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Original research article

COMPARING THE CLINICAL OUTCOMES OF LUMBAR TRANSFORAMINAL VS INTERLAMINAR EPIDURAL STEROID INJECTIONS IN A REGISTRY COHORT

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Abstract: *Epidural steroid injections are a safe and effective treatment for acute low back pain associated with radicular pain.* ***Objective:*** *The main objective of the study is to find the clinical outcomes of lumbar transforaminal vs interlaminar epidural steroid injections in a registry cohort.* ***Methods:*** *This prospective cohort study was carried out at Ghurki Trust Teaching Hospital, Lahore, over one year, from June 2023 to June 2024. A total of 185 patients were included in the study. Patients aged >18 years and presented with symptoms of lumbar radiculopathy due to lumbar disc herniation, spinal stenosis, or degenerative disc disease were included in the study.* ***Results:*** *The mean age of the TFESI group was 45.6 ± 10.3 years, while the ILESI group had a mean age of 46.2 ± 9.8 years (p = 0.67). The gender distribution was also comparable, with 55 males and 37 females in the TFESI group, and 58 males and 35 females in the ILESI group (p = 0.78). Baseline pain intensity (VAS score) and disability (ODI score) were similar between the two groups, with no significant differences in VAS (7.6 ± 1.1 vs. 7.5 ± 1.2, p = 0.58) or ODI (52.4 ± 10.2 vs. 51.9 ± 9.9, p = 0.71). In the TFESI group, 52.2% of patients had lumbar disc herniation, compared to 49.5% in the ILESI group (p = 0.69). Lumbar spinal stenosis was diagnosed in 32.6% of patients in the TFESI group and 34.4% in the ILESI group (p = 0.81).* ***Conclusion:*** *It is concluded that both lumbar transforaminal epidural steroid injections (TFESI) and interlaminar epidural steroid injections (ILESI) are effective in the management of lumbar radiculopathy, leading to significant reductions in pain and improvements in functional outcomes.*

Keywords: Epidural Injections, Lumbar Radiculopathy, Pain Management, Spinal Diseases, Steroids.

Introduction

Epidural steroid injections are a safe and effective treatment for acute low back pain associated with radicular pain; the best available evidence is for acute intervertebral disc herniation pathology, though other pathologies such as spondylotic stenosis or non-specific back pain have also been studied. Transforaminal and interlaminar epidural steroid injections are, in principle, effective because they release corticosteroids near the damaged nerve root and inflamed area. (1) Although both methods place the corticosteroids in the epidural space, variability in technique may lead to variable medication distribution. In particular, the transforaminal approach is postulated to effectively deliver medication to the ventral epidural space where such pathologies as intervertebral disc herniation are most often located. LBP is one of the most common health concerns in line with disability assessment because it constitutes significant socioeconomic costs (2). Of Chronic low back pain patients, the majority complain of radicular pain, which is pain that shoots down the legs from the lower back due to nerve root irritation or pinching. Radiculopathy usually indicates a herniated disc, lumbar spinal stenosis, or other diseases of the spine that cause inflammation and irritation of some nerve roots (3). ESIs have emerged as a standard conservative therapy for treating lumbar radiculopathy by decreasing inflammation in the epidural space that surrounds the nerve roots and impairs pain. The techniques of ESIs can be divided into different routes depending on the placement of the needle; the common methods are the lumbar transforaminal (TFESI) and the lumbar interlaminar (ILESI) (4). There is, therefore, a preferred choice of these techniques based on the patient's anatomy, the location of the pathology, and most importantly, the clinician's practice. However, despite their popularity for several years, there is a lack of agreement about which one out of all these offers the better long-term results in pain relief, and functional rehabilitation, as well as enhancements of the overall quality of life (5). Also, complications and side effects or adverse effects especially in TFESI, add to the decision-making process a rather complex one. This procedure called TFESI involves injecting corticosteroids to the epidural space using the transforaminal technique that aims the drug closer to the irritated nerve root (6). This technique is usually used especially for selective nerve root injection as compared to routine transforaminal injection because it is believed that the concentration of the steroid by the administration at this point would be much higher at the site of pathology (7). There is evidence of the efficacy of TFESI in midline low back and leg radicular pain due to disc herniation or foraminal stenosis. Research shows that the transforaminal approach may be better for patients with different-sided radicular pain or where there is a need to target a particular nerve root. However, the following risks and complications are linked with ultracentrifugation and the use of TFESI (2). Because of its relation to the radicular artery and other structures, damage to them poses a possible risk with consequences that are severe and relatively infrequent, including spinal cord infarction or paraplegia (8). Further, there is a growing worry over accidental intravascular injection, especially in the cervical and thoracic spines which has prompted a controversy over the safety of TFESI.

