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Research Article

Effectiveness Of Lumbar Transforaminal Epidural Steroid Injection (Conventional Approach) in Patients with Lumbar Radicular Pain

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Abstract: ***Introduction:*** One of the leading causes of chronic low back pain and disability is lumbar radicular pain caused by lumbar intervertebral disc protrusion. A fluoroscopy-guided transforaminal epidural steroid injection (TFESI) is a minimally invasive approach to treating patients who do not respond to conservative therapy.**Objective:** To evaluate the effectiveness of conventional lumbar TFESI in reducing pain and improving functional outcome in patients with lumbar radicular pain.**Materials and Methods**: This prospective clinical study enrolled 25 patients with MRI-confirmed lumbar intervertebral disc protrusion and unilateral radiculopathy that failed to respond to conservative treatment. They all received a fluoroscopy-guided transforaminal epidural steroid injection (TFESI) of a mixture of triamcinolone and bupivacaine. Pain and functional outcomes were measured by Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) at 8 weeks after the treatment.**Results:** After TFESI, major changes in pain and functional disability were reported. Around 80% of patients experienced a reduction of 50% or more in VAS scores, together with gradual improvement in ODI scores and elevated patient satisfaction levels. Besides, no serious complications were recorded.**Conclusion:** Conventional fluoroscopy-guided lumbar TFESI is a safe and effective minimally invasive treatment for lumbar radicular pain, providing significant short-term pain relief and functional improvement.

Keywords: Lumbar radiculopathy, transforaminal epidural steroid injection, lumbar disc prolapse, fluoroscopy, VAS, ODI.

INTRODUCTION

Low back pain is a leading contributor to disability worldwide and remains a significant public health concern due to its high prevalence, recurrent nature, and socioeconomic burdens. Lumbar radicular pain or sciatica is a highly prevalent expression of low back problems, which presents as pain radiating into one or both lower extremities originating from compression or irritation of the lumbar nerve roots. The distal part of the lumbar nerve roots that causes the symptoms originates from the lumbar intervertebral disc herniation, lumbar degenerative disc disease, or constriction of the lumen of the foramen. All these conditions can cause extreme painful sensations with limiting functional abilities and decreased quality of life. (1,2).

Generally, the primary treatment of lumbar radiculopathy is with non-surgical methods like altering activities physiotherapy NSAIDs, analgesics, and neuropathic pain medications. While many patients get better symptomatically through conservative treatment, a significant number continue to suffer from pain and functional limitations, leading them to seek additional therapies. In these patients, epidural steroid injection treatment (ESI) has become a leading minimally invasive intervention capable of relieving pain, reducing inflammation around the affected nerve, and postponing or even eliminating the need for surgery. (2,3)

Epidural steroid injections can be done by using the caudal, interlaminar, or transforaminal approaches. Of these methods, the transforaminal epidural steroid injection (TFESI) has become very popular because it allows for the precise delivery of corticosteroid and local anesthetic right next to the irritated spinal nerve root in the ventral epidural space, which is the main site of inflammatory mediators. This more focused technique means that a smaller amount of drug is used, yet the local drug concentration is much higher, which might cause better pain relief and restoration of function than other types of epidural injections. (3,5)

It is a fact that fluoroscopic guidance is the standard way of performing TFESI as it assists in the exact placement of the needle in the neural foramen with a minimum risk of complications. Injections into "safe triangle" area under fluoroscopic guide and confirming with contrast medium A lot increase the procedural accuracy and guarantee the proper epidural spread of the injectate. A mixture of corticosteroid and local anesthetic works by lessening the inflammation of the nerve root, reducing the discharge of the nervous system, and breaking the pain cycle. This, in turn, makes it possible for the patients to be re-educated quickly and, most importantly, leads to a better outcome. (4-6)

A number of clinical trials have exhibited short-term positive outcomes of TFESI in patients with lumbar radiculopathy induced by disc prolapse or degenerative spinal pathology. Large-scale decrease in pain intensity, improvement in functional disability, and reduction in analgesic consumption have been reported after the intervention. But, existing literature is still very diverse about the extent and time of the clinical benefits. Certain prospective studies have documented different levels of effectiveness based on risk factors, type of pathology, method of injection, and follow-up period among others. That means, more prospective clinical trials are necessary to ascertain the effectiveness of TFESI in various patient groups and healthcare environments. (5-7)

This clinical prospective study aims to determine the efficacy of fluoroscopy-guided conventional lumbar transforaminal epidural steroid injection technique in the management of unilateral lumbar radicular pain caused by lumbar intervertebral disc protrusion after failure to respond adequately to conservative treatment. Intervention eficacy will be determined by assessing variations in pain intensity through the Visual Analogue Scale (VAS), functional disability through the Oswestry Disability Index (ODI), and overall patient satisfaction through serial follow-ups. The results of this research may offer additional support to the role of TFESI as a viable, low-risk intervention option for lumbar radiculopathy in everyday orthopaedic settings. (6-8).

