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Transforaminal Epidural Steroid Injection Technique: Fluoroscopy-Guided Minimally Invasive Injection for Lower Limb Radiculopathy—Twelve Golden Steps

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Abstract

Radicular back pain is defined as low back pain radiating into the lower extremities in a dermatomal pattern caused by compression or irritation of the nerve root. Fluoroscopy is an excellent tool for the management of lower limb radiculopathies that are secondary to discogenic pathologies not responding to the conservative trial. Transforaminal epidural steroid injection technique is a minimally invasive intervention for radiculopathies, which can easily be done in a day care setting, and it should be considered before surgery; however, precision and expertise is required.

Keywords

- fluoroscopy intervention
- lower limb radiculopathy
- transforaminal epidural steroid injection

Introduction

Radicular back pain is defined as low back pain that radiates into the lower extremities in a dermatomal pattern caused by compression or irritation of the nerve root.[1] Initial treatment options for radicular back pain include exercise, physical therapy, psychological programs, and oral medications. Interventional treatment options such as fluoroscopy-guided transforaminal, interlaminar, or caudal epidural steroid injections should be considered for patients who do not respond efficiently to conservative approaches for a reasonable period of time.[2,3] Indication for TFESI is disc herniations with compression of nerve roots, either at the level of the lateral recess, within the neuroforamen, or outside of the foramen (extraforaminal). By far, the two most commonly affected lumbar levels by disc herniation (> 95%) are L4–L5 as well as L5–S1.[4]

According to Manchikanti et al, 77% patients in the caudal group, 72% patients in the interlaminar group, and 80% of patients in the transforaminal group showed significant improvement at the end of 1 year.[5]

Fluoroscopy provides real-time anteroposterior (AP) and lateral views, real-time dye spread, and is less time-consuming. Prior to intervention, all patients should be clinically evaluated for the presenting complaints, physical/neurological examination, and review of available up-to-date imaging of the spine in the region of interest (X-rays and MRI) to exclude other causes of back pain, such as fracture, infection, or malignancy.[6]

Absolute contraindications are systemic or local infection, bleeding diathesis, allergy to contrast, anesthetic agent, or corticosteroid, and local malignancy. Relative contraindications are uncontrolled diabetes mellitus, congestive heart failure, and pregnancy due to fluoroscopy.

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Fig. 1 Patient is lying in the prone position.

Fig. 2 Adequate position with a pillow placed under the abdomen to compensate for lumbar lordosis.

TFESI as the initial invasive treatment is similarly effective to surgical microdiscectomy at reducing pain and disability from sciatica without neurological deficit, with symptom duration between 6 weeks and 12 months.[7]

Neurostimulation (peripheral nerve stimulation or spinal cord stimulation) is an emerging treatment option for radiculopathy not responding to conservative measures, nonsurgical interventions, and surgery. Neurostimulation induces electric pulses, which modulate the perception of pain in the affected region, and hence reduce pain and improves quality of life.[8,9]

Technique

TFESI is a target-specific injection given adjacent to the nerve root in the ventral epidural space where disc pathology is more commonly located.

Preprocedural Steps

1. *Patient position*: Patient should be in the prone position with adequately exposed lower back(►**Fig. 1**).
2. *Pillow under abdomen*: A pillow is placed under the abdomen to compensate for lumbar lordosis and better visualization of neural foramina (►**Fig. 2**).
3. *Side identification*: Patient's symptomatic side is identified with a metallic marker, which should be on the interventionist's right side (►**Fig. 3**).
4. *Level identification*: Fluoroscopy-guided cranial to caudal counting of L1 to L5 vertebrae is required to rule out transitional vertebrae so that the correct level of disc pathology is identified.
5. *Aseptic precautions*: Routine preprocedural cleaning and draping steps are followed.

