ORIGINAL

Transforaminal full-endoscopic surgery under local anesthesia for lumbar radiculopathy : Preliminary results

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Abstract : Background : Transforaminal full-endoscopic spine surgery (TF-FESS) under local anesthesia is a minimally invasive approach for treating lumbar radiculopathy and is increasingly being used worldwide. Methods : This case series reports the preliminary results for 6 patients with lumbar radiculopathy who underwent TF-FESS under local anesthesia between November 2023 and November 2024. Results : The patient cohort consisted of 3 men and 3 women with a mean age of 49 ± 13 years. The mean operation time was 80.7 ± 15.9 min, and the mean anesthesia time was 149.2 ± 16.3 min. Significant improvements were observed in visual analog scale scores for back and leg pain after surgery, with respective mean decreases of 2.7 ± 2.0 and 6.3 ± 2.3 points. Oswestry Disability Index scores showed a mean recovery of 55% ± 10%. Patients could return very quickly to their daily activities within a mean of 1.5 days and to work within a mean of 2.7 weeks postoperatively. No complications or recurrences were reported during follow-up. The results were good or excellent in all patients according to MacNab's criteria. Conclusion : The results in this preliminary case series suggest that TF-FESS under local anesthesia is a feasible and effective treatment for lumbar radiculopathy. J. Med. Invest. 73 : 129-134, February, 2026

Keywords **:** *Lumbar radiculopathy, full-endoscopic transforaminal, local anesthesia, discectomy, foraminoplasty.*

INTRODUCTION

Lumbar radiculopathy is a common cause of debilitating pain for which several treatment options are available, ranging from conservative management with medication and rehabilitation to surgical intervention (1). Open and microsurgical techniques have traditionally been considered the gold standard for nerve decompression and have demonstrated high success rates. However, these methods are associated with significant drawbacks, including a need for extensive incisions, potential damage to spinal anatomy, postoperative pain, and complications. Therefore, minimally invasive surgical approaches, particularly endoscopic surgery, which requires only small incisions, have gained prominence due to their advantages of less tissue trauma, minimal blood loss, shorter hospital stays, and fewer complications (2).

Conventional spine surgery typically requires general anesthesia to ensure patient comfort and optimal surgical conditions. However, general anesthesia precludes real-time intraoperative assessment of nerve function, potentially leading to inadvertent nerve injury. Furthermore, intraoperative nerve monitoring requires specialized equipment and experienced personnel, which limits its widespread adoption. In contrast, local anesthesia has been shown to reduce the risk of nerve damage by 10%, the risk of postoperative nausea and dizziness by 15%, and the overall risk of systemic adverse effects. Despite these benefits, approximately 5% of patients who receive local anesthesia experience pain during surgery and require supplementary analgesia. Epidural anesthesia, while offering superior pain control and higher patient satisfaction, has yet to be fully investigated in endoscopic procedures (3).

The transforaminal percutaneous discectomy technique was pioneered by Hijikata in 1975 (4) and further refined by the introduction of the "safe triangle" approach by Kambin and the development of specialized endoscopic tools (5). Subsequently, the full-endoscopic transforaminal technique was advanced by clinicians globally, demonstrating its efficacy in the treatment of lumbar radiculopathy. This technique is performed under local anesthesia and provides immediate symptom relief in a conscious patient during the procedure.

Today, transforaminal full-endoscopic surgery performed via an 8-mm incision under local anesthesia is widely regarded as the least invasive surgical option for lumbar radiculopathy (6). Building upon these advances, we have recently implemented this technique at Can Tho Central General Hospital. This report describes the preliminary outcomes of the first 6 cases of lumbar radiculopathy treated by full-endoscopic transforaminal surgery under local anesthesia at this institution.

MATERIALS AND METHODS

Study design and subjects

This case series includes 6 patients with lumbar radiculopathy who underwent full- endoscopic transforaminal surgery under local anesthesia in the Orthopedic Trauma Center at Can Tho Central General Hospital between November 2023 and November 2024. The cohort consisted of 1 patient with foraminal stenosis and 5 patients with disc herniation (including 1 patient who underwent two-level surgery).

Statistical Analysis

Paired t-tests were used to compare preoperative and postoperative Visual Analog Scale (VAS) and Oswestry Disability

Received for publication June 10, 2025 ; accepted December 1, 2025.

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Index (ODI) scores. All analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA).

