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Effect of Transforaminal Epidural Steroid Injection on Pain Relief and Functional Outcome in Lumbar Disc Herniation: A Prospective Observational Study

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Abstract: ***Background**: Backache with radiculopathy due to disc herniation has become a substantial rehabilitation and management challenge. In addition to mechanical compression, a growing body of evidence implicates inflammatory mediators released from herniated disc material in the generation of radicular pain. Transforaminal epidural steroid injection is gaining popularity as an alternative for managing disc-herniation-related pain, though its effectiveness remains debated. **Aim**: To assess the effect of TFESI on pain relief in lumbar disc herniation and to evaluate functional outcome using the Oswestry Disability Index. **Methods**: This was a facility-based prospective observational study conducted in a tertiary care centre among patients with degeneration of the intervertebral disc leading to disc bulge/protrusion/extrusion, from December 2020 to June 2023. Patients with disc bulge/protrusion/extrusion on MRI compressing the lumbar thecal sac with nerve roots leading to radiculopathy without neurodeficit were included. All patients received a single TFESI under fluoroscopic guidance using the sub-pedicular approach, with 40 mg triamcinolone acetonide injected along with 1 mL of 1% lidocaine at the transforaminal site. Functional outcome was assessed by ODI pre-operatively, immediately post-operatively, and at 3, 6, and 12 months. **Results**: Thirty-five cases were enrolled and analysed (response rate 100%). The majority- 17 (48.57%)- were aged 31–45 years, with a mean age of 44.97 ± 10.10 years (range 33–65 years); 29 (82.86%) were male. Right-sided involvement was present in 21 (60%). On MRI, 20 (57.14%) had disc protrusion and 15 (42.86%) had extrusion, with the L4–L5 level most commonly affected in 20 (57.14%) cases. Among the 35 cases, the pre-operative ODI was 31–40% in 18 (51.43%) and 41–50% in 17 (48.57%). The mean ODI declined significantly from 40.6 ± 2.8 pre-operatively to 14.4 ± 7.6 immediately post-operatively, 13.6 ± 7.2 at 3 months, 11.9 ± 6.1 at 6 months, and 10.1 ± 0.8 at 12 months ($p < 0.0001$). Mean change from baseline was −26.2 ± 4.8, −27 ± 4.4, −28.7 ± 3.3, and −30.5 at the corresponding intervals ($p = 0.0001$). By the end of 12 months, successful pain relief was achieved in 29 (82.86%) cases, while 6 (17.14%) required discectomy. **Conclusions**: TFESI produced a significant and sustained reduction in disability and an approximately 83% success rate at 12 months in patients with lumbar disc herniation and radiculopathy. It is an effective, economical, and low-morbidity alternative to surgery in patients who fail conservative treatment.*

Keywords: transforaminal epidural steroid injection, lumbar disc herniation, radiculopathy, Oswestry Disability Index, functional outcome

1. Introduction

Backache with radiculopathy due to disc herniation has become a real rehabilitation and management challenge in our society. A herniated disc is a condition in which the nucleus pulposus is displaced from the intervertebral space; in some instances it can compress the nerve or the spinal cord, causing pain consistent with nerve compression or spinal cord dysfunction known as myelopathy. The prevalence of a symptomatic herniated disc in the lower back is about 1% to 3%, with the highest prevalence among people aged 30 to 50 years and a male to female ratio of 2:1. In individuals aged 25 to 55 years, about 95% of herniated discs occur in the low back at the L4/5 and L5/S1 levels; disc herniation above this level is more common in people over 55 years.

The causes and pathophysiology of disc-herniation radiculopathy remain incompletely understood. Several studies have identified inflammatory mediators-phospholipase A2, prostaglandin E2, leukotrienes, nitric oxide, immunoglobulins, and pro-inflammatory cytokines such as interleukin-1α, IL-1β, IL-6, and tumour necrosis factor alpha- along with autoimmune reactions, in disc herniation. The leakage of these agents may produce excitation of nociceptors, direct neural injury, nerve inflammation, or enhancement of sensitization to other pain-producing substances such as bradykinin, leading to nerve root pain. Once inflammation is established, the nerves become exquisitely sensitive to pressure, producing prolonged, pain-generating discharge. Such local inflammation is caused by mediators such as IL-6 produced by macrophages and monocytes, and high concentrations of these mediators may cause a systemic inflammatory reaction which is why levels of high-sensitivity C-reactive protein (hsCRP) are believed to rise with back pain. (1)

In the spine, the intervertebral disc is composed of the cartilaginous endplates, the annulus fibrosus, and the nucleus pulposus. As humans age, the nucleus pulposus becomes less hydrated and weakens, leading to progressive disc herniation

that can cause symptoms; the second most common cause is trauma, while connective tissue disorders and congenital disorders such as short pedicles are also implicated. Disc herniation is most common in the lumbar spine, followed by the cervical spine.

