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Research Letter

Lumbar erector spinae plane block: which side of the fascia? The role of injection depth and volume in a cadaveric model

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To the Editor:

The lumbar erector spinae plane block (L-ESPB) is a regional anesthetic technique used for various acute and chronic pain conditions. In the classic approach, the local anesthetic is injected between the transverse process (TP) and the overlying erector spinae muscle (ESM).[1] Cadaveric

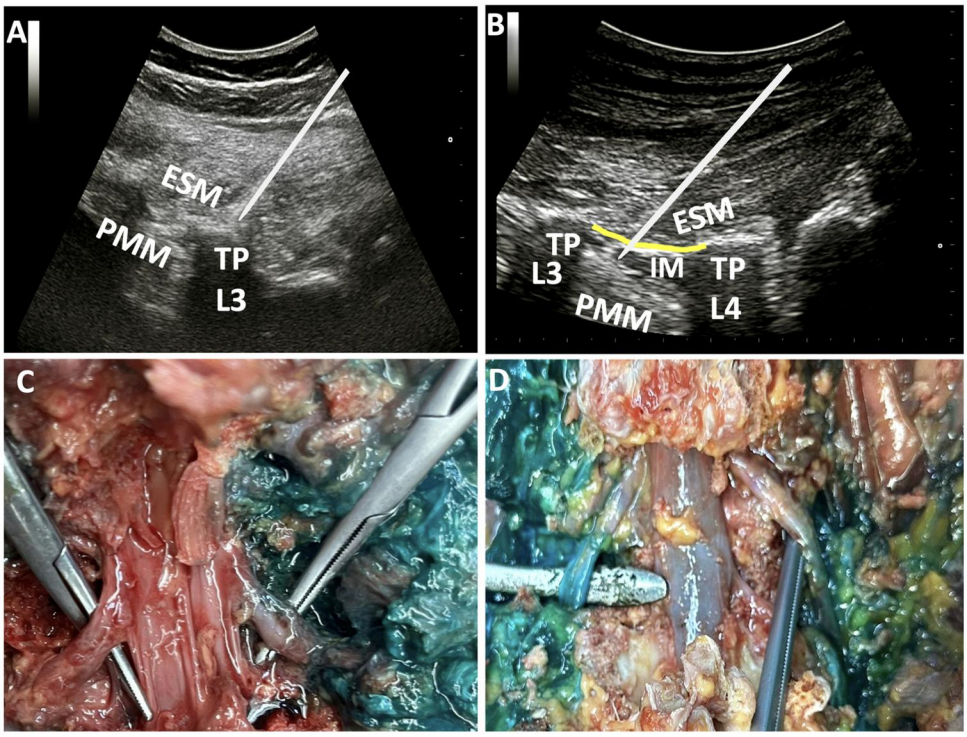


Figure 1. Ultrasound-guided superficial versus deep lumbar erector spinae plane injection technique and dye spread. (A) Superficial approach with the needle positioned between the transverse process (TP) and erector spinae muscle (ESM) at the L3 vertebral level. (B) Deep approach with the needle tip located beneath the fascial boundary (yellow line) between the ESM and psoas major muscle (PMM) at the L3 and L4 level. (C and D) Corresponding cadaveric sections (posterior elements removed) demonstrating dye distribution patterns following (C) 30 mL and (D) 40 mL injections at the L3 spinal nerve roots. For each volume, the left side shows the superficial technique and the right side shows the deep technique. Abbreviation: IM, injectate mixture.

