# A Prospective Evaluation of Iodinated Contrast Flow Patterns with Fluoroscopically Guided Lumbar Epidural Steroid Injections: The Lateral Parasagittal Interlaminar Epidural Approach Versus the Transforaminal Epidural Approach

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**BACKGROUND:** Lumbar midline interlaminar and transforaminal (TF) epidural steroid injections are treatments for low back pain with radiculopathy secondary to degenerative disk disease. Since pain generators are located anteriorly in the epidural space, ventral epidural spread is the logical target for placement of antiinflammatory medications. In this randomized, prospective, observational study, we compared contrast flow patterns in the epidural space using the parasagittal interlaminar (PIL) and transforaminal approaches with continual fluoroscopic guidance.

**METHODS:** Sixty adult patients with low back pain and unilateral radiculopathy from herniated or degenerated discs were enrolled. Subjects were randomly assigned to one of two groups: TF or PIL (30 in each). All procedures were performed using continual fluoroscopic guidance and 5 mL of contrast. Contrast spread was rated (primary outcome measure) by the interventionalist. Spread was scored 0–2, with 0 = no anterior spread; 1 = anterior spread, same level as needle insertion; and 2 = anterior spread at ≥1 segmental level. The secondary outcome measure was analgesia at 2 wk, 1, 3, and 6 mo.

**RESULTS:** One hundred percent (29 of 29) patients in the PIL group and 75% (21 of 28) patients in the TF group demonstrated anterior epidural spread. The mean spread grade was 1.93 (95% confidence interval [CI], 1.83–2.0) in the PIL group and 1.46 (95% CI, 1.17–1.46) in the TF group ($P = 0.003$). Mean fluoroscopy time was 28.96 s (95% CI, 23.9–34.1 s) in the PIL group and 46.25 s (95% CI, 36.27–56.23 s) in the TF group ($P = 0.003$). Visual analog scale scores were equivalent between groups.

**CONCLUSIONS:** The PIL approach is superior to the TF approach for placing contrast into the anterior epidural space with reduction in fluoroscopy times and an improved spread grade. With increasing attention to neurological injury associated with TF, the PIL approach may be more suitable for routine use.

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Midline interlaminar and transforaminal (TF) lumbar epidural steroid injections (LESI) are two accepted treatments in the conservative care of low back pain with radiculopathy secondary to lumbar disk disease. It is thought that the inflammatory response may be localized at the nerve root/intervertebral disk interface, which is in proximity to the anterior epidural space.[1] Previous studies have demonstrated that with the midline interlaminar epidural injections, the injectate spreads into the anterior epidural space only 36% of the time.[1] As a result, practitioners are increasingly performing TF ESI instead of standard midline interlaminar ESI. The TF approach is a proven technique and has shown analgesic effectiveness in multiple studies.[2–6] Although effective, TF injections sometimes lead to complications including spinal cord injury and permanent paralysis.[7] In an effort to provide a suitable and reliable alternative to the TF approach, we studied the parasagittal interlaminar (PIL) epidural approach. With this interlaminar approach, the injection is performed at the lateralmost part of the interlaminar space instead of the usual midline interlaminar approach. No study has compared the two

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techniques (PIL and TF) in terms of the contrast flow patterns and utility for driving medication into the anterior epidural space. In this randomized, single-blind, prospective study, we investigated the spread of contrast media in the anterior epidural space using fluoroscopic guidance. We also studied the analgesic benefit of choosing the PIL or the TF technique.