Preoperative evaluation and preparation

Diagnostic imaging : Patients underwent a comprehensive clinical evaluation, supplemented by radiographic, magnetic resonance, and computed tomography (CT) imaging of the lumbar spine, to confirm the diagnosis. Selective nerve root or intradiscal lidocaine injections were used when there was multilevel involvement so that the exact pain generators could be identified.

Preoperative medications : Prophylactic antibiotic cover (cefazolin 2 g intravenously) was administered 30 min before surgery. Diphenhydramine hydrochloride 10 mg was administered intramuscularly and fentanyl 50 μg intravenously at the start of the surgical procedure.

Patient positioning and preparation : The patient was positioned prone with the chest, abdomen, and pelvis elevated and the knees slightly flexed, using foam padding for comfort. The surgical field and needle insertion/incision site were determined on preoperative CT and magnetic resonance images (MRI) and marked on the skin under fluoroscopic guidance. The patient, surgeon, nursing staff, instrument table, fluoroscopic screen, and endoscopic monitor were strategically positioned to optimize workflow and minimize operation time.

Local anesthesia and surgical procedures

Local anesthesia : In all cases, 1% lidocaine was used for local anesthesia, with a total of 20-22 ml administered per level (see figure 1).

Surgical technique

The surgical procedure was determined preoperatively based on the affected nerve root and MRI findings and was performed to achieve adequate decompression and discectomy. Following endoscope insertion into Kambin's triangle, the superior articular process (SAP) and pedicle were identified. Radiofrequency ablation was used for hemostasis. The outer wall of the SAP was partially resected using a high-speed drill to expand the surgical field (enlargement of Kambin's triangle) and improve visualization of the intervertebral disc. Disc herniation was addressed by direct removal in the outside view (outside-in technique) or intradiscal discectomy in the intradiscal view (inside-out technique). Thermal annuloplasty was performed if there was pathology