Steroids are administered through epidural injections and are thought to be integral in decreasing inflammation around the affected nerve tissue, thereby reducing pain. They also reduce the chances of post-inflammatory fibrosis. A corticosteroid has several modalities of action in reducing pain: membrane stabilization, blockade of phospholipase A2, inhibition of synthesis or release of pro-inflammatory substances, suppression of sensitization of dorsal horn neurons, and a reversible local anaesthetic effect. Transforaminal epidural injection is considered an invasive procedure that causes improvement in symptoms. (2,3)

Among the different techniques of intraspinal steroid injection- transforaminal, interlaminar, and caudal- selective nerve root block is a highly target-oriented procedure with good efficacy in patients with lumbar disc disease, because the corticosteroid is injected directly near the dorsal root ganglion and the inflamed nerve root. The sub-pedicular approach is the current common clinical method: the needle is advanced towards the safe triangle under the inferior surface of the pedicle to locate the superolateral spinal nerve, allowing agents to be injected into the anterior extradural space between the back of the herniated disc and the anterior nerve root dural sleeve. The efficacy of SNRB in acute lumbar disc herniation has been quoted variedly in previous studies, ranging from 30% to 80%. While early surgery in carefully selected patients can achieve rapid relief, potential disadvantages include risks of infection, discitis, recurrence, nerve root injury, and anaesthetic complications-complications that epidural block may avoid. (4)

In this context, the purpose of this study was to elucidate the functional outcome of transforaminal epidural block using the sub-pedicular approach in patients with lumbar radicular pain, and to investigate its short-term effects up to a period of 1 year and possible complications during injection.

Aim: To assess the effect of transforaminal epidural steroid injection on pain relief in lumbar disc herniation.

Objectives:
1) To establish a relationship between transforaminal steroid injection and pain relief in lumbar disc herniation.
2) To assess the effect of transforaminal epidural steroid injection on functional outcome for patients with disc herniation and radiculopathy using the Oswestry Disability Index.

2. Materials and Methods

Study Design and Setting
This was a facility-based prospective observational study conducted in a tertiary care centre among patients with degeneration of the intervertebral disc leading to disc bulge/protrusion/extrusion, from December 2020 to June 2023. The protocol of the study was approved by the Institutional Ethical Committee of the medical college. Written informed consent was taken from all study subjects before collection of data, and they were informed of the complete right to withdraw from the study at any time without disadvantage.

Inclusion and Exclusion Criteria

Inclusion criteria:
Patients with disc bulge/protrusion/extrusion on MRI compressing the lumbar thecal sac with nerve roots leading to radiculopathy without neuro-deficit.

Exclusion criteria:
1) Patients with diagnosed neuro-deficit
2) Patients with congenital spine deformities or spinal tumours
3) Patients with spinal instability
4) Patients with localised back pain

Sample Size and Sampling
Sample size was estimated from the findings of Taskaynatan et al., whose study on the effectiveness of transforaminal epidural steroid injection in patients with radicular low back pain due to lumbar disc herniation reported a response rate of 72%. Considering this prevalence, at a 95% confidence interval and 15% allowable error, the sample size came out to be 35. The formula used was $n = [DEFF \times Np(1-p)] / [(d^2/Z^2_{1-\alpha/2} \times (N-1) + p \times (1-p)]$, computed with Epi Info version 3.0. The method of sampling was universal, and patients meeting the inclusion criteria within the study duration of 18 months were included until the sample size was satisfied.

Assessment
After obtaining consent and satisfying the inclusion and exclusion criteria, patients were enrolled. All cases were analysed with thorough history and physical examination using pre-validated questionnaires in a face-to-face interview. Detailed history regarding onset and progression of symptoms, and history of trauma, was taken. Detailed neurological examination was performed, following which X-ray of the lumbar spine and MRI of the lumbar spine with whole-spine screening were carried out.

The degree of spinal cord compression was classified into one of four groups: Level 0- no pressure on the thecal sac; Level 1- mild compression on the thecal sac; Level 2- thecal sac compression <1/3; and Level 3- thecal sac compression >1/3. Cases were then evaluated for pain using the Oswestry Disability Index, which was pilot tested after ensuring its validity.

The ODI questionnaire examines the perceived level of disability in 10 everyday activities of daily living. Each section contains six statements scored from 0 (minimum difficulty) to 5 (maximum difficulty);if more than one statement is marked in a section, the highest score is taken. Total score is summed to a maximum of 50 points, and the index is calculated as a percentage (Figure 1).

