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Multipoint Annulus Fibrosus Infiltration in PTED for Giant Central Lumbar Disc Herniation: A Case Report

Liang Xiong
Zhijiang People's Hospital
Fengping Liu
Yichang Central People's Hospital
Xue'e Yan
Zhijiang People's Hospital
Xingchun Long
Longxc@126.com

Zhijiang People's Hospital

Case Report

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Abstract

Background

In the treatment of lumbar disc herniation (LDH), full-endoscopic techniques have been widely recognized for their minimal invasiveness and rapid recovery. However, central giant disc herniation accompanied by severe spinal stenosis remains a challenge for percutaneous transforaminal endoscopic discectomy (PTED). During conventional procedures under local anesthesia, patients often experience excruciating pain and reflex limb movements when instruments touch or manipulate the highly innervated outer annulus fibrosus and posterior longitudinal ligament. This significantly increases the risk of nerve injury and surgical difficulty. This article introduces a modified technique of PTED with multipoint infiltration anesthesia of the annulus fibrosus in the lateral recess to effectively resolve these challenges.

Case Presentation:

A 29-year-old male was admitted with a 5-month history of bilateral radicular pain in the lower extremities. Imaging revealed a central giant LDH at the L4-5 segment with severe dural sac compression and corresponding spinal stenosis. The patient underwent PTED under local infiltration anesthesia. Intraoperatively, after adequately exposing the lateral recess, the patient's visual analogue scale (VAS) score for back pain reached 9 when the herniated annulus fibrosus was touched. Subsequently, the surgeon used an annulus suture cannula to perform multipoint visualized infiltration anesthesia in the annulus fibrosus adjacent to the nerve root, injecting 5 ml of 0.5% lidocaine. After the anesthesia took effect, the maximum VAS score upon touching the annulus dropped to 3. This excellent analgesic effect enabled the surgeon to successfully remove the incarcerated nucleus pulposus and advance the endoscope across the midline to the contralateral lateral recess for exploration and decompression. The patient's bilateral radicular pain was significantly relieved on the day of surgery. MRI and CT scans performed 3 days postoperatively confirmed that the central spinal canal was adequately decompressed without obvious compression, and bilateral lateral recesses were fully decompressed.

Conclusion

Multipoint infiltration anesthesia of the annulus fibrosus in the lateral recess is a simple, safe, and highly effective adjunctive technique. It overcomes the pain bottleneck of conventional local anesthesia, providing high-quality anesthesia and decompression outcomes for central giant LDH.

Introduction

Lumbar disc herniation (LDH) is a common disease in spine surgery. With the development of endoscopic technology, full-endoscopic techniques have been widely recognized for their minimal

trauma and rapid recovery [1]. However, central giant LDH remains one of the challenges in endoscopic surgery [2]. Such herniations are often accompanied by severe spinal stenosis, and excessive resection of the superior articular process during percutaneous transforaminal endoscopic discectomy (PTED) may lead to exacerbated postoperative back pain and potential lumbar instability [3]. Therefore, central or paracentral LDH is considered a relative contraindication for PTED. Percutaneous endoscopic interlaminar discectomy (PEID) allows for unilateral laminotomy for bilateral decompression (ULBD) [4], but the incidence of complications related to nerve retraction after crossing the midline reaches 3.3% [5]. In conventional full-endoscopic surgery under local anesthesia, when instruments touch or manipulate the outer layer of the annulus fibrosus and the posterior longitudinal ligament—structures rich in nociceptive nerve endings—patients frequently experience unbearable pain and reflex limb movements. This greatly increases the risk of nerve injury and surgical difficulty. This article presents a modified PTED technique utilizing multipoint infiltration anesthesia of the annulus fibrosus in the lateral recess for the treatment of central giant LDH, which effectively resolves the aforementioned challenges.