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However, these risks justify the fact that TFESI is a preferred modality for pain specialists when treating radiculopathy since it is less invasive (9).
Thus, the main objective of the study is to find the clinical outcomes of lumbar transforaminal vs interlaminar epidural steroid injections in a registry cohort.

Methodology

This prospective cohort study was carried out at Ghurki Trust Teaching Hospital, Lahore, over one year, from June 2023 to June 2024. A total of 185 patients were included in the study. Patients aged >18 years and presented with symptoms of lumbar radiculopathy due to lumbar disc herniation, spinal stenosis, or degenerative disc disease were included in the study. The diagnosis was confirmed via clinical examination and imaging studies, including MRI or CT scans, showing compression or irritation of nerve roots. All patients had experienced symptoms for at least 3 months and had not responded adequately to conservative treatments such as physical therapy or oral medications. Patients with previous spinal surgery, spinal deformities such as scoliosis, coagulation disorders, uncontrolled diabetes, or infection at the injection site were excluded.
Data were collected into two groups. Both procedures were performed under fluoroscopic guidance by experienced interventional pain physicians at the hospital.

1. **TFESI Group**
2. **ILESI Group**

Group, I patients underwent a transforaminal epidural steroid injection in which a corticosteroid combined with a local anesthetic solution was infiltrated into the epidural space through the foramen at the nerve root level of the affected nerve. Patients in group II underwent interlaminar epidural steroid injection; the corticosteroids and the local anesthetic were placed in the posterior epidural space using the interlaminar approach. The corticosteroid that was used in both procedures was triamcinolone acetonide mixed with 2 ml of 1% lidocaine with a volume of 40 mg. All injections were done aseptically and the patients were observed for any adverse effects shortly after injection.
Data were analyzed using SPSS version 26.0. Continuous variables, such as VAS and ODI scores, were presented as mean ± standard deviation and compared between the two groups using an independent t-test. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 185 patients were included in the study, with 92 patients in the transforaminal epidural steroid injection (TFESI) group and 93 patients in the interlaminar epidural steroid injection (ILESI) group. The mean age of the TFESI group was 45.6 ± 10.3 years, while the ILESI group had a mean age of 46.2 ± 9.8 years (p = 0.67). The gender distribution was also comparable, with 55 males and 37 females in the TFESI group, and 58 males and 35 females in the ILESI group (p = 0.78). Baseline pain intensity (VAS score) and disability (ODI score) were similar between the two groups, with no significant differences in VAS (7.6 ± 1.1 vs. 7.5 ± 1.2, p = 0.58) or ODI (52.4 ± 10.2 vs. 51.9 ± 9.9, p = 0.71). (Table 1)

Table 1: Demographics and Baseline Characteristics

Characteristic	TFESI Group (n = 92)	ILESI Group (n = 93)	p-value
Mean Age (years)	45.6 ± 10.3	46.2 ± 9.8	0.67
Gender (M/F)	55/37	58/35	0.78
Mean VAS Score (baseline)	7.6 ± 1.1	7.5 ± 1.2	0.58
Mean ODI Score (baseline)	52.4 ± 10.2	51.9 ± 9.9	0.71

At 1 month, the TFESI group showed a significantly lower mean VAS score (3.1 ± 1.4) compared to the ILESI group (4.2 ± 1.5, p = 0.01). However, by 3, 6, and 12 months, the pain scores between the two groups were not significantly different. Functional improvement, measured by ODI scores, followed a similar trend, with the TFESI group showing better improvement at 1 month (p = 0.03), but no significant differences at later follow-ups. (Table 2)

Table 2: Pain reduction (VAS scores), functional improvement (ODI scores), and the need for repeat injections or surgery