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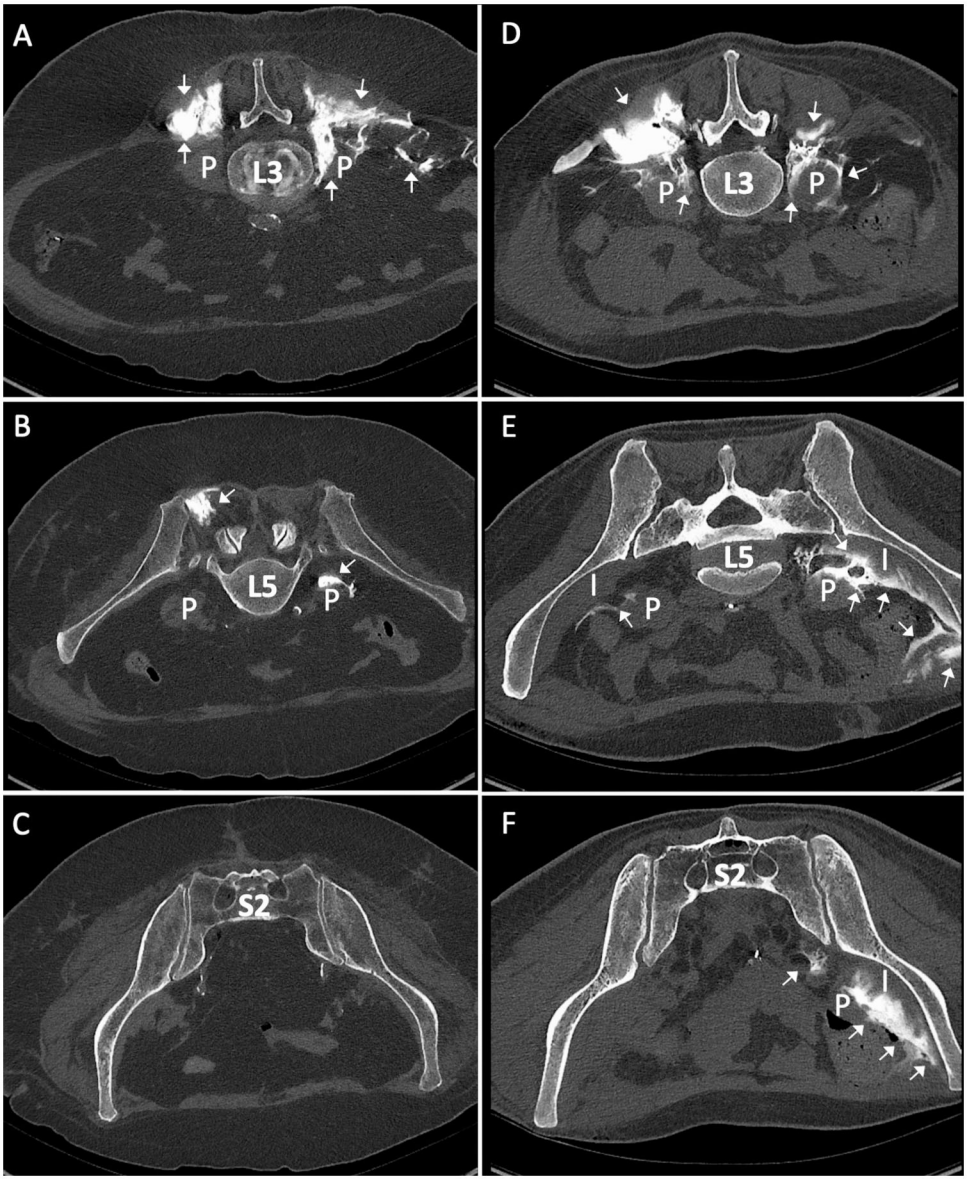


Figure 2. Axial computed tomography images demonstrating the distribution of radiopaque injectate at the L3, L5, and S2 vertebral levels following superficial (left side in all images) and deep lumbar erector spinae plane injections (right side in all images) performed at the L3 vertebral level. Panels A–C show contrast distribution following 30 mL injections, whereas panels D–F demonstrate contrast distribution following 40 mL injections at the same level. Arrows indicate contrast spread. Abbreviations: **P**, psoas major muscle; **I**, iliacus muscle.

investigations of L-ESPB have consistently demonstrated that the injectate remains confined to the posterior compartment,[2–4] suggesting that the block predominantly targets the dorsal rami. While deeper injections toward the psoas major muscle (PMM) have been suggested to enhance analgesia for lower-extremity surgery,[5,6] they remain unvalidated and likely represent a distinct technique with different spread patterns. The critical influence of injection depth and the optimal injectate volume have yet to be established. To address this gap, we performed a cadaveric study comparing the injectate distribution of the classic (superficial) approach with a deeper injection performed within the fascial plane between the ESM and PMM, using 2 injection volumes (30 mL and 40 mL).