Case Presentation

A 29-year-old male was admitted in July 2025 due to bilateral lower extremity radicular pain lasting for 5 months. The patient developed the pain without an obvious trigger 5 months ago, predominantly in the posterior thighs and lateral calves. The symptoms progressively worsened and were accompanied by intermittent claudication, with poor relief from oral analgesics, topical patches, massage, and hot compresses. Physical examination: The patient was conscious, the physiological curvature of the spine was maintained, and there was no percussion tenderness over the lumbar spinous processes. Bilateral paravertebral muscle tension was noted in the lower lumbar spine. Tenderness was present along the course of the sciatic nerve in the bilateral posterior thighs and lateral calves, which was more severe on the right side. Sensation was slightly decreased over the right lateral malleolus, without numbness in both feet. The muscle strength for ankle and hallux dorsiflexion was grade 4 on the right side. The straight leg raise test was approximately 40° bilaterally, with positive reinforcement tests. Bilateral knee and Achilles tendon reflexes were normal. Laboratory tests, including routine blood, biochemistry, and coagulation profiles, showed no abnormalities. Preoperative MRI and CT of the lumbar spine revealed a central giant disc herniation at the L4-5 segment, causing severe compression of the dural sac and corresponding spinal stenosis (Fig. 1A–1C). Preoperatively, the visual analogue scale (VAS) score for pain was 7 for the right lower extremity and 6 for the left.

Based on the patient's history, physical examination, and imaging data, the bilateral lower extremity pain and intermittent claudication were attributed to the space-occupying lesion in the L4-5 spinal canal, accompanied by spinal stenosis and nerve compression. Given the poor response to conservative treatment, clear surgical indications, and lack of obvious contraindications, PTED was performed. The patient was placed in a prone position with the abdomen suspended. Under fluoroscopic guidance, a guide pin was used to locate and mark the L4-5 intervertebral space, and a Kirschner wire marked the entry point and puncture trajectory. After routine disinfection and draping, local infiltration anesthesia

was administered. Depending on the patient's body habitus, an approximately 7-mm incision was made 11 cm lateral to the midline at the affected intervertebral space. A specialized puncture needle was inserted into the intervertebral foramen at a 30° angle to the body surface under fluoroscopy. Repeat fluoroscopy confirmed the needle trajectory passed ventral to the superior articular process to the posterior-superior margin of the vertebral body. A guidewire was inserted through the needle, followed by sequential insertion of dilation tubes to establish the working channel. The transforaminal endoscopic imaging system and normal saline irrigation system were then connected. Under endoscopic visualization, a coaxial trephine was used to remove the ventral-lateral portion of the articular process, enlarging the intervertebral foramen and fully exposing the lateral recess. After exposing the lateral border of the nerve root, the herniated annulus fibrosus was distinctly seen compressing the nerve root, and upon touching the annulus fibrosus, the patient's VAS score for back pain reached 9. Subsequently, an annulus suture cannula was advanced into the lateral recess (Fig. 2A), and multipoint visualized infiltration anesthesia was performed in the annulus fibrosus adjacent to the nerve root by injecting 5 ml of 0.5% lidocaine (Fig. 2B). After the anesthesia took effect, the maximum VAS score upon touching the annulus dropped to 3. Using nucleus forceps, the incarcerated nucleus pulposus surrounding the exiting nerve root was removed. The surgeon continued to remove hyperplastic osteophytes and resect the hypertrophic ligamentum flavum, fully decompressing the ipsilateral nerve root. After confirming no ventral compression on the nerve root, a radiofrequency probe was used to completely ablate the loose disc material. The endoscope was then advanced across the midline ventrally and contralaterally to reach the contralateral lateral recess (Fig. 2C) to explore and decompress the contralateral nerve root. Re-examination confirmed that bilateral nerve roots were well relaxed. After thorough hemostasis, 1 ml of betamethasone was injected through the channel to reduce postoperative nerve root edema. The endoscope and working channel were withdrawn, and the wound was sutured, disinfected, and dressed. On the day of surgery, the patient's bilateral radicular pain was significantly relieved (VAS score for bilateral lower extremities: 2), and the straight leg raise test became negative. Imaging follow-up at 3 days postoperatively (MRI and CT) demonstrated complete removal of the herniated nucleus pulposus at the L4-5 intervertebral space, restoration of the spinal canal morphology, and adequate decompression of the dural sac and bilateral nerve root canals (Fig. 1D, 1E, 1F).

Discussion

LDH is a common cause of sciatica, with an annual incidence of approximately 0.2–0.7/1000 [6], leading to a substantial socioeconomic burden. For patients who fail to respond to 3 months of standardized conservative treatment, surgical intervention becomes the primary option. Traditionally, surgical management of giant LDH typically involves open decompression alone or lumbar interbody fusion (LIF). However, open decompression inevitably causes extensive paraspinal muscle injury, while fusion sacrifices segmental motion and significantly increases the long-term risk of adjacent segment degeneration (ASD). For the young patient population with high functional demands and a long life expectancy, these two conventional approaches often carry a heavy long-term negative impact. Therefore, achieving adequate decompression while maximally preserving the natural spinal anatomy is