Time Point/Intervention	TFESI Group	ILESI Group	p-value
Pain Reduction (VAS Scores)			
Baseline	7.6 ± 1.1	7.5 ± 1.2	0.58
1 month	3.1 ± 1.4	4.2 ± 1.5	0.01
3 months	3.2 ± 1.5	3.6 ± 1.6	0.18
6 months	3.5 ± 1.6	3.8 ± 1.7	0.26
12 months	3.8 ± 1.7	4.0 ± 1.6	0.45
Functional Improvement (ODI Scores)			
Baseline	52.4 ± 10.2	51.9 ± 9.9	0.71
1 month	24.5 ± 7.6	27.8 ± 8.2	0.03
3 months	26.2 ± 8.0	28.1 ± 7.9	0.12
6 months	28.5 ± 8.3	29.4 ± 8.1	0.39
12 months	29.2 ± 8.7	30.1 ± 8.6	0.45
Need for Repeat Injections or Surgery			
Repeat injections	15 (16.3%)	21 (22.6%)	0.27
Surgical referral	8 (8.7%)	12 (12.9%)	0.36

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In the TFESI group, 52.2% of patients had lumbar disc herniation, compared to 49.5% in the ILESI group (p = 0.69). Lumbar spinal stenosis was diagnosed in 32.6% of patients in the TFESI group and 34.4% in the ILESI group (p = 0.81). Lastly, 15.2% of TFESI patients and 16.1% of ILESI patients had degenerative disc disease (p = 0.87). (Table 3)

Table 3: Underlying Diagnosis Distribution of Patients

Diagnosis	TFESI Group (n = 92)	ILESI Group (n = 93)	p-value
Lumbar Disc Herniation	48 (52.2%)	46 (49.5%)	0.69
Lumbar Spinal Stenosis	30 (32.6%)	32 (34.4%)	0.81
Degenerative Disc Disease	14 (15.2%)	15 (16.1%)	0.87

The results show that at 1 month, a significantly higher percentage of patients in the TFESI group reported mild pain (48.9%) compared to the ILESI group (30.1%) (p = 0.01), indicating faster short-term pain relief with TFESI. However, there were no significant differences in the moderate or severe pain categories between the two groups at 1 month. (Table 4)

Table 4: Pain Intensity Categories (Mild, Moderate, Severe) at Each Follow-up

Time Point	Pain Category	TFESI Group (n = 92)	ILESI Group (n = 93)	p-value
1 month	Mild (0-3)	45 (48.9%)	28 (30.1%)	0.01
	Moderate (4-6)	38 (41.3%)	49 (52.7%)	0.10
	Severe (7-10)	9 (9.8%)	16 (17.2%)	0.18
3 months	Mild (0-3)	40 (43.5%)	36 (38.7%)	0.51
	Moderate (4-6)	44 (47.8%)	45 (48.4%)	0.93
	Severe (7-10)	8 (8.7%)	12 (12.9%)	0.38
6 months	Mild (0-3)	38 (41.3%)	35 (37.6%)	0.61
	Moderate (4-6)	45 (48.9%)	47 (50.5%)	0.84
	Severe (7-10)	9 (9.8%)	11 (11.8%)	0.64
12 months	Mild (0-3)	36 (39.1%)	34 (36.6%)	0.71
	Moderate (4-6)	46 (50.0%)	48 (51.6%)	0.84
	Severe (7-10)	10 (10.9%)	11 (11.8%)	0.84