## METHODS

After IRB approval and informed written consent, 60 adult patients with a history of low back pain and unilateral lumbosacral radiculopathy were enrolled. Correlations of history and physical examination findings with diagnostic imaging (i.e., magnetic resonance imaging, computed tomography scan) were noted. Lumbar disk disease included disk herniations, bulging discs, and degenerated discs, where at least 50% of the disk height was preserved respective to contiguous levels. Patients with histories of previous spinal surgery, LESI(s) in the past year, allergy to drugs used, concurrent use of systemic steroid medications, opioid habituation, and pregnancy were excluded. Patients were randomly assigned to one of two groups using a computer-generated randomization table; group TF and group PIL. The intervertebral level and right versus left sides were determined according to the clinical examination and the results of diagnostic imaging studies. All patients were positioned prone, and standard ASA monitors were applied. The corresponding authors who were supervising Pain Management Fellows performed all injections. Fluoroscopic bi-planar imaging was used, with nonionic contrast (total volume = 5.0 mL) in anterior-posterior (AP) and lateral views. Fluoroscopy time was measured consecutively for all scout films, at each needle adjustment according to the protocol, and for the contrast injection phase. Fluoroscopy use was real-time and continuous (i.e., without interruption) during the contrast injection phase, with all personnel, except for the person performing the actual injection, standing more than 6 ft from the radiation source. For the PIL approach, a 20-gauge 3.5 in. Tuohy-type epidural needle was introduced at the level of demonstrated disk pathology by imaging, at the point corresponding to the lateralmost part of the interlaminar opening at its midlevel as indicated by the direct AP projection on fluoroscopy (no oblique or cephalo-caudad tilt used) (Figs. 1a and b). The needle was advanced directly perpendicular to the skin in a posterior to anterior direction, with the use of the loss-of-resistance to air technique in order to identify the epidural space. The parasagittal orientation of the needle was maintained throughout the procedure. Once the loss-of-resistance was obtained, contrast media, 5 mL (Iohexol-180, Amersham Health, Oslo, Norway) was injected using real-time, continuous fluoroscopy for the entire volume of 5 mL of injectate, and images were obtained in the lateral and AP projections (Figs. 2 and 3). The use

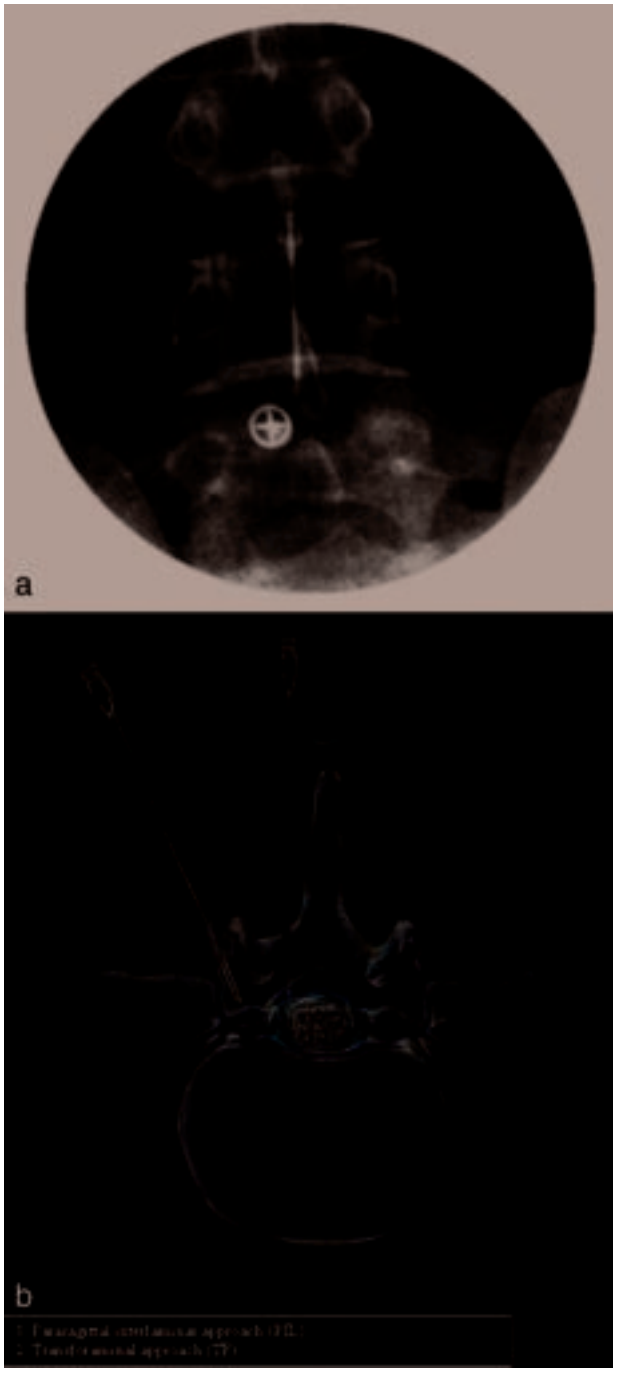


**Figure 1.** (a) Initial needle entry point for parasagittal interlaminar approach at L4–5 from the left. The midline is defined by the spinous processes where there is a straight needle between the L3 and L4 processes. The tunnel or gun-barrel view is used to follow the trajectory of the needle from posterior to anterior, directly perpendicular to the procedure table. (b) Comparison of the needle entry points for parasagittal interlaminar approach (PIL) versus the transforaminal approach (TF).