crucial. As an emerging minimally invasive spinal technique, full-endoscopic surgery has become a mainstream modality for LDH due to its minimal invasiveness, rapid recovery, and high safety profile [7]. Choi et al. [8] analyzed 10,228 patients who underwent PTED and found a high rate of residual compression in central LDH, which is correlated with anatomical constraints and intraoperative patient pain. In the degenerated intervertebral disc, a torn annulus fibrosus induces autoimmune responses, neovascularization, and inflammatory cell infiltration [9, 10]. The nucleus pulposus tissue releases pro-inflammatory cytokines (such as TNF-α, CD-68, p38MAPK, and IL-8) [11, 12], contributing to radicular hyperalgesia. Consequently, during full-endoscopic surgery under local anesthesia, nerve retraction and intradiscal manipulation are high-risk periods for severe pain. PEID requires resection of the ligamentum flavum and rotational downward pressure of the working channel, which may increase the risk of injury to the dural sac and cauda equina during exposure of the annulus fibrosus [13], resulting in symptoms such as lower extremity numbness and weakness. Furthermore, conventional peri-foraminal anesthesia often fails to fully cover the nociceptors in the stenotic lateral recess. Severe pain causes patient movement, increasing the risk of nerve root injury [14], and forces the surgeon to perform incomplete decompression out of concern for patient tolerance. Thus, optimal intraoperative anesthesia management has become an urgent area of research.

Studies have shown that epidural anesthesia can enhance intraoperative analgesia during PTED [15], but risks such as urinary retention, and dural sac and nerve root injury cannot be ignored. Alternatively, Duan et al. [16] applied intradiscal local anesthesia as an adjunct to PTED in 286 patients with mild to moderate LDH, significantly alleviating intraoperative back pain. Their study demonstrated that common low-concentration local anesthetics are non-cytotoxic to the intervertebral disc, safe, and effective. However, for central giant LDH, due to the highly dense degenerated annulus fibrosus and severely thickened posterior longitudinal ligament complex, simple intradiscal injection often fails to allow the local anesthetic to sufficiently diffuse to the outermost layer of the lesion. The multipoint infiltration anesthesia of the annulus fibrosus in the lateral recess presented in this case accurately bridges this anatomical blind spot of anesthesia and offers several notable advantages: 1. Precise realization of pain-tactile separation: By performing multipoint infiltration of the anesthetic agent into the lateral recess and the compressed annulus fibrosus under direct visualization, the nociceptive nerves distributed within the annulus fibrosus [5, 17] are specifically blocked from multiple directions. This completely eliminates the severe pain experienced when the surgeon manipulates the annulus fibrosus and posterior longitudinal ligament, while fully preserving the motor function of the lower extremities and the mechanical tactile sensation of the nerve roots themselves. During surgical manipulation, if an instrument excessively retracts or inadvertently touches the nerve root, the patient can still provide timely feedback, thereby minimizing the risk of iatrogenic nerve injury [18]. 2. Breaking through the midline operation restricted zone to ensure complete decompression: Central giant LDH is often accompanied by bilateral lateral recess stenosis, requiring bilateral decompression across the midline. Under conventional local anesthesia, tilting the working cannula or endoscope ventrally and contralaterally to expose the contralateral nerve root easily triggers unbearable pain and even restless movements due to the

retraction of the ventral dural sac and annulus fibrosus. Excellent analgesia dramatically increases the patient's tolerance to ventral dural retraction, enabling the surgeon to comfortably advance the endoscope across the midline to address contralateral pathology, achieving an effect similar to ULBD. 3. Stabilizing analgesic efficiency: PTED relies on continuous normal saline irrigation to maintain visualization. Conventional local anesthetics are easily washed away and diluted by the high-pressure water flow, leading to reduced analgesic efficiency. This technique innovatively utilizes an annulus suture cannula to inject the anesthetic agent at multiple points directly into the dense annulus fibrosus, utilizing the tissue interstitial space to form a relatively closed drug reservoir. This effectively resists the washout effect of the irrigation fluid, providing stable and long-lasting local intraoperative analgesia.

This study has certain limitations. Firstly, it is a single-case report with a short follow-up period; the clinical efficacy and safety need to be further validated in larger cohort studies. Secondly, although definitive analgesic effects were observed intraoperatively, there was a lack of comparison using neurophysiological monitoring. Future prospective randomized controlled trials are warranted to systematically evaluate the comprehensive advantages of this technique compared with conventional local or epidural anesthesia in the management of central giant LDH.