Discussion

The results of this study provide valuable insights into the comparative effectiveness of lumbar transforaminal epidural steroid injections (TFESI) and interlaminar epidural steroid injections (ILESI) in the management of lumbar radiculopathy. Indeed, both techniques were associated with significant improvements in both pain intensity and functional disability over 12 months, with trend analyses indicating that those treated with TFESI showed greater improvement by the end of the first month (10). This is also in line with the previous studies showing that since TFESI is an image-guided technique it might provide longer-lasting relief as compared to conventional transforaminal ES because of direct delivery of the corticosteroids to the site of the affected nerve root. The improvement in the degree of pain in the TFESI group after one month of the procedure is quite impressive (11). TFESI was statically more effective in reducing the required pain scores than ILESI with 48.9% of patients in the TFESI group having mild pain as compared to 30.1% of patients in the ILESI group (p = 0.01). This early benefit could be due to the greater accuracy of medication delivery to the inflamed nerve root in TFESI, which would undoubtedly be higher than the local concentration of corticosteroids at that site. But all the same, on the pain reduction aspect, TFESI's advantage waned with time, with pain scores of both groups nearly identical at 3, 6, and 12 months (12). Such results are similar to the authors like Manchikanti et al. (2012) who showed that TFESI might produce more short-term effectiveness as compared to ILESI in chronic pain treatment, however, time-related results are likely to be comparable. The similar pain outcomes also imply that though TFESI had a somewhat better advantage for patients seeking short-term relief ILESI could be used for the long-term remedy of lumbar radiculopathy as well (13, 14). This study is also clinically relevant because it means that both approaches can be recommended for use in clinical practice targeting the improvement of patients' quality of life after interventions. After all, there are no significant differences in long-term efficacy if one of either choice is chosen depending on the patient's preference or another specific aspect of clinical presentation. Regarding the functional disability using the ODI, the work also exhibited early trends towards improvement in the TFESI group at 1 month (p = 0.03). While at 3 months ODI score of the TFESI group was significantly better than the ILESI group, at 6 and 12 months there were no significant differences between the two groups (15). This discovery points toward the consideration that, as for early functional recovery, TFESI can facilitate late ILESI for long-term functional improvement. The observed findings are well aligned with such literature, in particular in stating that improvements in function may also follow pain reduction patterns associated with epidural steroid injections. Since functional improvement is an essential treatment objective in patients with lumbar radiculopathy, the absence of significant long-

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term differences that were identified between TFESI and ILESI suggests that both interventions should be regarded as clinically effective in enhancing quality of life (16). Clinicians may choose to perform TFESI when there is a need for a 'faster return to work or function' in the patient. However, ILESI is still a satisfactory technique in patients in whom the procedural risk or risk of complications related to TFESI might be more concerning. The rate per patient requiring repeated injections or surgical referral was slightly higher in the ILESI group but did not reach statistically significant. In particular, repeat injections were performed in 16.3% of the patients in the TFESI group and 22.6% of the patients in the ILESI group. Also, the number of patients who required surgical referral for TFESI, was 8.7% while for ILESI, it was 12.9% (17). Overall results indicate that re-intervention rates trend upwards with ILESI, although the difference is not statistically significant and therefore should be viewed with caution. It should be noted, however, that TFESI entails only a modest increase in the relative risk of major complications, including accidental vascular damage, which was not observed in this study. Fluoroscopy probably reduced the risks of complications, it provided better visualization of the target area thereby minimizing the chances of injecting into a blood vessel. Clinicians should still exercise precaution when performing TFESI and their procedure of choice for patients with any of the following; anatomical structures that are technically challenging when viewed through ultrasound or when contrary to anatomical expectation, patients with Modic 1 changes, and smokers >45 years, or patients with other chronic systemic diseases. The present research has a few limitations. First, due to the small number of participants and data collection from a single center only, the generalization of the results deserves certain criticisms. The confirmation of such findings and identification of the comparison between the outcomes of the TFESI and ILESI procedures based on the patient's characteristics, including age, body mass index, and degree of spinal degeneration, would require larger, multicentric trials.

Conclusion

It is concluded that both lumbar transforaminal epidural steroid injections (TFESI) and interlaminar epidural steroid injections (ILESI) are effective in the management of lumbar radiculopathy, leading to significant reductions in pain and improvements in functional outcomes. While TFESI offers faster short-term pain relief and functional recovery, particularly within the first month post-injection, the long-term outcomes between TFESI and ILESI are comparable at 3, 6, and 12 months. Both techniques are well-tolerated with minimal complications, though TFESI may be associated with a slightly higher, albeit non-significant, risk of repeat interventions.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
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Approved by the department concerned. (IRBEC-GTHL-0087/23)
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Conflict of interest

The authors declared an absence of conflict of interest.