3. Procedure

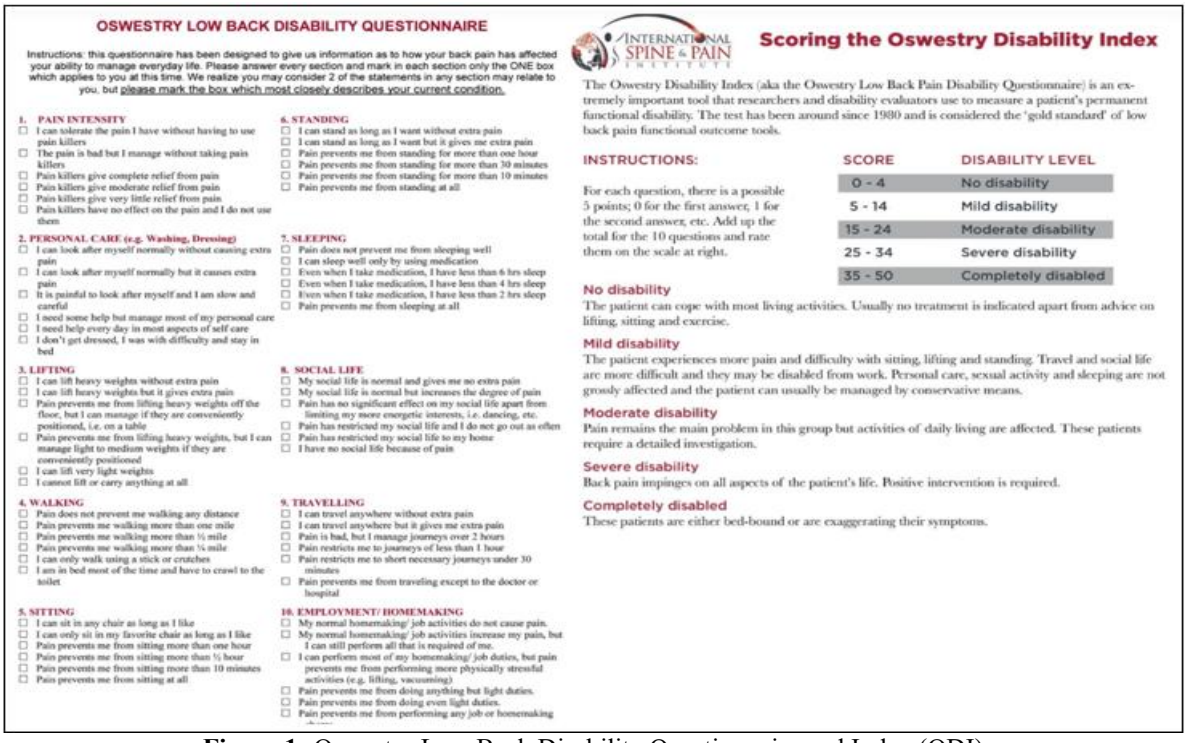
All patients underwent a single TFESI under fluoroscopic guidance, with 40 mg triamcinolone acetonide injected along with 1 mL of 1% lidocaine to the transforaminal site at each patient's level. All injections were performed by the same surgeon. The patient was placed in the prone position. Under fluoroscopic guidance, after anaesthesia, a 23-gauge, 3.5-inch spinal needle was gently advanced on the oblique view to Kambin's triangle, composed of the exiting nerve root, the upper border of the lower vertebral body, and the border of the pedicle. Both anteroposterior and lateral fluoroscopic projections confirmed proper needle placement. At each level, 0.5 mL of contrast medium (iohexol) was injected to confirm position, and no blood or cerebrospinal fluid was aspirated. The needle was then removed, a bandage was placed on the insertion site, and the patient was brought to recovery for observation. (Figure 2)

In theatre, after 6 hours of fasting for solid food, routine monitors (non-invasive blood pressure, electrocardiogram, pulse oximetry) were used. Peripheral intravascular cannulation was established and Ringer's lactate solution was started slowly. All patients received antibiotic ceftriaxone 1 g after a proper test dose, and resuscitation equipment was checked. The drugs used were bupivacaine 0.5%, Omnipaque dye (300 mg iodine/mL), triamcinolone acetate 40 mg/1 mL, and lignocaine 2% for skin infiltration.

Under C-arm fluoroscopy, the midpoint of the intervertebral space at the target level was identified, and the lower endplate of the target vertebral body was aligned by moving the C-arm in a cephalocaudal direction. In the AP view, vertebral endplates were aligned and the spinous process was kept midline by cephalad tilt of the image intensifier. By the sub-pedicular approach, the spinal nerve was approached after local infiltration of lignocaine. Using the end-on view of the needle, the 6 o'clock position of the pedicle was reached; an ipsilateral tilt of 30 degrees produced the "Scotty Dog" appearance, with the pedicle of the corresponding vertebra identified as the eye of the Scottish dog.

Radio-opaque dye was then injected. An S-shaped spread along the nerve root pathway was considered ideal, and the drug was given. A geographic pattern raised suspicion of vascular injection, and the procedure was abandoned. Dye settling as a linear shadow in the lateral view raised suspicion of intrathecal injection, and the needle was adjusted or the procedure abandoned. If the dye traversed a different path, the needle was withdrawn and the procedure repeated by the sub-pedicular approach; if the pattern persisted, accidental vascular injection was suspected and the procedure abandoned. After administration of the drug, the diluted dye was visible on the subsequent fluoroscopic image. The drug administered was preservative-free, as administration of local anaesthetic with preservative causes flocculation. The patient was observed for half an hour and shifted back to the ward. (Figure 3,4)

For L5 nerve TFESI, a 15-degree angle was used while inserting the needle, due to the 15-degree lordosis normally present. For S1 nerve TFESI, the approach differs: the needle is placed through the posterior S1 foramen onto the pedicle of S1, with the C-arm adjusted slightly cephalocaudal and slightly ipsilateral oblique to superimpose the anterior and posterior S1 foramina. The needle enters at the lateral margin of the posterior S1 foramen; the safe technique is to initially hit the bony surface of the sacrum and then walk off into the foramen. Depth is checked in the lateral position to ensure the needle does not pass anteriorly into the pelvic cavity. Once in position, radio-contrast dye is injected to confirm spread along the S1 nerve root sleeve, and the triamcinolone acetate mixture is injected under continuous fluoroscopy.