of the real-time and continuous imaging was to verify that no contrast attained intravascular, subarachnoid, subdural, or intradiscal spread. Next, the antiinflammatory corticosteroid, methylprednisolone acetate, 80 mg, along with 1 mL of normal saline and 1 mL of lidocaine 1%, was injected into the epidural space (total volume; 4 mL). The saline was added to dilute

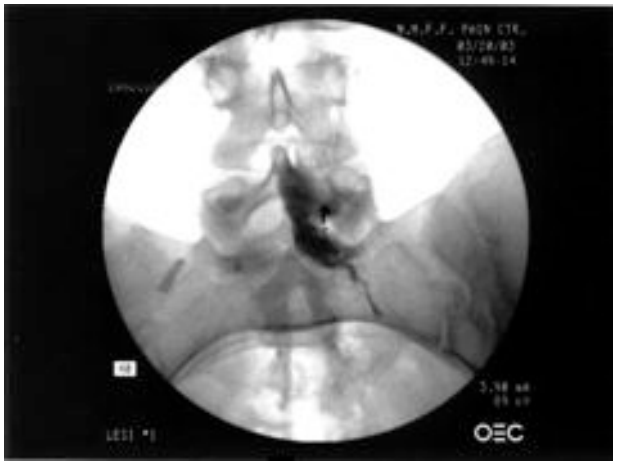

**Figure 2.** Right parasagittal interlaminar approach; contrast spread L5–S1. Note that the column of dye remains sequestered to the right of the midline as defined by the spinous processes, and also captures more than one nerve root on the right side (see Fig. 1 above).

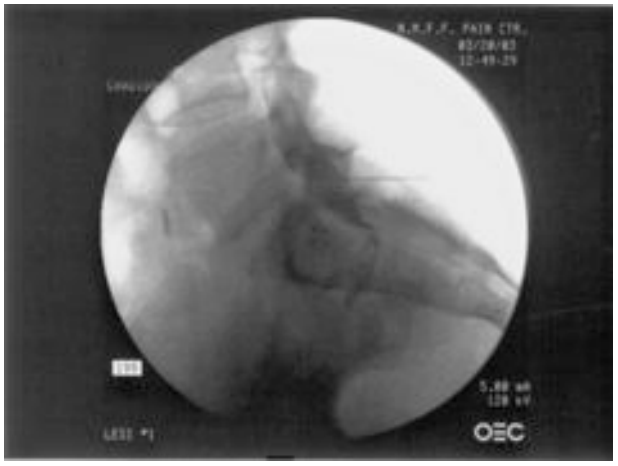

**Figure 3.** Parasagittal interlaminar approach at L5–S1, lateral projection (same patient as in Fig. 2). Note that the dye spreads both to the ventral epidural space, reaching the posterior longitudinal ligament and posterior vertebral body limit, and that it spreads for multiple segments both ventrally and dorsally. A posterior disk bulge at L5–S1 indents the column of dye, giving it a scalloped appearance.

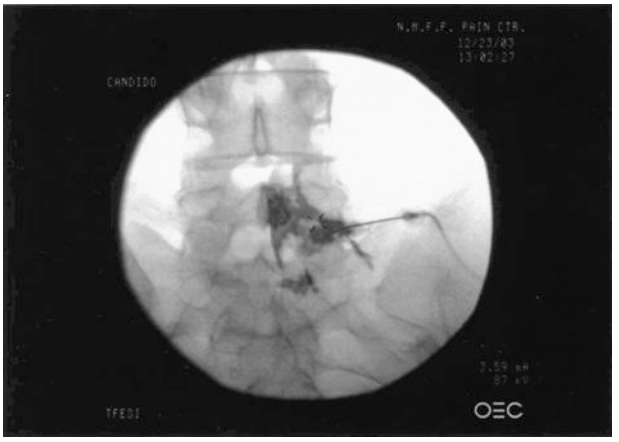

**Figure 4.** Transforaminal approach at L5–S1, right sided, anterior-posterior projection. Notice the spread of the contrast along the right L5 nerve root, and medially into the epidural space. (Same patient as in Figs. 2 and 3 above; different pain clinic visit).