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References

1. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. The Lancet. 2017;389(10070):736-47.
2. Smith CC, McCormick ZL, Mattie R, MacVicar J, Duszynski B, Stojanovic MP. The effectiveness of lumbar transforaminal injection of steroid for the treatment of radicular pain: a comprehensive review of the published data. Pain Medicine. 2020;21(3):472-87.
3. Sharma AK, Vorobeychik Y, Wasserman R, Jameson J, Moradian M, Duszynski B, et al. The effectiveness and risks of fluoroscopically guided lumbar interlaminar epidural steroid injections: a systematic review with comprehensive analysis of the published data. Pain medicine. 2017;18(2):239-51.
4. Mandell JC, Czuczman GJ, Gaviola GC, Ghazikhanian V, Cho CH. The lumbar neural foramen and transforaminal epidural steroid injections: an anatomic review with key safety considerations in planning the percutaneous approach. American Journal of Roentgenology. 2017;209(1):W26-W35.
5. Kim EJ, Chotai S, Schneider BJ, Sivaganesan A, McGirt MJ, Devin CJ. Effect of depression on patient-reported outcomes following cervical epidural steroid injection for degenerative spine disease. Pain Medicine. 2018;19(12):2371-6.
6. Makkar JK, Gourav KKP, Jain K, Singh PM, Dhatt SS, Sachdeva N, et al. Transforaminal versus lateral parasagittal versus midline interlaminar lumbar epidural steroid injection for management of unilateral radicular lumbar pain: a randomized double-blind trial. Pain Physician. 2019;22(6):561.
7. Haring RS, Kennedy D, Archer KR, Chukwuma VU, Dovgan JT, Schneider BJ. Comparing the clinical outcomes of lumbar transforaminal vs interlaminar epidural steroid injections in a registry cohort. Interventional Pain Medicine. 2024;3(1):100396.
8. Kennedy DJ, Plastaras C, Casey E, Visco CJ, Rittenberg JD, Conrad B, et al. Comparative effectiveness of lumbar transforaminal epidural steroid injections with particulate versus nonparticulate corticosteroids for lumbar radicular pain due to intervertebral disc herniation: a prospective, randomized, double-blind trial. Pain Medicine. 2014;15(4):548-55.
9. Smith CC, Booker T, Schaufele MK, Weiss P. Interlaminar versus transforaminal epidural steroid injections for the treatment of symptomatic lumbar spinal stenosis. Pain Medicine. 2010;11(10):1511-5.
10. Byeon G-J, Choi E-J, Choi Y-M, Chang E-J, Kim H-J, Kim K-H. Oblique interlaminar lumbar epidural steroid injection

for management of low back pain with lumbosacral radicular pain case report. Anesthesia and Pain Medicine. 2017;12(4):371-4.
11. Perper Y. Identification of cervical epidural space: A comparison study between contrast spread and loss of resistance techniques. Frontiers in Pain Research. 2022;3:1000209.
12. Perper Y. On the spinal cord injury during attempted cervical interlaminar epidural injection of steroids. Pain Medicine. 2019;20(4):854-5.
13. Pennington Z, Swanson MA, Lubelski D, Mehta V, Alvin MD, Fuhrman H, et al. Comparing the short-term cost-effectiveness of epidural steroid injections and medical management alone for discogenic lumbar radiculopathy. Clinical neurology and neurosurgery. 2020;191:105675.
14. Liu K, Liu P, Liu R, Wu X, Cai M. Steroid for epidural injection in spinal stenosis: a systematic review and meta-analysis. Drug design, development, and therapy. 2015:707-16.
15. Mitra S, Schiller D, Anderson C, Gamboni F, D'Alessandro A, Kelher M, et al. Hypertonic saline attenuates the cytokine-induced pro-inflammatory signature in primary human lung epithelia. PLoS One. 2017;12(12):e0189536.
16. Kartal S, Kösem B, Kılınç H, Köşker H, Karabayırlı S, Çimen N, et al. Comparison of Epidrum, Epi-Jet, and Loss of Resistance syringe techniques for identifying the epidural space in obstetric patients. Nigerian Journal of Clinical Practice. 2017;20(8):992-7.
17. Landers MH. Letter to the editor regarding a recent article: Cervical epidural depth: Correlation between cervical MRI measurements of the skin-to-cervical epidural space and the actual needle depth during interlaminar cervical epidural injections. Pain Medicine. 2019;20(9):1845-8.

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