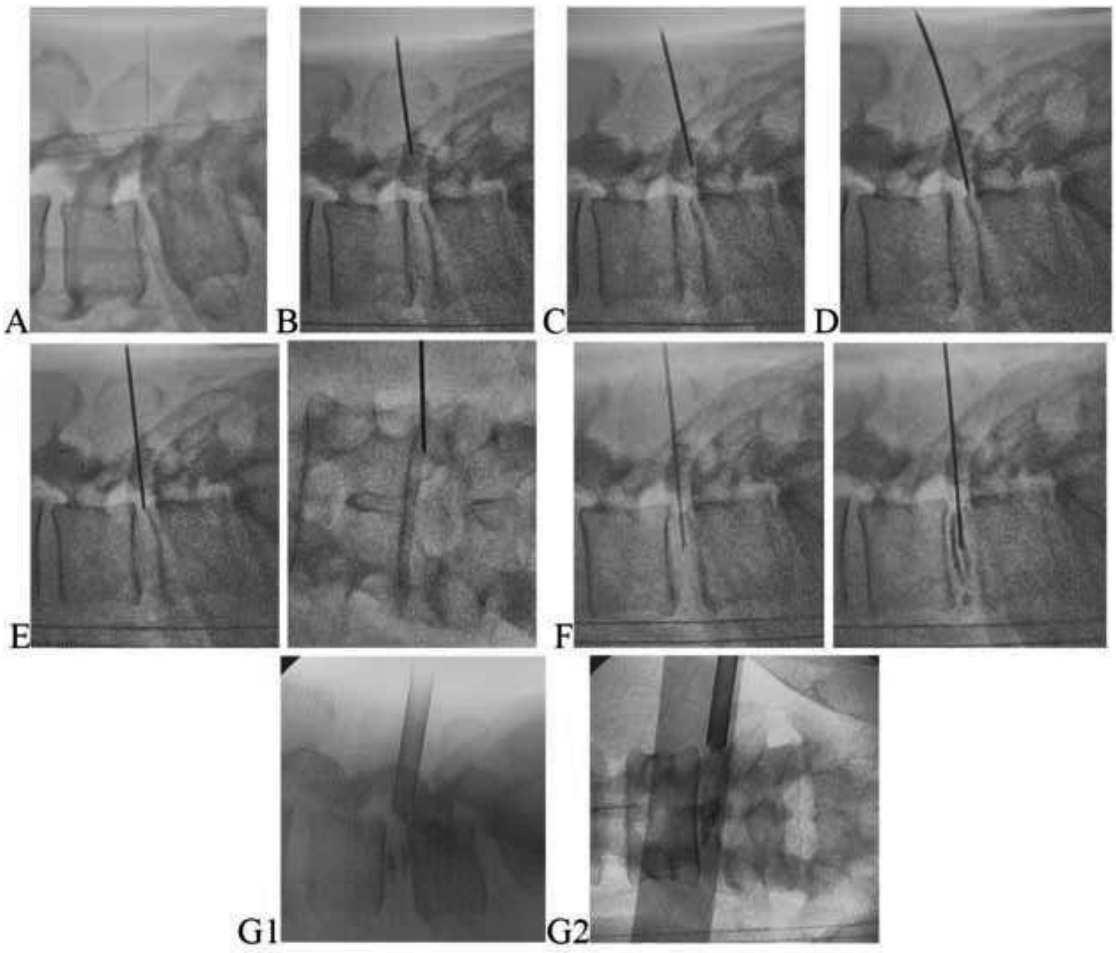

Figure 1. Local anesthesia and cannula insertion
(A) Two milliliters of lidocaine 1% was administered for skin and 8 ml for the subcutaneous tissue, fascia, and muscle. (B) Two milliliters of lidocaine 1% was administered for the facet joint. (C) Two milliliters of lidocaine 1% was administered at the junction of the superior articular process and transverse process. (D) Two milliliters of lidocaine 1% was administered for the pedicle and 2 ml for the posterior border of the vertebral body and the upper endplate of the lower vertebra. (E) Two milliliters of lidocaine 1% was administered for the annulus fibrosus of the intervertebral disc. (F) One or two milliliters of lidocaine 1% was administered for the nucleus pulposus (with contrast). An 8-mm cannula was placed after local anesthesia and insertion of serial dilators in the anteroposterior (G1) and lateral (G2) views.

involving high-intensity zone lesions. Combined procedures were performed as clinically indicated, including discectomy, herniation removal, thermal annuloplasty, partial resection of the ventral SAP and ligamentum flavum (for transverse nerve root decompression), and foraminoplasty (for foraminal stenosis) (see figure 2). A drain was used to prevent hematoma postoperatively and removed within 24 hours after surgery.

Postoperative care and rehabilitation

Early mobilization, including sitting and walking as tolerated, was encouraged within the first 24 hours postoperatively. Increased mobility and return to daily activities were permitted after drain removal. Although a lumbar brace was not strictly required in view of the minimally invasive nature of the procedure, patients were recommended to wear a brace for 3 weeks postoperatively for spinal protection.

Research ethics

The study adhered to ethical principles in medicine and was approved by the Ethics Committee of Can Tho Central General Hospital.

RESULTS

The demographic, clinical, and surgical data of the patients are shown in Table 1. The patient cohort consisted of 3 men and 3 women with a mean age of 49 ± 13 years. The mean postoperative follow-up duration was 14.2 ± 4.4 (range, 6.4-18.4) months. The mean postoperative hospital stay was 3.5 ± 1.1 days. The mean operation time per level was 80.7 ± 15.9 (range, 50-100) min, and the mean anesthesia time was 149.2 ± 16.3 (range, 135-180) min.

Patient demographic, clinical, and surgical data

The demographic, clinical, and surgical data for all patients was recorded, (in Table 1).

Clinical outcomes

Pain relief

Back and leg pain were assessed pre- and postoperatively using a visual analog scale (VAS). Postoperative pain was assessed when the patient could return to daily work. Pain improvement was determined by the change in VAS score (see figure 3). The mean improvement in the VAS score was 6.3 ± 2.3 points for leg pain and 2.7 ± 2.0 points for back pain.

Functional recovery and complications

All the patients in this series could return to their daily activities at 1 or 2 days after surgery (mean, 1.5 ± 0.5 days). The mean time to return to light work was 2.7 ± 0.5 (range, 2-3) weeks. We assessed functional recovery using the Oswestry Disability Index (ODI) when the patient could return to light work (3 weeks postoperatively) and at 3, 6, and 12 months (5 patients) after surgery (see figure 4). The ODI recovery rate was calculated as the preoperative ODI minus the postoperative ODI. The postoperative ODI recovery rate was high, with a mean of 55% ± 10%.

Surgical outcomes were evaluated at 6 months postoperatively using MacNab's criteria.

Outcomes were considered excellent and good in 3 cases each. No intraoperative or postoperative complications have been recorded, and no recurrence has been reported to date.