MATERIALS AND METHODS

2.1Study Design and Setting

This clinical trial was a prospective one, and it took place in the Department of Orthopaedics at SLN Medical College and Hospital. The duration of the study was one year (2024-2025). The aim of the research was to assess the efficacy of the fluoroscopy-guided traditional lumbar transforaminal epidural steroid injection (TFESI) for the relief of lumbar radicular pain caused by lumbar intervertebral disc protrusion. Before initiating the project, institutional ethical clearance was given, and every subject gave their written informed consent before being included in the study.

*2.2*Study Population

Out of 25 consecutive patients with the Department of Orthopaedics who were complaining of chronic low back pain and unilateral lumbar radiculopathy, the study included all of them. A thorough clinical examination was done for all patients. Radiological examinations were carried out to confirm the diagnosis and identify the level of the nerve root involved. Normal lumbar spine X-rays were taken to look for any bony changes. However, all patients had lumbar magnetic resonance imaging (MRI) done to make sure that the lumbar intervertebral disc was protruding and to determine the level of the spine that was affected.

2.3 Eligibility Criteria

Individuals who are 18 years of age or older and have a one-sided lumbar radiculopathy that has been present for over six months mainly caused by MRI-detected lumbar intervertebral disc protrusion and have not been sufficiently responsive to conservative treatment are deemed suitable for enrollment. Conservative treatment entailed the use of suitable medications, exercise therapy, and change in activities. Exclusion criteria covered patients with lumbar spinal canal stenosis, prior lumbar spine surgery, chronic kidney disease, or those not willing to give informed permission.

2.4 Injection Procedure

Each of the procedures done was at the patient's hospital stay under very strict aseptic measures with the help of the fluoroscope. The patients were laid on their stomachs on the fluoroscopy table with proper supports ensuring their lumbar spine remained aligned. By turning the fluoroscopic C-arm obliquely, a clear view of the neural foramen was obtained, making it easier to identify the safest triangle for the needle insertion. A 22-gauge, 12-cm spinal needle was pushed through the skin under continuous fluoroscopic guidance to the safe triangle just beside the diseased nerve root. Afterwards, a lateral fluoroscopic image was taken to verify the exact anteroposterior position of the needle tip.

Once appropriate needle positioning was verified, a small volume of about 1 mL of non-ionic contrast medium (Iohexol 300 mg iodine/mL) was delivered to ascertain epidural delivery and rule out accidental intravascular or intrathecal injection. Then, after the correct needle placement was confirmed, a solution made up of 0.5 mL of 0.5% heavy bupivacaine hydrochloride and 40 mg (1 mL) of triamcinolone acetonide suspension was slowly introduced into the epidural space. Immediately post-procedure, all patients were monitored for the development of any unexpected complications before being discharged in line with the institutional protocol.

2.5 Outcome Assessment

The principal outcome measure was the decrease in pain level after TFESI. The Visual Analogue Scale (VAS) was used to evaluate pain intensity both pre-procedure and at follow-up. A treatment was deemed successful if the patient's VAS score was reduced by more than 50% two weeks after the injection versus baseline. For assessing the functional recovery we used the Oswestry Disability Index (ODI), which is a reliable tool for evaluation of disability caused by low back pain. The scores of the ODI were taken at baseline and then at two four six, and eight weeks post-intervention to track the changes in functional condition as time progressed. Two weeks post-procedure, patient comfort with the therapy was again evaluated through a five-point satisfaction scale, ranging from 0 to 4, where scores of 0 1 2, 3, and 4 meant poor fair good, very good, and

excellent respectively. This increment gave an overall glimpse into patients' sense of effectiveness of the intervention.

2.6 Statistical Analysis

The data gathered were keyed into a digital database and analyzed with the help of suitable statistical software. Continuous variables were represented as mean standard deviation, while categorical variables were displayed as counts and percentages. The paired t-test was performed to compare the variations in pain scores before and after transforaminal epidural steroid injection. Besides, Chi-square test was employed to analyze categorical variables. For all statistical analyses, a p-value <0.05 was regarded as statistically significant.