OSWESTRY LOW BACK DISABILITY QUESTIONNAIRE

Instructions: this questionnaire has been designed to give us information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only the ONE box which applies to you at this time. We realize you may consider 2 of the statements in any section may relate to you, but please mark the box which most closely describes your current condition.

1. PAIN INTENSITY
- I can tolerate the pain I have without having to use pain killers
- The pain is bad but I manage without taking pain killers
- Pain killers give complete relief from pain
- Pain killers give moderate relief from pain
- Pain killers give very little relief from pain
- Pain killers have no effect on the pain and I do not use them

2. PERSONAL CARE (e.g. Washing, Dressing)
- I can look after myself normally without causing extra pain
- I can look after myself normally but it causes extra pain
- It is painful to look after myself and I am slow and careful
- I need some help but manage most of my personal care
- I need help every day in most aspects of self care
- I don't get dressed, I wash with difficulty and stay in bed

3. LIFTING
- I can lift heavy weights without extra pain
- I can lift heavy weights but it gives extra pain
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, i.e. on a table
- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- I can lift very light weights
- I cannot lift or carry anything at all

4. WALKING
- Pain does not prevent me walking any distance
- Pain prevents me walking more than one mile
- Pain prevents me walking more than ½ mile
- Pain prevents me walking more than ¼ mile
- I can only walk using a stick or crutches
- I am in bed most of the time and have to crawl to the toilet

5. SITTING
- I can sit in any chair as long as I like
- I can only sit in my favorite chair as long as I like
- Pain prevents me from sitting more than one hour
- Pain prevents me from sitting more than ½ hour
- Pain prevents me from sitting more than 10 minutes
- Pain prevents me from sitting at all

6. STANDING
- I can stand as long as I want without extra pain
- I can stand as long as I want but it gives me extra pain
- Pain prevents me from standing for more than one hour
- Pain prevents me from standing for more than 30 minutes
- Pain prevents me from standing for more than 10 minutes
- Pain prevents me from standing at all

7. SLEEPING
- Pain does not prevent me from sleeping well
- I can sleep well only by using medication
- Even when I take medication, I have less than 6 hrs sleep
- Even when I take medication, I have less than 4 hrs sleep
- Even when I take medication, I have less than 2 hrs sleep
- Pain prevents me from sleeping at all

8. SOCIAL LIFE
- My social life is normal and gives me no extra pain
- My social life is normal but increases the degree of pain
- Pain has no significant effect on my social life apart from limiting my more energetic interests, i.e. dancing, etc.
- Pain has restricted my social life and I do not go out as often
- Pain has restricted my social life to my home
- I have no social life because of pain

9. TRAVELLING
- I can travel anywhere without extra pain
- I can travel anywhere but it gives me extra pain
- Pain is bad, but I manage journeys over 2 hours
- Pain restricts me to journeys of less than 1 hour
- Pain restricts me to short necessary journeys under 30 minutes
- Pain prevents me from traveling except to the doctor or hospital

10. EMPLOYMENT/ HOMEMAKING
- My normal homemaking/ job activities do not cause pain.
- My normal homemaking/ job activities increase my pain, but I can still perform all that is required of me.
- I can perform most of my homemaking/ job duties, but pain prevents me from performing more physically stressful activities (e.g. lifting, vacuuming)
- Pain prevents me from doing anything but light duties.
- Pain prevents me from doing even light duties.
- Pain prevents me from performing any job or homemaking

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Scoring the Oswestry Disability Index

The Oswestry Disability Index (aka the Oswestry Low Back Pain Disability Questionnaire) is an extremely important tool that researchers and disability evaluators use to measure a patient's permanent functional disability. The test has been around since 1980 and is considered the 'gold standard' of low back pain functional outcome tools.

INSTRUCTIONS:

For each question, there is a possible 5 points; 0 for the first answer, 1 for the second answer, etc. Add up the total for the 10 questions and rate them on the scale at right.

SCORE	DISABILITY LEVEL
0 - 4	No disability
5 - 14	Mild disability
15 - 24	Moderate disability
25 - 34	Severe disability
35 - 50	Completely disabled

No disability
The patient can cope with most living activities. Usually no treatment is indicated apart from advice on lifting, sitting and exercise.

Mild disability
The patient experiences more pain and difficulty with sitting, lifting and standing. Travel and social life are more difficult and they may be disabled from work. Personal care, sexual activity and sleeping are not grossly affected and the patient can usually be managed by conservative means.

Moderate disability
Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation.

Severe disability
Back pain impinges on all aspects of the patient's life. Positive intervention is required.

Completely disabled
These patients are either bed-bound or are exaggerating their symptoms.