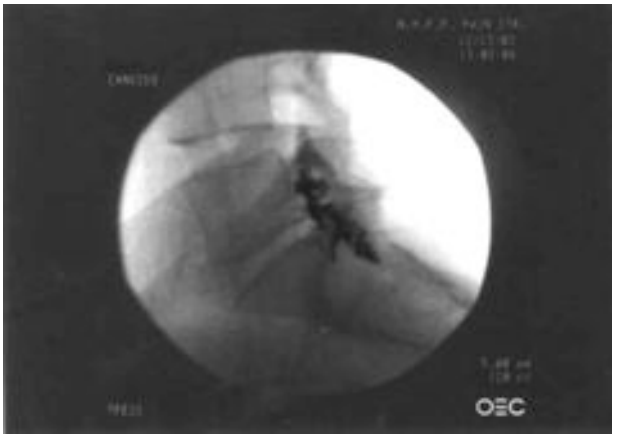

**Figure 5.** Transforaminal approach at L5–S1 from the right side, lateral projection. Note the spread of contrast ventrally and dorsally in the epidural space extending for more than one segment. (Same patient as in Figs. 2 and 3 above; different pain clinic visit).

polyethylene glycol 4000 (28.6 mg/mL), the vehicle added during manufacture of methylprednisolone that has been implicated to be associated with arachnoiditis. For the TF approach, a 22-gauge 3.5 in. Whitacre pencil point needle with the tip slightly curved was introduced at the appropriately documented level of disk pathology using first an AP and, subsequently, an oblique orientation of the fluoroscopy C-arm.

Once the superior pars interarticularis was identified, the C-arm was oriented obliquely 15 degrees in the caudocephalad direction. The needle was advanced towards the tip of the pars until that structure was contacted, and the needle tip was then advanced in a slightly cephalad direction. The needle was advanced until the needle tip was at the posterior and superior aspect of the intervertebral neural foramen as seen in the lateral projection, and in line with the pedicle on AP view. After incremental injection of the contrast media (Figs. 4 and 5), the same volume and dose of corticosteroid as above for the PIL technique was injected with continual intermittent aspiration. On the lateral projection, the patterns of contrast spread were documented as "anterior" or "posterior" and the degree of spread was quantified using a grading scale from 0 to 2. Zero was equal to "no anterior epidural spread"; 1 was equal to "anterior epidural spread at the same level of needle entry"; 2 was equal to "anterior epidural spread at more than one segmental level from the needle entry point. " Anterior spread was considered present if the dye traveled to the level of the posterior longitudinal ligament or abutted the posterior aspect of the contiguous vertebral body(s) at the level of the needle insertion. An independent blinded radiologist (D.T.), not affiliated with the primary study institution, reviewed the scoring done contemporaneously with the

**Table 1.** Demographic Data

| | TF | PIL |
|---|---|---|
| Age (yr) | 51.96 (95% CI, 47.05–56.88) | 52.31 (95% CI, 46.29–58.32) |
| Height (cm) | 169.80 (95% CI, 165.52–174.09) | 169.37 (95% CI, 165.56–173.19) |
| Weight (kg) | 85.21 (95% CI, 78.86–91.57) | 81.63 (95% CI, 74.76–88.52) |

TF = Transforaminal approach; PIL = Parasagittal Interlaminar approach.

procedures by the interventionalists, viewing only the lateral projection fluoroscopic images from each patient. The percentage of patients demonstrating anterior epidural spread was reported in each group. Also, the total fluoroscopy time and pain relief using verbal analog scale score (VAS) at 2 wk, 1, 3, and 6 mo were evaluated. Sixty patients were included. Group sample sizes of 29 and 29 achieved 81% power to detect a difference of 0.39 between the null hypothesis that both group proportions are 0.36, and the alternative hypothesis that the proportion in group PIL is 0.75 using a two-sided $\chi^2$ test with continuity correction and with a significance level of 0.05.