RESULTS

Twenty-five patients experienced unilateral lumbar radicular pain from their MRI findings of lumbar intervertebral disc protrusion. These patients were recruited for the study. All of them got the lumbar transforaminal epidural steroid injection (TFESI) under fluoroscopy guidance without any issues. There were no serious procedural complications. Besides being followed up for the medication effects for 2 months after the intervention, all patients were still physically present. The assessment of clinical outcomes was Mostly based on the Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and patient satisfaction score.

Table 1. Baseline demographic and clinical characteristics of the study population (n = 25)

Variable	Number (%)
Age (years)	
18–30	5 (20.0)
31–45	9 (36.0)
46–60	8 (32.0)
>60	3 (12.0)
Gender	
Male	14 (56.0)
Female	11 (44.0)
Affected side	
Right	13 (52.0)
Left	12 (48.0)
Level of disc protrusion	
L3–L4	2 (8.0)
L4–L5	15 (60.0)
L5–S1	8 (32.0)

The mean VAS score before the procedure was 8.16±0.94 signifying that the pain was very strong among the study subjects. After TFESI, a gradual decrease in pain levels was evidenced and a Really improved result at the two-week follow-up ($p < 0.001$). Also, the average ODI score was continuously getting better during the follow-up period which correlates with functional improvement after the therapy.

Table 2. Comparison of VAS and ODI scores before and after TFESI

Outcome Measure	Baseline	2 Weeks	4 Weeks	6 Weeks	8 Weeks	p-value
Mean VAS Score	8.16 ± 0.94	3.84 ± 1.10	2.96 ± 1.01	2.44 ± 0.96	2.12 ± 0.88	<0.001
Mean ODI Score (%)	58.72 ± 8.54	42.16 ± 7.32	31.84 ± 6.48	24.64 ± 5.82	18.56 ± 4.94	<0.001

Most patients experienced a major decrease in their pain levels that was considered clinically significant, which we define as an improvement of more than 50% in their VAS score two weeks after the injection. Also, most patients were very pleased with their results, as the percentage who rated the outcome as good, very good, or excellent was quite high.

Table 3. Treatment effectiveness and patient satisfaction after TFESI

Variable	Number (%)
VAS improvement >50% at 2 weeks	
Yes	20 (80.0)
No	5 (20.0)
Patient satisfaction score	
Poor (0)	1 (4.0)
Fair (1)	2 (8.0)
Good (2)	6 (24.0)
Very Good (3)	10 (40.0)
Excellent (4)	6 (24.0)

On the whole, fluoroscopy-guided conventional lumbar transforaminal epidural steroid injections (TFESI) provided notable short-term relief to the patients with lumbar radicular pain. Marked decreases in pain levels and disability scores were statistically recorded at all the assessed time points. Most of the patients, i.e. 80%, had pain relief that was considered clinically significant, and 64% expressed a very good or excellent satisfaction level with the procedure. Meaning TFESI can act as an effective minimally invasive treatment method for aptly selected patients with lumbar disc-related radiculopathy.

Figure 1. Distribution of patients according to lumbar intervertebral disc level involved (n = 25)