Figure 1: Oswestry Low Back Disability Questionnaire and Index (ODI)

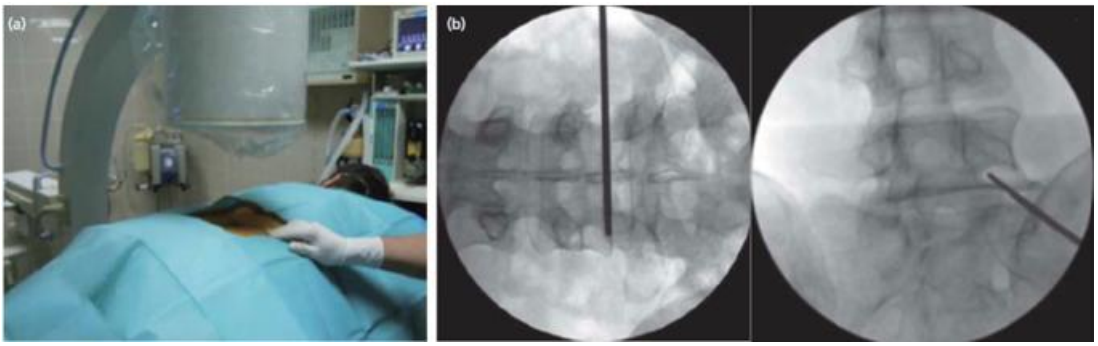


Figure 2: AP view position (a) and corresponding fluoroscopy images showing end plate alignment and entry making (b)

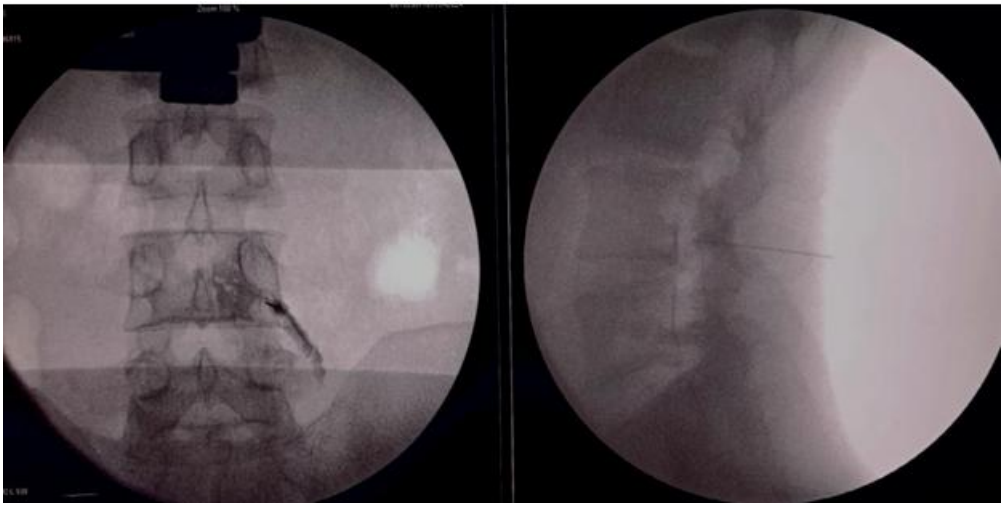
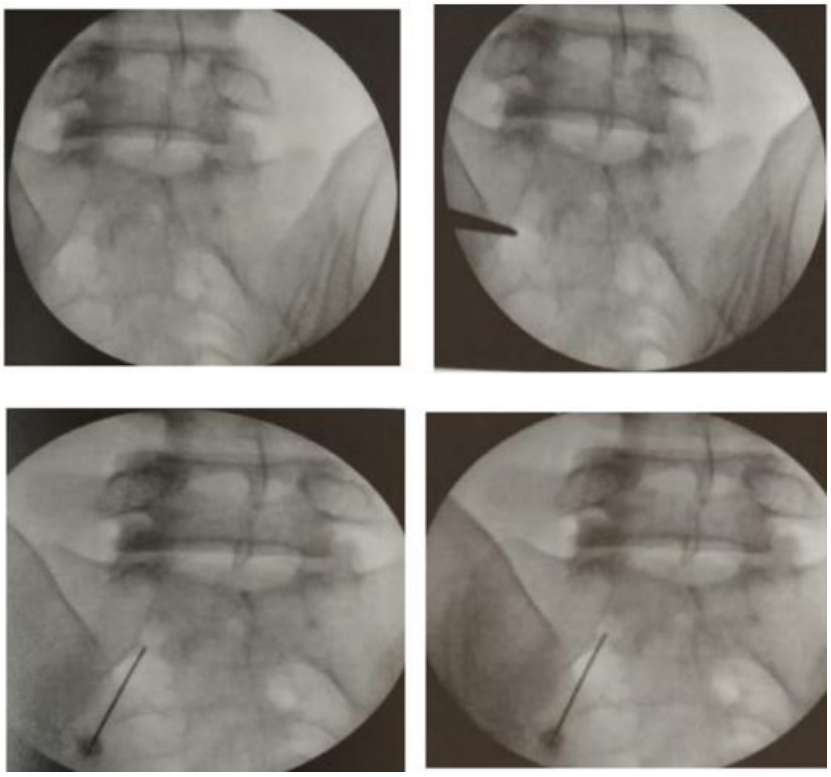