Procedural Steps

6. *True AP image* (standardization): Endplates should be parallel to each other. Cranial and caudal tilt is required to achieve parallel end plates (►**Fig. 4A, B**).
7. *True central image*: Spinous process should be equidistant from bilateral pedicles (►**Fig. 5A, B**).
8. *Ipsilateral oblique image (Scottie dog image)—Interventional image*: Ipsilateral 15- to 20-degree tilt of fluoroscope gives Scottie dog appearance of vertebrae, that is, an

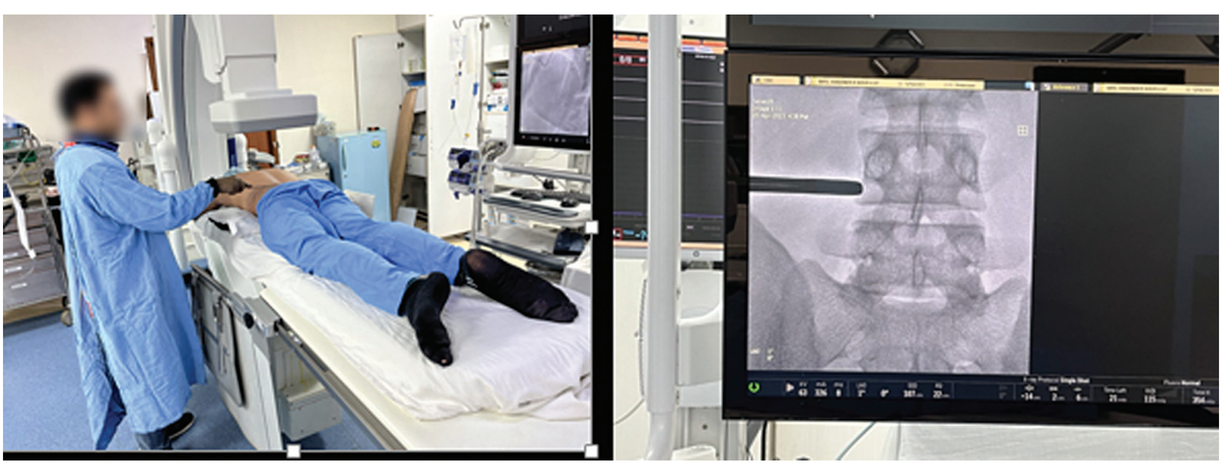

Fig. 3 Interventionist using a metallic marker to identify the affected side.

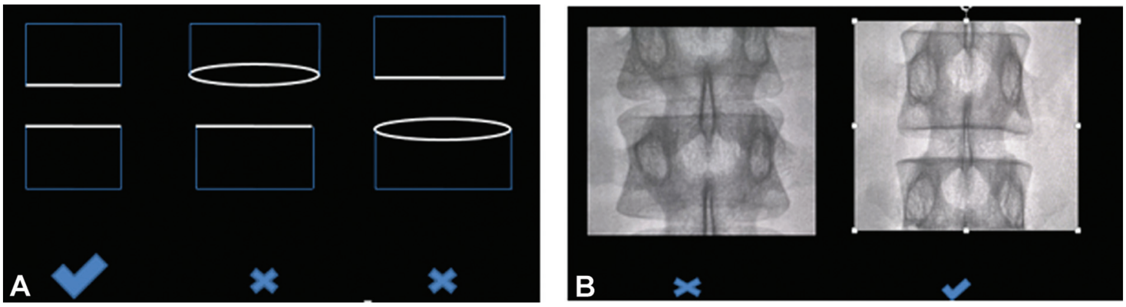

Fig. 4 (**A** and **B**) Schematic and fluoroscopy images show true parallel end plates.

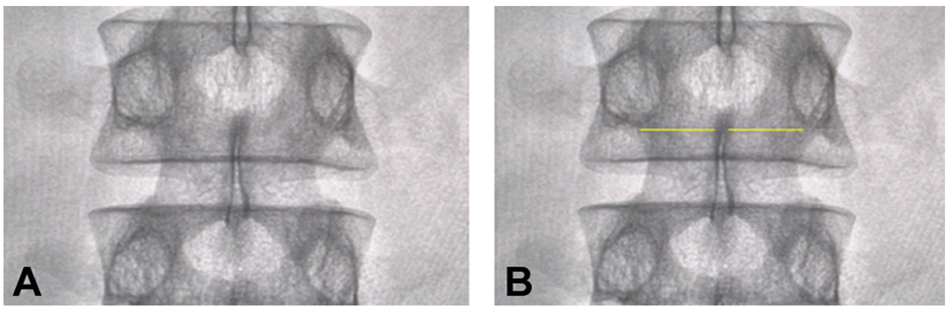

Fig. 5 (**A** and **B**) Fluoroscopy images show the true central image: Spinous process is equidistant from bilateral pedicles as shown by the yellow line in the second image.