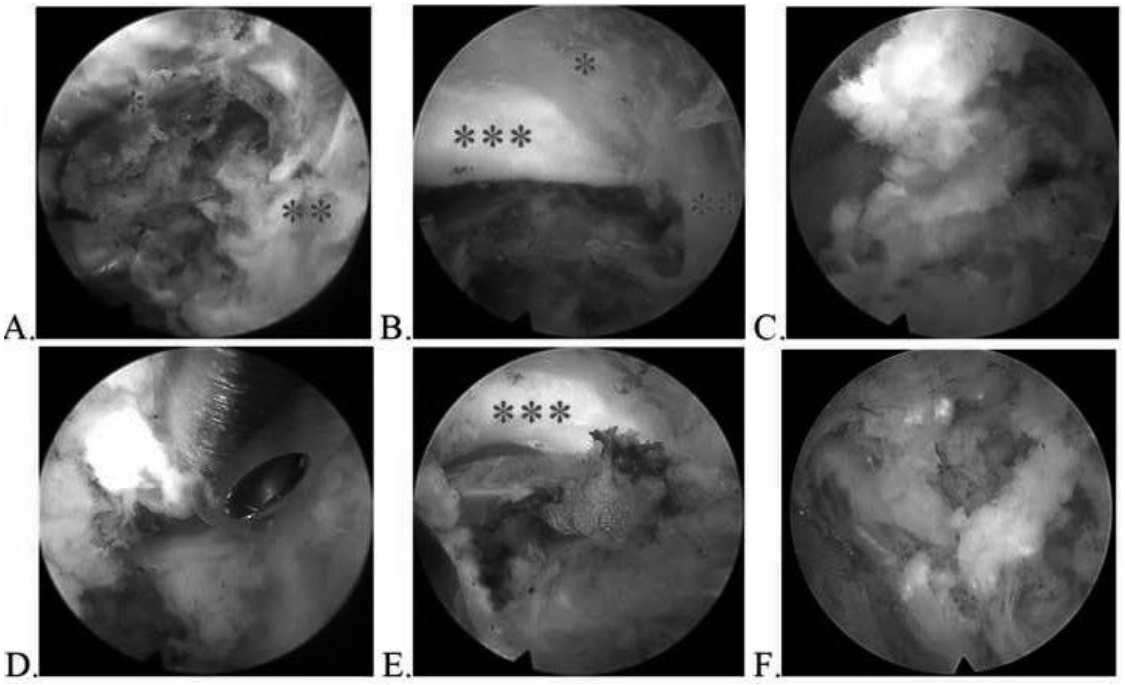

Figure 2. Endoscopic view during surgery
(A) Initial view after endoscope insertion. (B) View after foraminotomy with central advancement. (C) Removal of the herniated disc mass using the outside-in technique. (D) Intradiscal discectomy. (E) Decompression of the transverse nerve root (following C and D). (F) Decompression of the exiting nerve root after foraminoplasty. *Superior articular process. **Pedicle of the inferior vertebra. ***Ligamentum flavum (visualized after foraminotomy). The blue arrow indicates the transverse nerve root, and the green arrow indicates the exiting nerve root.

Table 1. Demographic, clinical, and surgical data for the 6 cases in this series

Pt No, sex, Age (years)	PreOp VAS	PreOp ODI	Radiating pain	MRI diagnosis	Surgical procedure	Hospital stays (days)
1, M, 65	VAS-B 3 **VAS-L 9**	68%	Left L5 root	Left L5/S1 FS	Left L5/S1 foraminoplasty	3
2, M, 53	VAS-B 1 **VAS-L 8**	64%	Left L5 root	L4/5 DH	L4/5 discectomy	3
3, F, 47	**VAS-B 7** VAS-L 3	56%	Bilateral S1 roots	L5/S1 DH + HIZ	L5/S1 discectomy + TA	4
4, F, 28	**VAS-B 6** **VAS-L 8**	60%	Bilateral L5 and left S1 roots	L4/5 DH + HIZ L5/S1 DH	L4/5 discectomy + TA L5/S1 discectomy	5
5, F, 58	VAS-B 3 **VAS-L 9**	80%	Right S1 root	L5/S1 DH	L5/S1 discectomy	2
6, M, 43	VAS-B 3 **VAS-L 9**	64%	Right L5 root	L4/5 DH	L4/5 discectomy	4

-B, back pain ; DH, disc herniation ; F, female ; FS, foraminal stenosis ; HIZ, high-intensity zone ; -L, leg pain ; M, male ; MRI, magnetic resonance imaging ; ODI, Oswestry Disability Index ; Pt, patient ; TA, thermal annuloplasty ; VAS, visual analog scale ; PreOp, Preoperative.