## RESULTS

Two patients in the TF group were excluded from analysis due to the inability of the interventionalist to successfully place the needle tip into the cephalodorsad quadrant of the intervertebral foramina at the level of the pedicle in <60 s of fluoroscopy time (including scout films). One patient in the PIL group was excluded from the analysis because she experienced a nonsustained paresthesia in the low back radiating down the right leg with needle insertion; though no contrast or steroid was injected, the procedure was aborted at the discretion of the treating physician (MR). The data from 57 patients were analyzed. Twenty-eight patients received TF (12 women; 16 men) and 29 patients received PIL (18 women; 11 men). Demographics (age, height, weight) were similar between groups (Table 1). Patient pathologies, interventions, and outcomes are listed in Table 2. The spread of contrast in patients between TF and PIL groups was as follows: all patients (29 of 29) (100%) in the PIL group and 21 of 28 (75%) patients in the TF group demonstrated anterior epidural spread; 28 of 29 (97%) patients in the PIL group had both anterior and posterior spread compared with 18 of 28 (64%) patients in the TF group; and 0 of 29 (0%) in the PIL group had only posterior spread compared with 7 of 28 (25%) patients in the TF group. The mean spread grade was 1.93 (95% CI, 1.83–2.0) in the PIL group and 1.46 (95% CI, 1.17–1.46) in the TF group ($P = 0.003$). Mean fluoroscopy time was 28.96 s (95% CI, 23.9–34.1 s) in the PIL group and 46.25 s (95% CI, 36.27–56.23 s) in the TF group ($P = 0.003$). VAS pain scores at 2 wk were TF 48.85 (95% CI, 37.08–60.61); PIL 40.55 (95% CI, 28.81–52.28) ($P = 0.31$). VAS pain scores at 1 mo were TF 52.77 (95% CI, 40.72–64.83); PIL 52.14 (95% CI, 39.47–64.81) ($P = 0.94$). VAS pain scores at 3 mo were TF 42.93 (95% CI, 29.07–56.78); PIL 46.60 (95% CI, 35.08–58.13) ($P = 0.68$). VAS pain scores at 6 mo were TF 47.07 (95% CI, 36.79–57.36); PIL 41.22 (95% CI, 28.59–53.85) ($P = 0.46$). These data are represented in Figure 6 and show VAS across time. There were no differences from control within either group. The aggregate pain VAS scores were less at all times compared with baseline. The two-way analysis of variance for repeated measures was used to compare these values. There were no observed dural punctures in either group, no subdural or intrathecal injections, and no intrathecal or intradiscal injections. No patient in either group sustained any infectious complications, postdural puncture cephalalgia, persistent paresthesias, systemic steroid reactions, skin lesions, or any adverse reaction to contrast media or adjuvant medications.

## DISCUSSION

The use of ESIs and TF injections has been increasing steadily in the United States, even though meta-analyses of their respective efficacies have been less than enthusiastic.[8,9] The rationale for use of steroidal medications neuraxially in low back pain conditions is largely due to the impression that the medication neutralizes the PLA-2 liberated from herniated and degenerated discs.[10,11] Steroids, then, exert an antiinflammatory effect by their demonstrated action by inhibiting PLA-2 and by blocking C-fiber nociception as well.[12]

Notwithstanding the support for an antiinflammatory and antinociceptive effectiveness of steroids, some have suggested that an interlaminar epidural technique of LESI in radiculopathy lacks legitimate rationale and empirical proof of efficacy, since the medication may not reach the target nerve.[13] The target(s) are likely sequestered in the interface of the disk and the exiting root, found in the ventral epidural space. A meta-analysis of all randomized controlled trials related to LESIs showed that they were effective only in the short-term, reducing the need for hospitalization and opioid analgesic requirements.[14] A large prospective randomized controlled trial showed that conventional LESI were effective in the short-term but did not reduce the need for surgery versus placebo control.[15] The presumed failure of long-term success with LESI may be related to the lack of ability to drive the steroid into the ventral or anterior epidural space at the interface of the inflamed nerve root and disk pathology using interlaminar LESI. This lack of anterior epidural placement of medication has been extrapolated to the lumbar situation, from contrast studies of