Figure 3: Lumbar TFESI fluoroscopy images



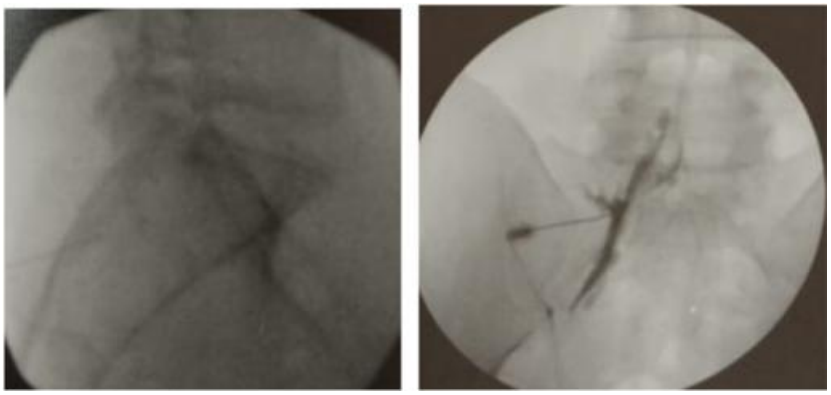


Figure 4: Procedure for S1 TFESI fluoroscopy images

Post-operative Protocol and Follow-up

Patients were advised strict bed rest for 2 weeks with limited mobilisation, lumbar strengthening exercises from the 15th day onwards, and avoidance of weight lifting and sports for 2 months. Some patients complained of post-operative increased pain attributed to the mass effect of the drug given at the foraminal level, which settled within 48 hours with analgesics. Follow-up ODI was recorded on post-operative day 1 month, 3 months, 6 months, and 1 year.

Statistical Analysis

Quantitative data were tested by mean and standard deviation, and differences between more than two means were tested by ANOVA. A p value < 0.05 was considered significant.

4. Results

In this longitudinal observational study, 35 cases of degeneration of the intervertebral disc leading to disc bulge/ protrusion/ extrusion were planned for inclusion. All 35 cases presented, were included, and could be analysed, giving a response rate of 100%.

Demographic and Baseline Characteristics

The majority- 17 (48.57%)- were from the age group of 31–45 years, followed by 10 (28.57%) aged >60 years, and 8 (22.86%) aged 46–60 years. The mean age was 44.97 ± 10.10 years (range 33–65 years).

Table 1: Distribution of cases according to age group (n = 35)

Age group	Cases	
(years)	No.	Percentage (%)
31-45	17	48.57
46-60	8	22.86
>60	10	28.57
Total	35	100
Mean ± S.D.	44.97+_10.10 years.	
Range	33-65 Years	

In the present study, majority 17 (48.57%) of the cases were from the age group of 31-45 years followed by 10 (28.57%) from the age group of >60 years and least i.e. 08 (22.86%) from the age group of 46-60 years. Mean age of the patients was 44.97 + 10.10 years.

Regarding gender, 29 (82.86%) were male and only 6 (17.14%) were female. With respect to laterality, the right side was affected in 21 (60%) cases and the left in 14 (40%).

Table 2: Distribution of patients according to laterality (n = 35)

Laterality	Frequency	Percent
Left	14	40
Right	21	60
Total	35	100

In the present study, most i.e. 21 (60%) of the cases affected side was right side of the body while in 14 (40%) was left side.

Table 3: Distribution according to MRI finding (n = 35)

MRI finding	Frequency	Percent
Protrusion of the disc	20	57.14
Extrusion of the disc	15	42.86
Total	35	100

In the present study, among majority i.e. 20 (57.14%) of the cases MRI finding was protrusion of the disc while in 15 (42.86%) there was extrusion of the disc.

Table 4: Distribution of patients according to diagnosis

Diagnosis	Frequency	Percent
L3L4 IVDP	3	8.57
L4L5 IVDP	20	57.14
L5S1 IVDP	12	34.29
Total	35	100

In the present study, majority i.e. 20 (57.14%) of the cases had intervertebral disc protrusion at L4L5 level followed by 12 (34.29%) cases at L5-S1 level, 03 (8.57%) at L3-L4 level.

Table 5: Level of transforaminal block (n = 35)

Level of transforaminal block	Frequency	Percent
L4	3	8.57
L5	12	34.29
L5S1	9	25.71
S1	11	31.43
Total	35	100

In the present study, among most i.e. 12 (34.29%) of the cases transforaminal block was given at L5 vertebral level followed by 11 (31.43%) at S1 level, 09 (25.71%) cases each at L5S1 level and least i.e. 03 (8.57%) at L4 level.

Table 6: Distribution of Patients According to Oswestry Disability Index (ODI) Functional Outcome Score

ODI (%)	Pre-operative		Immediate post-op		3 months post-op		6 months post-op		12 months post-op	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
0–10	0	0	15	42.86	18	54.54	18	58.06	23	79.31
11–20	0	0	16	45.71	11	33.33	11	35.48	6	20.69
21–30	0	0	1	2.86	2	6.06	1	3.23	0	0
31–40	18	51.43	3	8.57	2	6.06	1	3.23	0	0
41–50	17	48.57	0	0	0	0	0	0	0	0
Total	35	100	35	100	33*	100	31*	100	29*	100

Table 7: Comparison of mean pre-operative Oswestry Disability Index (ODI) score with post-operative ODI functional outcome score

Pre-op ODI (Mean± SD) (n=35)	Immediate post-op ODI (Mean ± SD) (n=35)	3 months post-op ODI (Mean ± SD) (n=35)	6 months post-op ODI (Mean ± SD) (n=31)	12 months post-op ODI (Mean ± SD) (n=29)
40.6 ± 2.8	14.4 ± 7.6	13.6 ± 7.2	11.9 ± 6.1	10.1 ± 0.8
P<0.0001				
Mean change from baseline	-21.4	-22.6	-25.4	-32.5
P=0.0001				

In the present study, mean Oswestry Disability Index (ODI) score assessing functional outcome has shown significant declining trend post operatively at day 0, 3 months, 6 months and 12 months (p<0.0001). Mean change of Oswestry Disability Index (ODI) score from baseline also has shown significantly more declined post operatively at day 0, 3 months, 6 months and 12 months (p=0.0001).