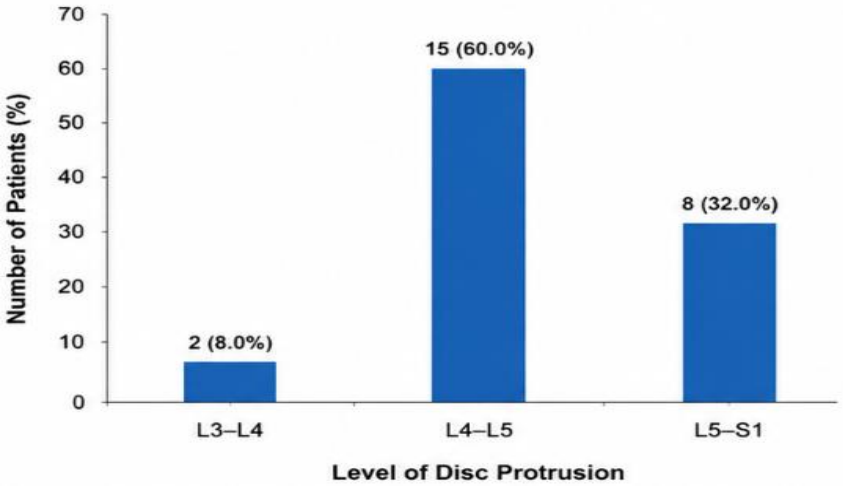
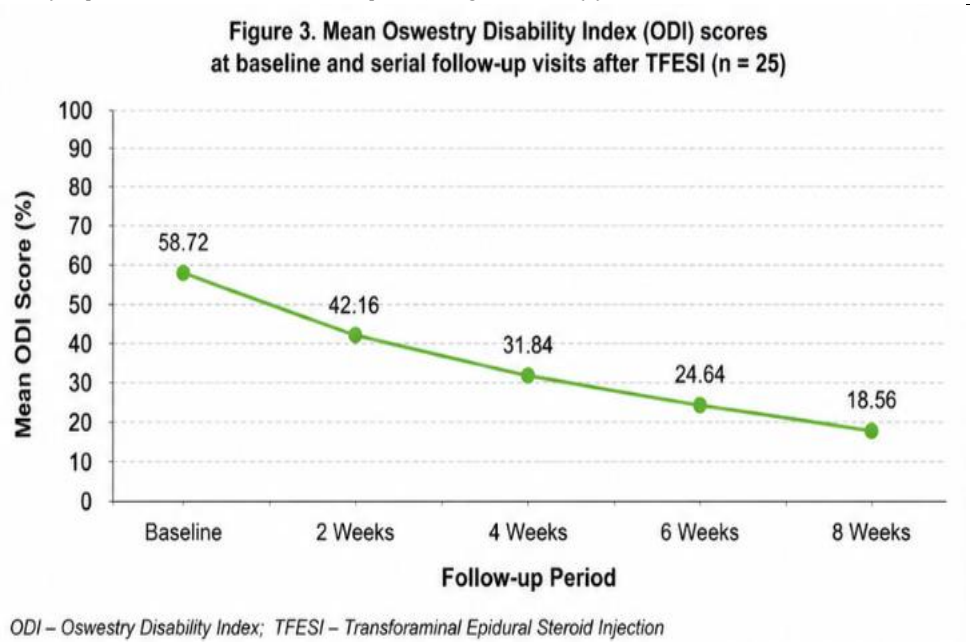


Figure 2. Mean Visual Analogue Scale (VAS) scores at baseline and during follow-up after TFESI (n = 25)

TFESI – Transforaminal Epidural Steroid Injection



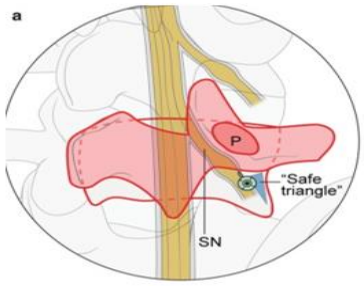
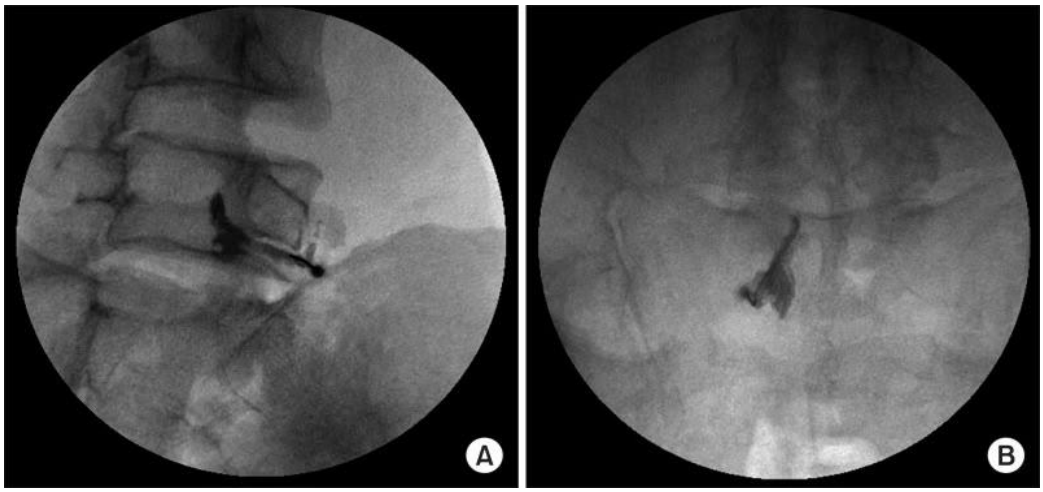
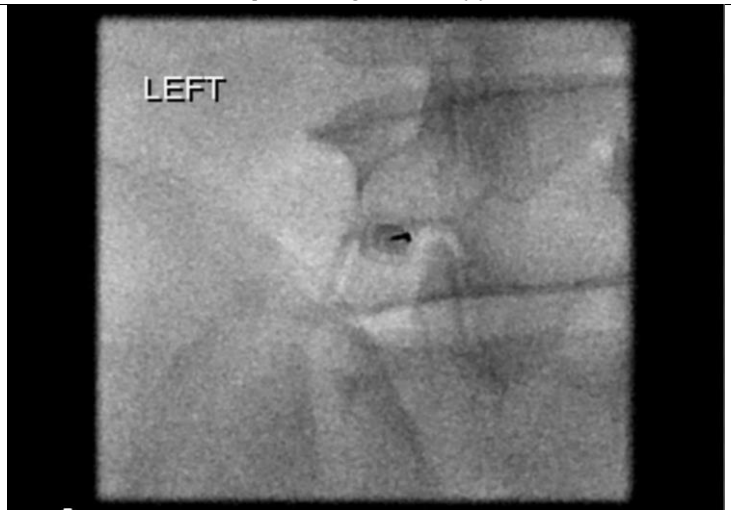