**Table 2.** Types of Pathology, Group Assignment, Outcomes in All Study Cases

| Patient | Sex | Age (yr) | Group | Baseline VAS (0–10) | Symptom Duration (mo) | Motor Function (LE) | Pathology (HNP, SS, DDD, FS) | Outcome (surgery, further injections, medication mgmt) |
|---|---|---|---|---|---|---|---|---|
| 1 | M | 33 | TF | 8 | 8 | 5/5 | HNP | NAT |
| 2 | F | 75 | TF | 7 | >24 | 5/5 | DDD, SS, HNP | NAT |
| 3 | M | 58 | PIL | 7 | 24 | 5/5 | SS | 2 PIL; NAT |
| 4 | F | 57 | PIL | 10 | 12 | 5/5 | DDD, SS | 3 PIL; SIJ; no change |
| 5 | F | 67 | TF | 7 | 3 | 5/5 | SS, DDD | 1 TF; no change |
| 6 | M | 39 | PIL | 8 | 1 | 4/5 | HNP, DDD | Surgery; NAT |
| 7 | F | 78 | PIL | 8 | 7 | 5/5 | DDD, SS | No change |
| 8 | F | 61 | TF | 10 | >24 | 5/5 | DDD, SS | 1 PIL; NAT |
| 9 | M | 47 | TF | 6 | 24 | 5/5 | HNP | 1 PIL; NAT |
| 10 | F | 62 | PIL | 6 | 12 | 5/5 | DDD, SS | 1 PIL; NAT |
| 11 | M | 66 | TF | 5 | 3 | 5/5 | HNP | NAT |
| 12 | F | 60 | PIL | 5 | <1 | 5/5 | DDD, SS | 1 PIL; NAT |
| 13 | F | 49 | PIL | 5 | 13 | 5/5 | HNP | NAT |
| 14 | F | 56 | TF | 8 | 4 | 5/5 | DDD, FS | 1 TF; 1 PIL, NAT |
| 15 | M | 75 | TF | 5 | 12 | 5/5 | SS | NAT |
| 16 | F | 49 | TF | 7 | 2 | 4/5 | HNP | 1 PIL; FJB; NAT |
| 17 | F | 52 | PIL | 7 | >24 | 5/5 | DDD, SS | 3 PIL; discography; NAT |
| 18 | M | 30 | PIL | 8 | 10 | 5/5 | HNP | Lost to F-up |
| 19 | F | 36 | PIL | 10 | 2 | 5/5 | HNP | 1 TF; discography, PDD |
| 20 | F | 31 | TF | 3 | >24 | 5/5 | HNP | Discography; no change |
| 21[a] | F | 53 | PIL | XX | XX | XX | HNP | Paresthesia; dropped out |
| 22 | M | 41 | TF | 9 | 8 | 5/5 | DDD | 1 PIL; no change |
| 23 | M | 30 | PIL | 8 | 18 | 5/5 | HNP | NAT |
| 24 | M | 48 | PIL | 8 | 1 | 5/5 | HNP | 1 PIL; 1 TF; NAT |
| 25 | F | 66 | PIL | 7 | 4 | not stated | SS | 2 PIL; FJB; NAT |
| 26 | F | 51 | TF | 8 | 4 | 5/5 | HNP | 1 TF; no change |
| 27 | M | 39 | PIL | 8 | 3 | 4/5 | HNP, FS | NAT |
| 28 | F | 57 | TF | 5 | 24 | 5/5 | HNP | NAT |
| 29 | F | 37 | PIL | 8 | 24 | 4/5 | HNP | 1 TF; 1 PIL; NAT |
| 30 | F | 75 | PIL | 4 | 2 | 5/5 | HNP, FS | NAT |
| 31 | M | 57 | TF | 9 | >24 | 5/5 | HNP, SS | 1 TF; 3 PIL; NAT |
| 32 | M | 71 | PIL | 8 | 3 | 5/5 | DDD | 1 PIL; 1 FJB; NAT |
| 33 | F | 49 | PIL | 8 | 4 | 5/5 | HNP | Lost to f-up |
| 34[a] | M | 59 | TF | XX | XX | XX | XX | Failure; dropped-out |
| 35 | M | 69 | PIL | 4 | 9 | 5/5 | HNP | 5 PIL; no change |
| 36 | F | 80 | PIL | 10 | 5 | 5/5 | DDD | 2 PIL; 1 TF; NAT |
| 37 | M | 80 | PIL | 6 | 1 | 4/5 | DDD, SS | 1 TF; 1 PIL; NAT |
| 38 | M | 40 | PIL | 1 | 2 | 5/5 | HNP | 1 PIL; 1 FJB; 1 SIJ; discography; no change |
| 39 | F | 58 | PIL | 8 | 4 | 5/5 | DDD, SS | 3 FJB, 1 PIL; NAT |
| 40 | F | 54 | TF | 2 | 10 | 5/5 | SS | NAT |
| 41 | M | 50 | TF | 5 | 4 | 4/5 | HNP | 1 TF; NAT |
| 42 | M | 49 | TF | 3 | >24 | 5/5 | HNP | No change |
| 43 | M | 59 | TF | 5 | 3 | 5/5 | DDD | Lost to F-up |
| 44 | F | 59 | PIL | 9 | 24 | 5/5 | SS | Lost to F-up |
| 45 | M | 35 | PIL | 3 | >24 | 5/5 | HNP | No change |
| 46 | F | 69 | TF | 8 | >24 | 5/5 | DDD, SS | 1 TF; 1 PIL; NAT |
| 47 | F | 39 | TF | 5 | 18 | 5/5 | DDD | 1 PIL; 2 SIJ; NAT |
| 48 | F | 30 | PIL | 3 | 3 | 5/5 | HNP | NAT |
| 49 | M | 44 | PIL | XX | 4 | 5/5 | HNP | NAT |
| 50 | F | 52 | TF | 5 | >24 | 4/5 | SS | 2 PIL; NAT |
| 51 | M | 25 | TF | 7 | 7 | 5/5 | HNP | 1 TF, 1 PIL; discography; no change |
| 52 | M | 50 | TF | 7 | >24 | 5/5 | HNP | 1 PIL; no change |
| 53 | M | 41 | TF | 8 | 3 | 4/5 | HNP | 4 PIL; NAT |
| 54 | M | 61 | TF | 2 | 8 | 5/5 | HNP | 3 PIL; NAT |
| 55 | F | 49 | PIL | 3 | 6 | 5/5 | HNP, SS | 1 FJB; NAT |
| 56[a] | M | 70 | TF | XX | XX | XX | XX | Failure; dropped-out |
| 57 | M | 53 | TF | 8 | 0.5 | 4/5 | HNP | NAT |
| 58 | M | 52 | TF | 10 | 8 | 4/5 | HNP | 1 TF, 1 PIL; NAT |
| 59 | F | 32 | PIL | 10 | >24 | 5/5 | DDD | Lost to follow-up |
| 60 | F | 36 | TF | 5 | 7 | 4/5 | HNP | 1 PIL; NAT |