With approval from the university ethics committee, the study was performed on 2 fresh, unembalmed cadavers. Both cadavers were non-obese elderly adults of average size with no history of previous spinal surgeries or deformities. Each cadaver received bilateral injections at the L3 level: a superficial (classic) technique on the left side and a deep intertransverse technique on the right. One cadaver received 30 mL per side and the other 40 mL of an injectate composed of iopamidol (50%), methylene blue (5%), and saline (45%). For the superficial technique, the needle was inserted in a caudocranial direction and parasagittal orientation, and advanced until bony contact with the medial half of the TP was achieved. For the deep technique on the contralateral side, the needle was advanced beyond the deep fascial boundary between the ESM and PMM, just inferior to the tip of the L3 TP and posterior to the psoas major muscle (Figure 1A and B).

After the injections, both cadavers were transferred to the radiology suite for CT imaging of the lumbosacral region. The time from completion of the blocks to completion of the

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CT scan was approximately 30 minutes. Computed tomography (CT) imaging was performed using a 128-slice scanner (Siemens Healthineers Somatom) with 0.6-mm axial slice thickness.

A neurosurgeon (HC) and an anatomist (GK) jointly performed the anatomical dissections and assessed the spread of the injectate to the relevant anatomical structures. One hour after the injection, dissection was initiated, and the same protocol was applied to all cadavers. Following a midline thoracolumbar incision in the prone position, the skin and subcutaneous tissues were reflected laterally, and the latissimus dorsi fascia and erector spinae muscles were exposed. The stained erector spinae fascia and muscle fibers were identified and documented.

Accordingly, total laminectomy, facetectomy, and pedicle subtraction osteotomy were performed at the L2 and L4 vertebral levels, where the most intense staining was observed, and the posterior bony elements—including facet joints and pedicles—were removed (Figure 1C and D). These findings were photographed and recorded for documentation.

Following CT imaging and subsequent dissection, the results demonstrated a clear distinction in injectate spread between the 2 techniques.

Superficial injections resulted in dye spread limited to the dorsal aspect of the TPs, consistently staining the dorsal rami from L1 to L5. No ventral spread was observed with a 30 mL injection, whereas increasing the volume to 40 mL produced limited anterior migration. In contrast, deep injections consistently produced prominent ventral spread, staining the ventral rami from L3 to L4 with 30 mL and from L2 to L5 with 40 mL. The deep approach also generated extensive extraforaminal spread along the iliopsoas fascial plane. With 30 mL, the dye tracked caudally to the S1 level, and with 40 mL, it extended between the iliacus and psoas major muscles to the S3 and S4 levels, indicating involvement of the deep pelvic compartment and anterior extension toward the transversus abdominis plane (Figure 2). No epidural, central dural, or intraforaminal spread was observed with either technique, confirming the injectate's extraforaminal distribution.

This study has several limitations. First, it was conducted on cadavers, and the entire process—from injection to radiological evaluation and final dissection—was performed in the prone position, where gravity might have contributed to anterior spread of the injectate. Second, the limited sample size and the observational nature of the design may restrict the generalizability of the findings.

These findings provide an anatomical basis for predicting the clinical distribution and analgesic patterns of the L-ESPB. For posterior (paraspinal or dorsal) analgesia, the classic injection above the TP appears sufficient. In contrast, when lower-extremity analgesia is desired, a deeper injection plane may be more effective. This can be achieved with a high-volume (>30 mL) superficial injection to promote anterior migration or, more reliably, with a deep injection beneath the ESM fascia. However, staining of the ventral branches suggests that the deep technique may carry a higher risk of motor blockade compared with the classic approach. This prominent ventral spread to the ventral rami effectively constitutes an extraforaminal paravertebral infiltration, which provides the anatomical basis for this potential motor involvement. Clinicians should therefore recognize the distinct anatomical distributions of these techniques and balance the potential for broader analgesia against the risk of motor involvement. To prevent confusion from grouping 2 anatomically distinct methods under the same term, we propose designating the deeper approach as the "Deep Lumbar ESP Block" or "Lumbar Intertransverse Process Block." Further prospective studies are warranted to validate these anatomical findings and define their clinical implications.

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