLUSION

In this study, TFESI was found to be superior to ILESI in terms of pain (VAS), function (ODI), and neuropathic component (DN4) outcomes up to 6 months, with consistent advantages observed in both acute and chronic subgroups. Although DN4 was originally designed as a screening tool, when interpreted alongside improvements in VAS and ODI, reductions in DN4 provide clinically meaningful information. Safety profiles of both techniques were similar, with no major complications observed, and multivariable analyses confirmed that treatment response was independent of BMI.

Clinically, TFESI may be considered the preferred option in the presence of a radicular phenotype and a targetable level, whereas ILESI remains a rational alternative in diffuse or midline patterns. Patient satisfaction was shown to be sensitive to contextual and non-technical factors, highlighting the importance of expectation management and standardization

of concomitant therapies. These findings should be validated in prospective, multicenter trials employing standardized supraneural/infraneural techniques and predefined patient-reported outcomes.

Ethics

Ethics Committee Approval: The study was carried out in accordance with the principles of the Declaration of Helsinki and approved by the University of Health Sciences Türkiye, Adana City Training and Research Hospital Local Ethics Committee (approval no: 584, date: 10.07.2025).

Informed Consent: In this single-center retrospective cohort study was conducted between 2024 and 2025 at a tertiary pain management clinic.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.Y., Ç.K., Concept: A.Y., Ç.K., Design: A.Y., Ç.K., Data Collection or Processing: A.Y., Ç.K., Analysis or Interpretation: A.Y., Ç.K., Literature Search: A.Y., Ç.K., Writing: A.Y., Ç.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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