Conclusion

In summary, multipoint infiltration anesthesia of the annulus fibrosus in the lateral recess is a simple, safe, and highly effective adjunctive technique. It overcomes the pain bottleneck associated with conventional local anesthesia, yielding high-quality anesthesia and decompression outcomes for central giant LDH.

Abbreviations

LDH: Lumbar disc herniation; PTED: Percutaneous transforaminal endoscopic discectomy; PEID: Percutaneous endoscopic interlaminar discectomy; VAS: Visual analogue scale; ULBD: Unilateral laminotomy for bilateral decompression; LIF: lumbar interbody fusion; ASD: Adjacent segment degeneration.

Declarations

Written informed consent for publication was obtained from the patient. The authors confirm compliance with all ethical guidelines and grant the journal publication rights.

Ethics approval and consent to participate

All procedures were performed in compliance with the ethical guidelines established by the Ethics Committee of the Zhijiang People's Hospital and the Declaration of Helsinki principles. This case report was approved by the Ethics Committee of the Zhijiang People's Hospital (Approval No. ZJ2026-02). Clinical trial number: not applicable (this is a case report, not a clinical trial).

Consent for publication

The patient has provided written informed consent for the publication of this case, including any personal information, images and video. The author confirms adherence to ethical guidelines and grants the journal the right to publish the work.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare no conflicts of interest.

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Authors' contributions

L.X. drafted the main manuscript text. F.L. provided surgical guidance. X.Y. prepared the figures and collected the clinical data. X.L. performed the surgical procedure. All authors reviewed, revised, and approved the final version.