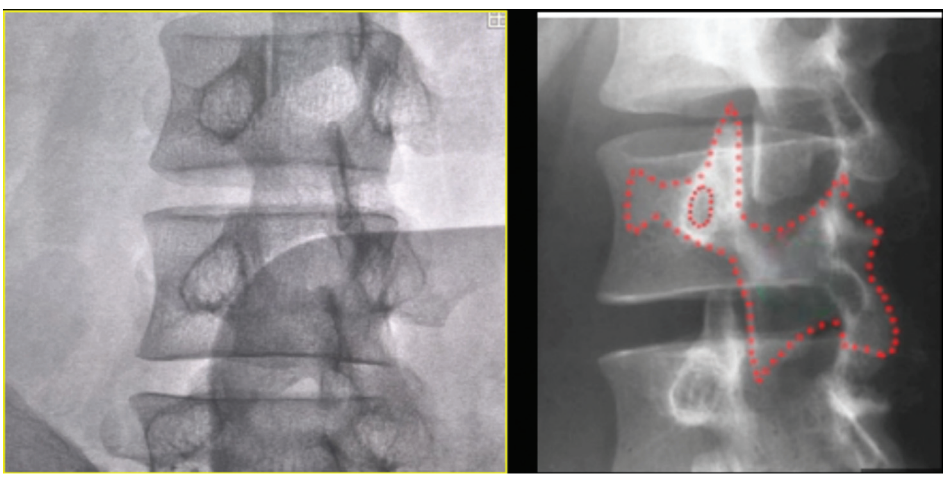

Fig. 6 Ipsilateral oblique image depicts Scottie dog appearance at the lower lumbar spine.

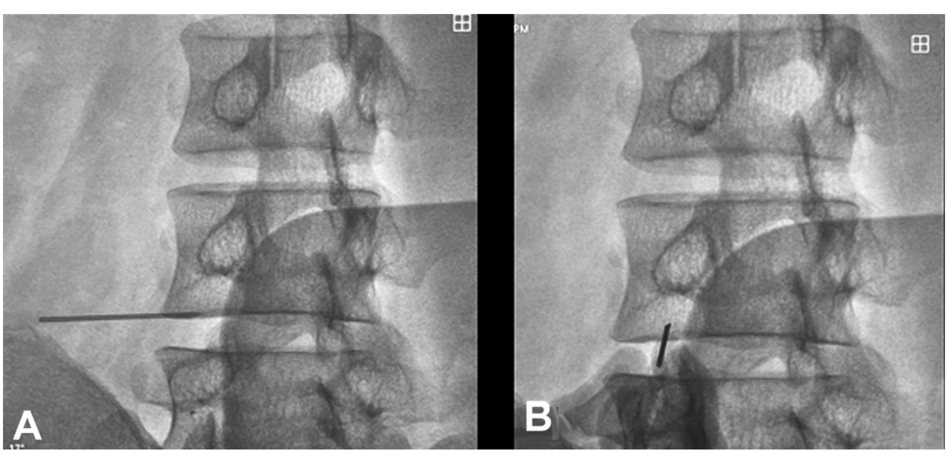

Fig. 7 (**A** and **B**) Oblique image depicts entry point at lower end plate and needle direction from lateral to medial toward the inferomedial aspect of the pedicle.

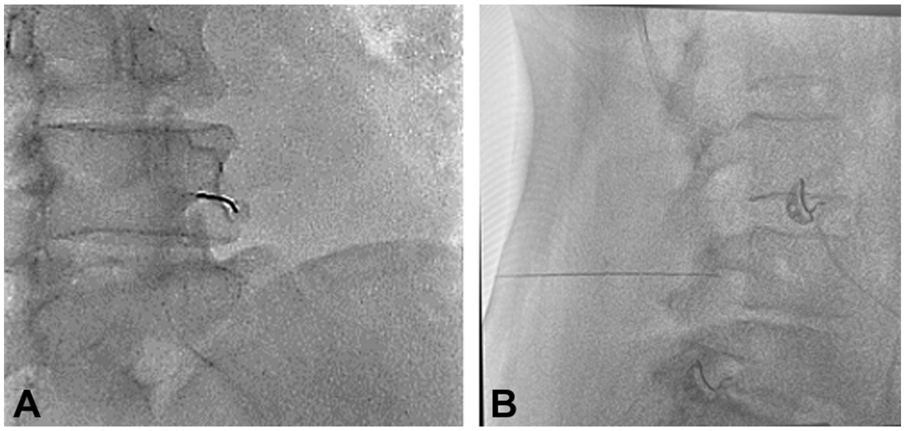

Fig. 8 (**A** and **B**) Anteroposterior view shows the final needle tip position at the inferomedial aspect of the pedicle at 5–6 o'clock position, and the lateral view confirms the needle tip at the subpedicular position.