Fig-4 Showing safe triangle in oblique view for TFESI





DISCUSSION

This prospective research assessed the efficacy of fluoroscopy-guided lumbar transforaminal epidural steroid injection (TFESI) for patients who suffer from chronic unilateral lumbar radicular pain due to lumbar intervertebral disc protrusion. Results indicated a marked decrease in pain level and physical disability after the intervention. A large number of participants gained Much from the analgesic effect, about 80% of whom had more than 50% reduction in VAS scores at the two-week point. The improvement in Oswestry Disability Index (ODI) scores together with the high level of patient satisfaction were consistent with the success of TFESI as a low-invasive therapeutic measure.

The decrease in pain levels we noticed aligns well with what other researchers have found when they showed that using TFESI Really alleviates the pain, although for a limited time, in patients suffering from lumbar disc-related radiculopathy. The main reason why the treatment works is the anti-inflammatory property of the corticosteroids. These steroids not only help in reducing the swelling around the nerve but also prevent the production of those chemical substances which cause inflammation in the nerve root area. As a result, the pain coming from the nerve is reduced. (9,10)

This study showed that plus pain relief, the patients' functional ability progressively improved, as shown by the decreasing ODI scores at the follow-up. Recovery of function after pain reduction helps patients to get back to normal activities and be more involved in rehabilitation process. Other prospective studies have also found similar positive changes in disability scores after TFESI, thereby uniting the procedure with promoting quality of life in patients with chronic lumbar radiculopathy. (10,11)

Fluoroscopic guidance is one key factor in achieving good results. Getting the needle right into the neural foramen and seeing how the contrast is spreading are two ways to make sure that medicine is delivered exactly to the nerve root that is causing pain, with least harm. It has been highlighted in earlier publications that image-guided TFESI achieves more accurate targeting and higher therapeutic effectiveness than the blind injection methods. (11,12)

Patient satisfaction in our study was quite high, most of them reviewing their results as good to excellent following the treatment. These findings are compatible to those published in the literature, where substantial decrease in pain and enhancement in the functions of the patient were linked to increase in patient satisfaction and decrease in the demand of surgical intervention. (12,13)

The results of this study are consistent with the existing literature showing that TFESI is an effective non-operative management for lumbar radiculopathy, although not all evidence points to the same levels of success. Variability in the data published to date may be explained by differences in patient demographics, clinical characteristics (duration of symptoms, severity of disc pathology), technique and length of follow-up. (13,14)

This study has a few limitations. First of all, the relatively small number of subjects, In reality it was conducted in a single centre, and a short length of follow-up are the main reasons why the results are limited in their capacity to be generalized and do not allow for the examination of the long-term results. For this reason, it is advisable that future studies be conducted in multiple centres so that the increase in the number of subjects and the extension of the follow-up time will provide a long-term assessment of the safety and effectiveness of this technique. (14,15)

According to the results of this study, the usage of fluoroscopy-guided conventional lumbar transforaminal epidural steroid injection might be recognized as a safe and effective minimally invasive treatment procedure for patients with lumbar radicular pain who no longer

respond to conservative treatment. The procedure can deliver quite substantial short-term pain alleviation, assist in the recovery of functional disability, and lead to a high degree of patient satisfaction. So, it can well be classified as a great treatment option before surgical intervention consideration. (15)

CONCLUSION

Fluoroscopy-guided conventional lumbar transforaminal epidural steroid injection (TFESI) is a minimally invasive procedure and a good option for patients with chronic lumbar radicular pain caused by lumbar intervertebral disc protrusion who have not responded to conservative management. This procedure offers beneficial effects of pain relief, are tied to functional disability, and patient satisfaction is reasonably high, with no serious safety concerns. So, TFESI may be regarded as a useful non-surgical therapeutic strategy which does not preclude surgery in properly selected patients. Large-scale, long-term follow-up studies are warranted for determining TFESI's long-term effects.

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