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Figures

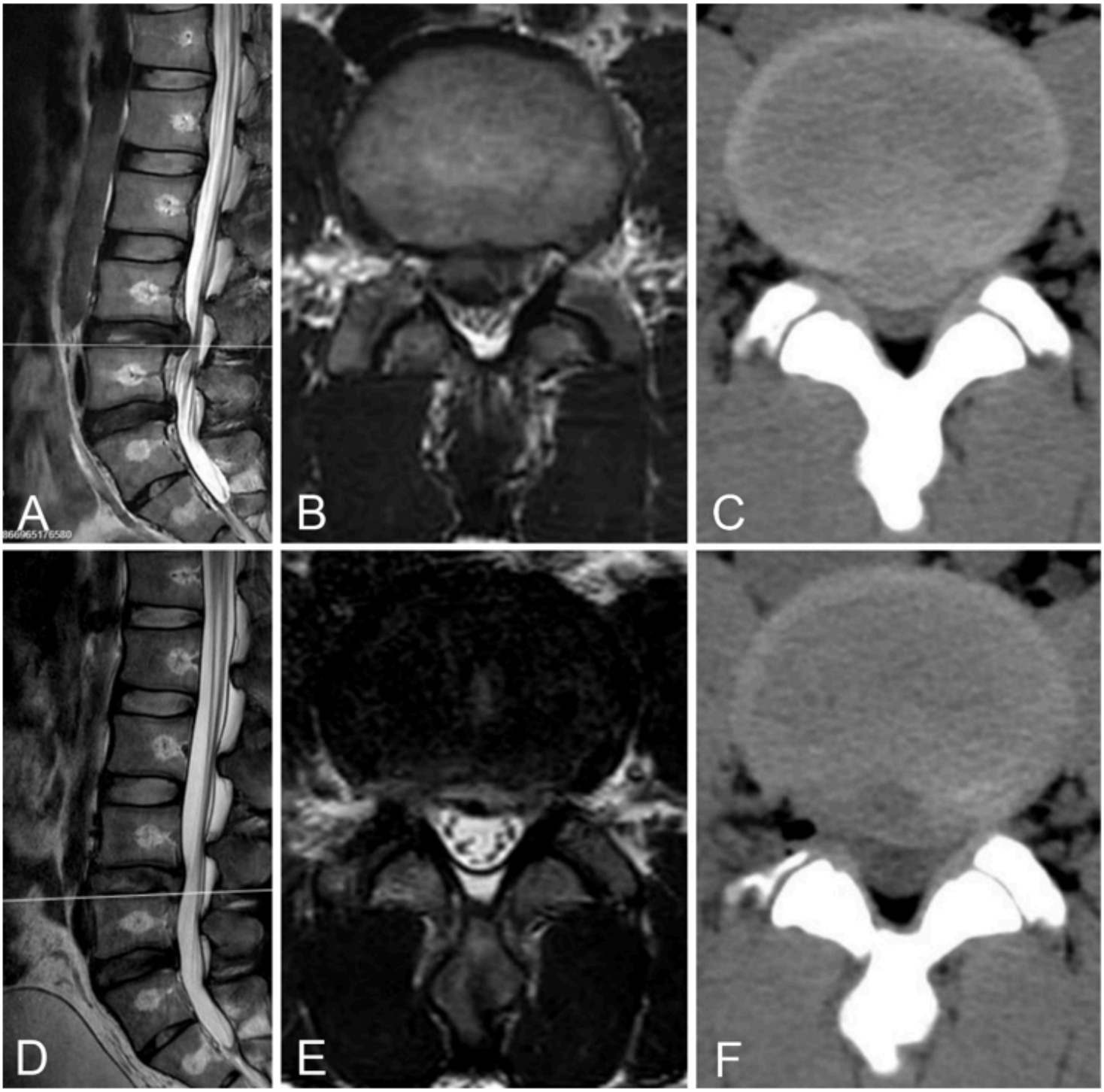


Figure 1

Preoperative sagittal MRI of the lumbar spine shows L4-5 disc herniation with compression of the dural sac at the corresponding segment; axial MRI reveals a central giant disc herniation in the L4-5 spinal canal with bilateral lateral recess stenosis (A, B). Preoperative axial CT shows the central giant disc herniation at L4-5 without bony compression in the central canal and bilateral nerve root canals (C). Postoperative sagittal MRI shows restoration of the dural sac morphology without obvious compression at L4-5; axial MRI shows no obvious compression in the central canal and adequate decompression of the bilateral lateral recesses (D, E). Postoperative axial CT shows partial resection of the right L5 superior articular process and adequate decompression within the central spinal canal (F).

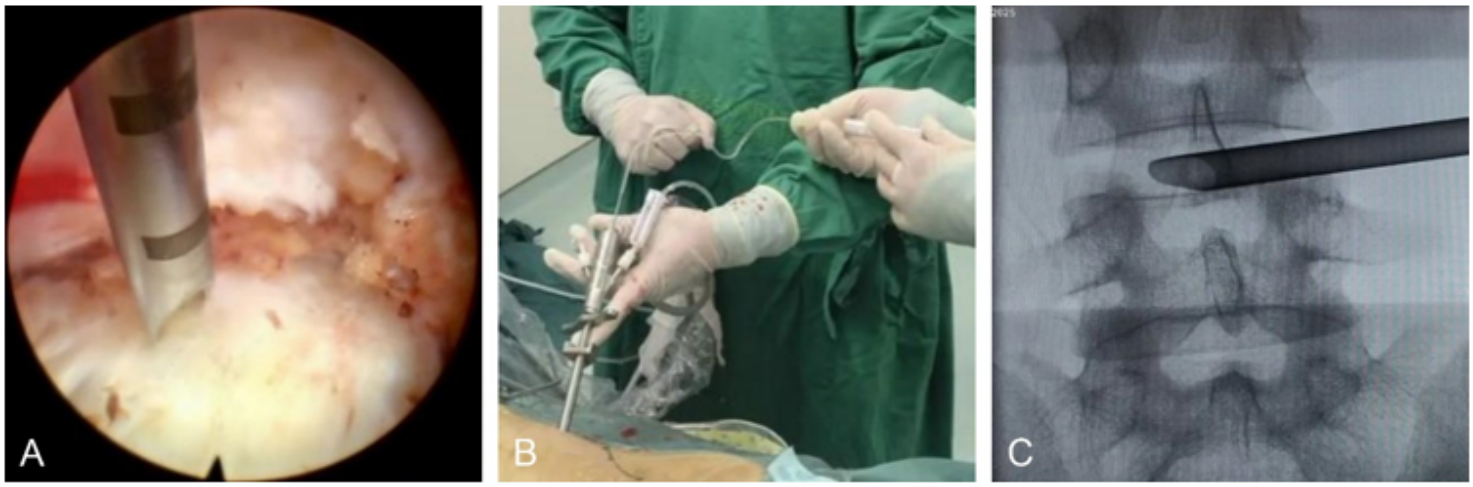


Figure 2

Intraoperatively, the annulus suture cannula enters the lateral recess for multipoint visualized infiltration anesthesia in the annulus fibrosus adjacent to the nerve root (A). An assistant injects 0.5% lidocaine intraoperatively (B). Intraoperative fluoroscopy shows the working cannula approaching the contralateral nerve root canal (C).