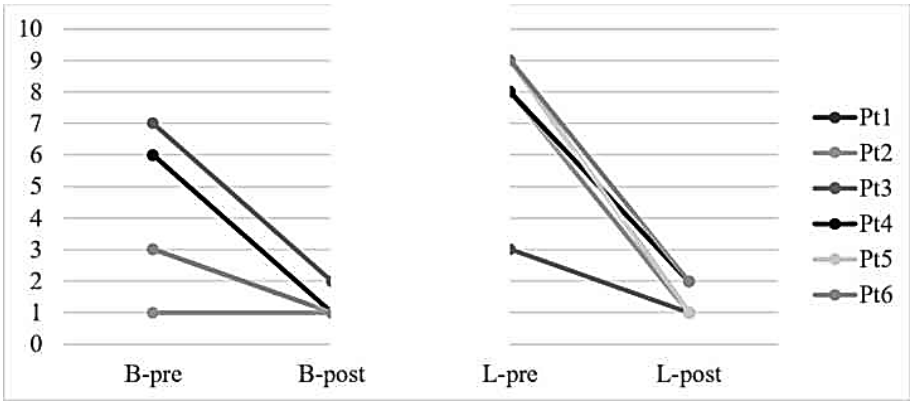

Figure 3. Improvement in pain after surgery. B, back pain ; L, leg pain ; pre, preoperative ; post, postoperative ; Pt, patient.

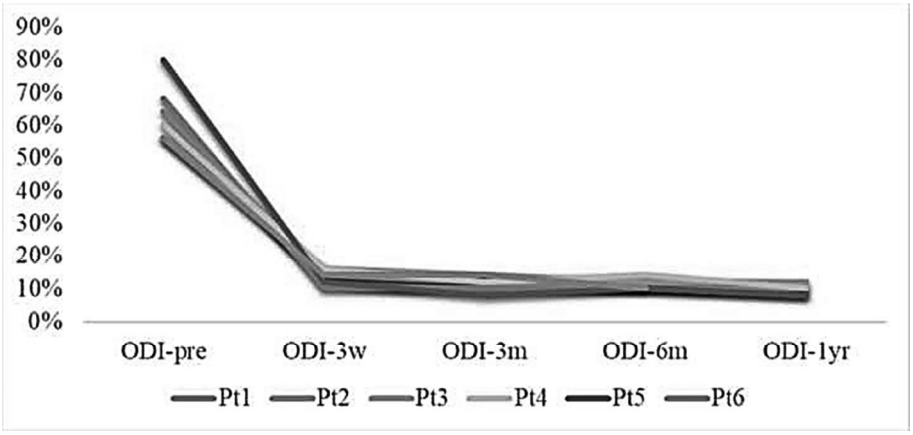

Figure 4. Recovery after surgery as indicated by the ODI. ODI, Oswestry Disability Index. Pt, patient ; pre, preoperative ; w, weeks ; m, months ; yr, year.

DISCUSSION

Effectiveness of local anesthesia for transforaminal full-endoscopic surgery

Local anesthesia with lidocaine has a very rapid onset, usually within 1 min after injection. The standard effective duration is 30-120 min for lidocaine alone and can increase to 60-240 min when mixed with epinephrine. The manufacturers recommend maximum doses of lidocaine 7 mg/kg with epinephrine and 4.5 mg/kg without epinephrine as safe for local infiltration in adults (7). Preoperative intramuscular injection of morphine can reduce pain during percutaneous transforaminal endoscopic discectomy and improve patient satisfaction without affecting the surgical outcome. This method is relatively safe and convenient, with the exception of a higher incidence of nausea and vomiting (8). Furthermore, in a study by Yamaya *et al*., 5 of 113 patients who underwent transforaminal full-endoscopic spine surgery (TF-FESS) under local anesthesia required additional analgesic medication during surgery (9).

All patients in our series were operated on successfully with local anesthesia. The maximum operation time was 100 min and the minimum effective anesthesia time was 135 min. The total amount of lidocaine 1% used was 20-22 ml per level, and 50 μg of fentanyl was administered intravenously before surgery in all patients. Consistent with other reports (10), we attribute the success of local anesthesia in our series to patient cooperation and use of intravenous fentanyl for enhanced pain control during surgery.