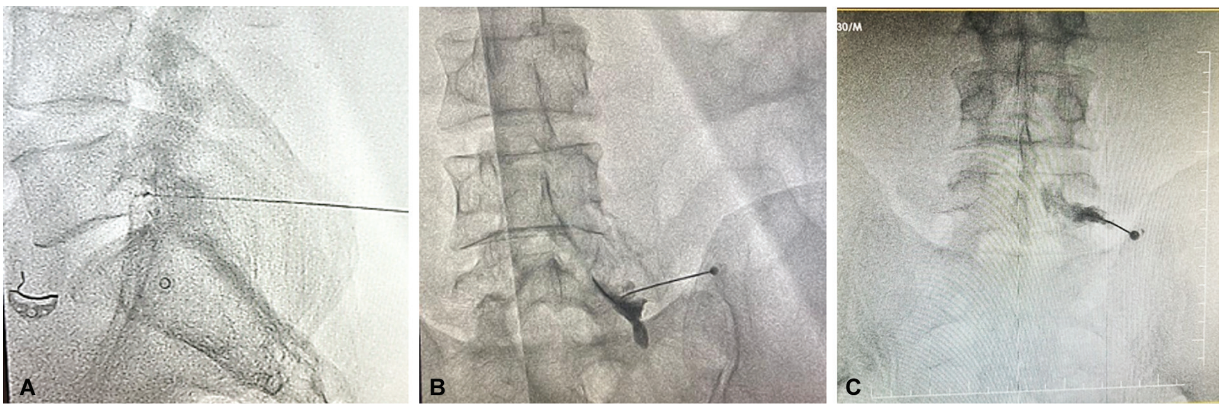

Fig. 9 (**A–C**) Lateral, oblique, and anteroposterior views depict dye spread along the exiting nerve root and along the medial border of the pedicle.

interventional image for transforaminal epidural injection (►**Fig. 6**).

9. *Identification of entry point and direction*:

   Target point is the inferomedial aspect of the pedicle; hence, the entry point should be caudal to the target point at the lower end plate of the vertebra. Intervention is done from the lateral to the medial direction (►**Fig. 7A, B**). A spinal needle of 22G, 10 cm length is used. Needle sizes that can be used are 20, 22, 23, and 25G; 22G is preferred.
10. *Final position*: On AP view, the needle tip should be at 5 to 6 o'clock position of the pedicle margin, and on lateral view, the needle tip should be at the subpedicular position (►**Fig. 8A, B**).
11. *Confirmation*: Once the needle is secured, the final position is confirmed with the help of dye instillation. Dye should be spread along the exiting nerve (►**Fig. 9A–C**).
12. *Drug injection*: After the confirmation of dye spread, a 2-mL cocktail of steroid and long-acting local anesthetic (triamcinolone 40 mg [1 mL]) + 0.25% bupivacaine [1 mL]) is given.

    Injectable corticosteroids commonly used for lumbar epidural steroid injections include particulates such as methylprednisolone, betamethasone, and triamcinolone and nonparticulate such as dexamethasone phosphate. Particulate steroids have a longer duration of action due to a local depot effect, resulting in continuous release of the active drug from the injection site, whereas nonparticulate steroids are water-soluble steroids with a small particle size, resulting in rapid clearance from the spinal canal and a short duration of action.[10]

Complications

TFESI is safe and well tolerated. Minor complications, including facial flushing and vasovagal reactions, may be encountered, which rapidly resolve with minimal supportive care. Serious complications are rare and include dural puncture, spinal anesthesia, and spinal cord infarction.

Discharge and Follow-up

Patient is monitored for vitals and dizziness for 2 hours and then discharged. Patient is advised to rest for 2 weeks and follow up at 3 weeks and 3 months postprocedure.

Conclusion

Fluoroscopy-guided transforaminal epidural steroid injection is an effective nonsurgical treatment option for patients with lumbar herniated nucleus pulposus and radiculopathy in whom conservative treatments are not effective, and it should be considered before surgical intervention.

Conflict of Interest
None declared.

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