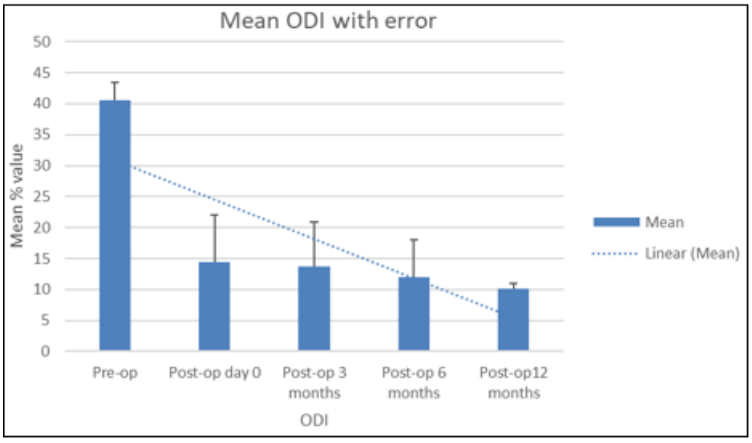


Chart 1: Comparison of mean ODI scores amongst cases **(P<0.0001)**

From this chart it seems that, mean Oswestry Disability Index (ODI) score significantly declined post operatively at day 0, 3 months, 6 months and 12 months (p<0.0001).

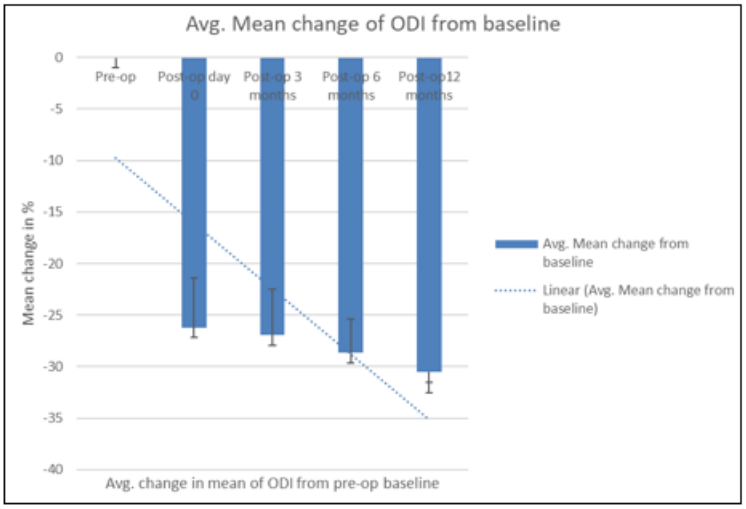


Chart 2: Comparison of mean change in ODI scores amongst cases from baseline pre-op scores **(P<0.0001)**

From this chart it seems that, mean change of Oswestry Disability Index (ODI) score from baseline (pre-op ODI) also has shown significantly more declining trend post operatively at day 0, 3 months, 6 months and 12 months (p=0.0001).

5. Complications

Reported complications included nausea, headache, dizziness, fainting due to anxiety from the procedure causing a sudden decrease in heart rate and blood pressure (vasovagal attack), flushing of the face, and dye reactions due to intravenous spread of dye. While very rare, long-term complications of lumbar epidural steroid injection include permanent neurologic deficit and chronic pain due to spinal cord or nerve root damage from the injection.

6. Discussion

This prospective observational study was carried out on 35 cases of degeneration of the intervertebral disc leading to disc bulge/protrusion/extrusion, to assess the effect of TFESI on pain relief and functional outcomes in lumbar disc herniation using the ODI.

The majority- 17 (48.57%)- were aged 31–45 years, followed by 10 (28.57%) aged >60 years and 8 (22.86%) aged 46–60 years, with a mean age of 44.97 ± 10.1 years and a male predominance (82.86%). These findings are consistent with Chae JS et al. (5), who observed a male majority; Sithapan Munjupong et al. (6), who noted a similar mean age and male majority; and Mohd Javed Bhatti et al. (7), who noted a consistent mean age of 50 years and male majority. Right lower limb radiculopathy was present in 21 (60%) cases and left-sided radiculopathy in 14 (40%).

On MRI, 20 (57.14%) cases had disc protrusion and 15 (42.86%) had extrusion; 20 (57.14%) had protrusion at the L4–L5 level, followed by 34.29% at L5–S1 and 8.57% at L3–L4. Accordingly, transforaminal block was given at the L5 vertebral level in 12 (34.29%) cases, at S1 in 11 (31.43%), at L5–S1 in 9 (25.71%), and at L4 in 3 (8.57%). Most common site of involvement was L4–L5.