HNP = herniated nucleus pulposis; SS = spinal stenosis; DDD = degenerative disc disease; FS = foraminal stenosis; PDD = percutaneous disc decompression; FJB = facet joint blocks; SIJ = sacroiliac joint injections; NAT = no additional treatment needed due to positive response to intervention performed; VAS = visual analog scale; LE = lower extremity.

[a] Dropped out due to failure or paresthesia.

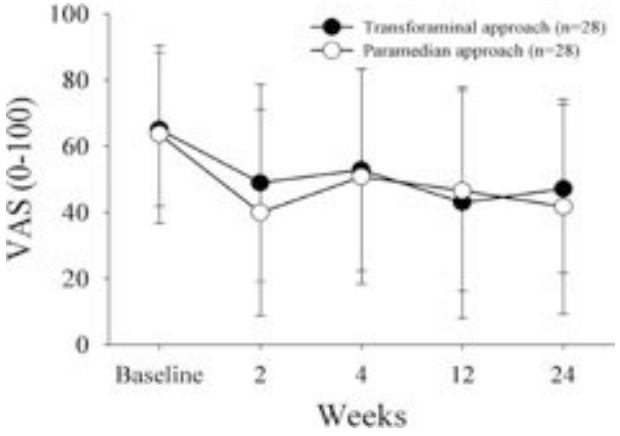


**Figure 6.** VAS scores across time.

cervical ESI,[16] and has also been evaluated directly using a midline lumbar approach. Botwin et al.[1] conducted a prospective evaluation of epidurography contrast patterns with fluoroscopic-guided lumbar interlaminar injections. In only 36% of cases (9 of 25 patients) was there anterior epidural spread.

The inability to drive the steroid anteriorly in the epidural space has led to a surge in the use of TF blocks.[8] It has also stimulated comparisons of conventional midline interlaminar epidural steroid block with TF block. Lutz and Wisneski[17] reviewed 50 patients with lumbar radiculopathy from herniated nucleus pulposus who responded well to TF ESIs. They postulated that delivery of the medication into the anterior epidural space led to a good clinical outcome. Thomas et al.[18] compared fluoroscopically guided TF and blind interlaminar LESI in 31 patients and noted that the TF approach was superior. Kolsi et al.[19] compared fluoroscopically guided TF and midline interlaminar approaches and were unable to prove whether nerve root injection was superior to an interspinous ligament injection. Kraemer et al.[3] compared perineural conventional epidural and paravertebral local anesthetic injections in the first phase of a two-part study. They then compared perineural steroid and saline. For the epidural perineural technique, the authors used an oblique interlaminar approach, without fluoroscopy. The introducer needle was inserted 1 cm below and 2 cm contralateral, with an angle of 30° to 45° to the midline. The 29-gauge needle then passed the flavum and ended up in the lateral part of the anterior epidural space, which was recognized by bony contact. They studied 182 patients and concluded that the epidural perineural injection was effective in lumbar radicular pain. Manchikanti et al.[20] performed retrospective evaluation of three types of injections: midline interlaminar without fluoroscopy, TF, and caudal injections under fluoroscopy. There were 75 patients in each group. They concluded that the TF and caudal injections were more effective than the midline epidural technique.