Pain relief and functional recovery

A cohort study by Ahn *et al*. also reported significant improvements in VAS pain scores for the back and leg following transforaminal endoscopic surgery (2), highlighting the benefits of this approach over open surgery in terms of recovery and patient satisfaction. Kerimbayev *et al*. similarly reported that back pain decreased by 58.5% and leg pain by 75.1% at 3 months postoperatively in their group that underwent TF-FESS under local anesthesia, with a further reduction of 80.8% for back pain and 98.7% for leg at 1 year after surgery (3). Our present study demonstrated significant reductions in pain, with an average improvement in VAS scores of 6.3 ± 2.3 for leg pain and 2.7 ± 2.0 for back pain. Another study by Casal-Moro *et al*. found that a reduction of at least 15% in the ODI score, as proposed by the US Food and Drug Administration, was clinically relevant in patients who underwent surgery for lumbar disc herniation (11). In our study, we observed a mean ODI recovery rate of 55% ± 10% (range, 42%-72%). Furthermore, in the study by Kerimbayev *et al*., the mean ODI score decreased from 48% before surgery to 18% at 3 months postoperatively, to 17.6% at 6 months, and to 17.1% at 1 year (3). In the study by Ahn *et al*., the mean ODI score decreased from 67.2% before surgery to 15.7% at 6 weeks after surgery and to 8.5% at 1 year, with the same result maintained at 5 years following surgery (2). These findings suggest that this treatment has high clinical efficacy and permits rapid functional recovery.

Our patients returned to their daily activities within a mean of 1.5 days and to work within a mean of 2.7 weeks after surgery, which is consistent with the findings of previous studies (12, 13). The time to return to work is influenced by classification. For example, a study of physicians by Fujii *et al*. (13) found that the recovery time was more rapid for patients with lighter work demands, whereas a study by Takeuchi *et al*. (14) reported that time to return to work was longer in their group with moderate work demands. These findings suggest a relationship between job demand and recovery time. All our patients reported a high level of satisfaction with the surgery based on MacNab's criteria, with 50% being very satisfied and 50% being satisfied, mirroring the positive trends reported by Ahn *et al*. (2).

Complications and recurrence

We have observed no complications or recurrences in our first 6 cases. Several authors have suggested that revision surgery following an endoscopic spinal procedure is generally less challenging than after open surgery because of reduced adhesions and tissue trauma.

However, this technique is also technically demanding and has potential complications, including dural tears (1%-4%), epidural hematoma (1%-2%), nerve root paralysis (2%- 3%), and partial facet joint damage (2%-5%) (15). Severe complications, such as thromboembolism, sepsis, significant bleeding, and pulmonary issues, are less frequent with endoscopic surgery than with open surgery.

Fan *et al*. reported a 9.76% overall complication rate (72/738 cases) for percutaneous transforaminal endoscopic discectomy, with the most common complications being recurrence (2.30%), persistent lumbosacral or leg pain (3.79%), dural tears (1.90%), incomplete decompression (0.81%), surgical site infection (0.41%), epidural hematoma (0.27%), and postoperative pain (0.27%)(16). Ju *et al*. compared complications between transforaminal and interlaminar endoscopic decompression and found that dural tears were more common in interlaminar procedures (2.19%), followed by epidural hematoma (0.76%) and transient sensory disturbances. In transforaminal procedures, transient sensory disturbances (1.46%) were most common, followed by pain (1.20%) and dural tears (1.20%) (17).

CONCLUSION

Full-endoscopic transforaminal lumbar surgery under local anesthesia effectively alleviates pain and improves functional recovery rapidly in patients with lumbar radiculopathy. The advantages of this procedure, including shorter operation time, avoidance of the risks of general anesthesia, shorter hospital stays, and an expedited return to daily activities and work, have contributed to enhanced treatment efficiency and patient satisfaction. While this minimally invasive technique is gaining popularity in lumbar spine surgery, meticulous patient selection and surgical expertise are essential for optimal outcomes.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to Can Tho Central General Hospital, and Can Tho University of Medicine and Pharmacy for their assistance with this work.

AUTHOR CONTRIBUTIONS

Le Minh Duong and Huynh Thong Em designed the study, searched literature, collected clinical data and wrote the manuscript. Nguyen Hoang Thuan, Lam Khai Duy, Huynh Van The, Trang Tien Dat assisted in the selection of the literature and revised the manuscript. Huynh Kim Hieu, Vo Van Thanh, Koichi Sairyo revised and edited the manuscript.

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