Using the ODI for functional outcome assessment, the pre-operative scores were 31–40% in 51.43% of cases and 41–50% in 48.57%- consistent with Ismail Yuce et al. (8). After transforaminal block, considerable improvement was observed: immediate post-operatively, 45.71% of cases scored 11–20% and 42.86% scored 0–10%, with none scoring 41–50% as seen pre-operatively. At 3 months there was further improvement, with 54.54% scoring 0–10% and 33.33% scoring 11–20%; at 6 months, 58.06% scored 0–10% and 35.48% scored 11–20%; and at 12 months, 79.31% scored 0–10% and 20.69% scored 11–20%.

By the end of 12 months, adequate pain relief was achieved in 82.86% of cases, while 17.14% required discectomy. These results compare favourably with the wider literature: Emiliano Neves Vialle et al.(9) reported a favourable outcome in 65.09% of cases after transforaminal block and concluded a positive effect from foraminal block in the treatment of sciatic pain triggered by lumbar disc herniation; 4 of 19 patients (21.05%) were treated by microdiscectomy for recurrent lumbar disc herniation, with pain relief successfully achieved in 15 (78.95%) patients; and Vipul L. Kuvad et al.(10) observed a favourable outcome in 88% of cases after transforaminal block, with 12% requiring surgery.

The mean ODI score showed a significant declining trend and consistent improvement in functional outcome post-operatively at day 0, 3 months, 6 months, and 12 months ($p < 0.0001$), and the mean change from baseline showed a significantly greater decline at the same intervals ($p = 0.0001$). Kennedy et al. (11) reported that transforaminal epidural corticosteroid injections are an effective treatment for acute radicular pain due to disc herniation and frequently require 1 or 2 injections for symptomatic relief. Transforaminal epidural steroid is a safe, simple, least morbid, and cost-effective approach for patients with lumbar disc herniation with radiculopathy. Laxmaiah Manchikanti et al., in a systematic review and meta-analysis, found that fluoroscopic caudal, lumbar interlaminar, and transforaminal epidural injections are efficacious at managing lumbar disc herniation in terms of pain relief and functional improvement. A mean ODI score of 29 at 6 months follow-up- a mean reduction of 13.7 points in ODI score compared with 42.7 at baseline ($P = 0.001$). It should be noted that the literature is not uniformly supportive. Shamliyan TA et al. (12) concluded that off-label epidural steroid injections provide small short-term but not long-term leg-pain relief and improvement in function, and that injection of steroids is no more effective than injection of local anaesthetics alone. The Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology, in a 2007 report, concluded that epidural steroid injections may result in some improvement in radicular lumbosacral pain when assessed between 2 and 6 weeks following injection compared with control treatments (Level C, Class I–III evidence); that the average magnitude of effect is small and generalizability limited; that in general they do not impact average impairment of function, need for surgery, or provide long-term pain relief beyond 3 months, so their routine use is not recommended (Level B, Class I–III evidence); and that there is insufficient evidence to make any recommendation for radicular cervical pain.

Mondal P et al. (13) concluded that TFESI is an effective adjunct to the usual conservative treatment protocol, improving not only Numerical Rating Scale pain intensity measurements and Modified Oswestry Disability Index scores significantly, but also walking pattern by changing pelvic angulations significantly.

7. Conclusion

In this prospective observational study on 35 cases of degeneration of the intervertebral disc leading to disc bulge/protrusion/extrusion:

The majority- 17 (48.57%)- were aged 31–45 years, with a mean age of 44.97 ± 10.1 years; the most common gender was male (82.86%).

Right-sided involvement was present in 21 (60%) and left-sided in 14 (40%). On MRI, 20 (57.14%) had protrusion and

15 (42.86%) had extrusion, with the majority (57.14%) at the L4–L5 level, followed by 34.29% at L5–S1 and 8.57% at L3–L4.

ODI functional outcome scores were high pre-operatively (18 [51.43%] cases at 31–40% and 17 [48.57%] at 41–50%), and improved considerably after transforaminal block, with most cases reaching an ODI of 0–10% or 11–20% and none in the 41–50% range as seen pre-operatively.

The mean ODI showed a significant declining trend and consistent improvement post-operatively at day 0, 3 months, 6 months, and 12 months ($p < 0.0001$), and the mean change from baseline also showed a significantly greater decline at the same intervals ($p = 0.0001$).

At the end of 12 months, transforaminal block achieved successful pain relief in 82.86% of cases, and only 17.14% in whom pain relief was not achieved required discectomy- a success rate of approximately 83%.

TFESI is therefore an effective procedure and an alternative to surgery for pain relief and functional improvement if a patient does not get relief with conservative treatment. It has much less morbidity compared with surgical procedures and is economical; even after surgery, pain can persist in up to 30% of cases.

Recommendations: Based on our study findings, we recommend transforaminal epidural steroid injection for effective pain relief and better functional outcome among patients with intervertebral disc prolapse/bulge/protrusion.

Limitations: This study was not a randomised controlled trial, and we did not include patients who were treated satisfactorily with medications alone.

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