A paramedian approach for interlaminar epidural block has been described[21]; however, the use of a fluoroscopically guided PIL approach for the purpose of delivery of medications into the anterior epidural space has not been described. The PIL approach demonstrated a 100% incidence of anterior epidural spread and fared better statistically than did the TF approach. Not only was the procedure highly effective technically, it also took less fluoroscopic time to perform than did the TF approach, leading to less radiation exposure for both the patient and the interventionalist. While the actual fluoroscopy times in the present study appear to be longer than one might encounter in a clinical setting wherein the volume of contrast injectate is on the order of 1 mL, we found the additional time essential in both groups to actually observe the entire flow of the 5 mL of dye in real-time without interruption, including the use of continual, intermittent (q-0.5 mL) aspiration tests.

Complications from TF injections are increasingly being reported. In the editorial accompanying Huntoon and Martin's case report,[7] the very utility of the TF injections was questioned in light of the serious complications, such as paraplegia.[22] Any alternative approach that is potentially safer and offers identical or superior results, vis a vis driving the solution to the ventral epidural space, is most desirable. From a clinical perspective, the results of our study demonstrate an equivalent analgesic response whether the TF or PIL techniques are used. If clinicians could attain identical results with the PIL approach, perhaps the clinical indications for a TF technique in the lumbar spinal area would diminish.

There is no long-term follow-up with our technique past 6 mo, unlike that of Riew et al.[23] for TF nerve root blocks. They showed no difference in outcomes regarding need for surgical intervention between groups treated with bupivacaine TF nerve root injections versus those treated with betamethasone/bupivacaine TF blocks, implying no benefit to using corticosteroids via this approach for improving long-term success. Although this analysis was regarding nerve root or sleeve injections, and not TF epidural injections, the techniques are related anatomically by virtue of the approach and target area of interest. Ackerman and Ahmad noted improved pain scores after TF injections compared with caudal or interlaminar ESI for patients with radicular pain and herniated discs at L5–S1, but used different volumes of contrast and steroid injectates, as well as very large saline volumes in the caudal space (19 mL). It is possible that the significant dilution of the modest dose of triamcinolone (40 mg) used could have resulted in an ineffective concentration of antiinflammatory medication reaching the target(s) to produce analgesia in the caudal ESI patients. They also excluded TF patients if contrast was noted to spread through the foramen at L5–S1, but did not indicate how many patients were thus excluded.[24] In a large retrospective review, Crall et al.[25] showed that needle tip positioning in selective (TF) nerve root injections within or in proximity to the

intervertebral space did not influence immediate outcome, further questioning the requirement to access the nerve root/anterior epidural space using this approach. The same group found a 5.5% "minor" complication rate in 1777 patient visits assessing TF injections. Although there were no reports of permanent neurological sequelae found in that review, we question the need to perform TF injections when the PIL approach would suffice to drive medication ventrally in the epidural space towards the interface of the exiting nerve root (i.e., the target) and the disk pathology (i.e., the etiology of the problem).[26]

We have demonstrated that, in nonoperated lumbar spines, the ability to place contrast media into the ventral epidural space in a timely fashion is more readily accomplished by using the PIL technique than the TF. Each of the supervising physicians has personally performed more than 200 PIL injections and more than 200 TF injections. There were two failures in the TF group due to exceeding the (arbitrary) time limit on radiation exposure, and one PIL patient who experienced a brief and nonsustained paresthesia. One limitation of the present study was the use of different gauge (i.e., 20 vs 22 g) needles for the PIL and the TF approaches. Although this might have affected speed of injection, the use of 5 mL of injectate assured that spread of contrast through the similar gauge needles would not be influenced unduly. Many practitioners inject only 1 mL of solution using the TF technique. Ackerman and Ahmad[24] selected 3 mL, and we selected the 5 mL volume to evaluate and compare where the spread actually goes once the injectate tracks into the epidural space along the nerve root. It is possible that the results attained by using a smaller volume (i.e., 1 or 3 mL) could have been different than those we noted. Additionally, we only controlled the first intervention for each patient; additional treatment decisions were made on a case-to-case basis, limiting our ability to make outcome conclusions in many cases as to the efficacy of one technique over another. Further prospective large-scale multicenter outcome studies are needed to convincingly prove the efficacy and safety of the lateral PIL approach to the anterior epidural space versus TF injections.


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