Technical Note

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Interlaminar endoscopic contralateral decompression: redefining technique through standardized maneuvers and nomenclature

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Lumbar endoscopic unilateral laminotomy for bilateral decompression (LE-ULBD) is a minimally invasive procedure designed to treat lumbar spinal stenosis. While traditional uniportal endoscopic decompression already reduces tissue damage and promotes faster recovery compared to open surgery, this work introduces standardized terminology and specific endoscope-camera maneuvers to improve visualization and precision during both ipsilateral and contralateral decompression. By describing endoscope ("shaft") and camera head ("optic") rotations in a degree–degree format (e.g., 0–0, 90–0, 135–135, 180–180), the technique allows reproducible, targeted access to key anatomical areas while minimizing unnecessary bone removal. This systematic approach addresses the steep learning curve and technical intricacies of lumbar endoscopy, aiding intraoperative communication and potentially decreasing complications from inadequate decompression or poor visualization. The method aims to improve training, safety, and consistency of outcomes in endoscopic lumbar decompression procedures stenosis.

Keywords: Endoscopy; Spinal stenosis; Lumbar vertebrae; Minimally invasive surgical procedures; Surgical decompression

Introduction

Spine endoscopy development started in the 1930s, when Burman employed arthroscopic tools for "myeloscopies," enabling direct visualization of the spinal cord and nerve roots [1]. Over the past thirty years, minimally invasive spine surgery has quickly progressed, with endoscopic methods becoming more popular because they cause less tissue damage and allow for quicker recovery than traditional open surgeries [2]. Endoscopic surgery has proven especially valuable for degenerative lumbar spinal stenosis, the most common spinal disorder among older adults [3,4].

Among these methods, endoscopic lumbar decompression using a uniportal technique provides a minimally invasive approach for effective neural decompression [5,6]. The AO has formally defined this approach as lumbar endoscopic unilateral laminotomy for bilateral decompression (LE-ULBD), which enables decompression of both sides through a unilateral route [7,8]. The key benefits of LE-ULBD involve maintaining midline structures like the spinous process and ligamentous complex, which help reduce postoperative segmental instability and speed up patient recovery [9]. Studies indicate that LE-ULBD provides comparable results to open laminectomy in alleviating claudication and neurological symptoms, but it results in fewer complications [10,11].

Successfully performing these minimally invasive procedures demands that surgeons develop advanced hand-eye coordination based on indirect video and fluoroscopic guidance, along with refined manipulation of endoscopic instruments—skills that usually take considerable experience to master [12,13]. The use of larger-diameter "stenosis endoscopes" (e.g., 7.1 mm) has enabled more efficient decompression [14,15]. However, the technical complexity still presents a challenge. To improve this, we suggest adopting a standardized nomenclature for endoscopic maneuvers, which will enhance coordination and visualization during both ipsilateral and contralateral decompression LE-ULBD.

Technical Notes

Ethics statement

This study adhered to the principles of the Declaration of Helsinki. The protocol received approval from the Institutional Review Board (IRB) of Indore Spine Centre (IRB No. ECCT2018-0036). Written informed consent was obtained from the patient for participation and the use of intraoperative data images.

Case

A 76-year-old woman presented with low back pain, bilateral lower limb radiculopathy, difficulty walking for over 2 months, and urinary incontinence. Clinical exam showed no significant neurological deficits. Imaging confirmed lumbar canal stenosis at L3–L4 and L4–L5 levels, with bilateral lateral recess stenosis. She is scheduled for a LE-ULBD at L3–L4 and L4–L5 from the right side (Fig. 1).

Surgical technique

The patient is positioned prone, and the target spinal level is identified with fluoroscopy. A small horizontal paramedian incision is made, soft tissues are dilated, and a working cannula is advanced to the lamina.

All procedures in this series were performed using a 15° stenoscope (commercially one of the most widely used angled stenoscopes) with a 10 cm outer diameter and 6 mm working channel, and the described degree–degree maneuvers apply to 15° and 25° endoscopes as well

A stenoscope is inserted, allowing burring of the cranial lamina to expand the interlaminar window. Soft tissues are then removed with a plasma ablation device, exposing the relevant bony landmarks for decompression.

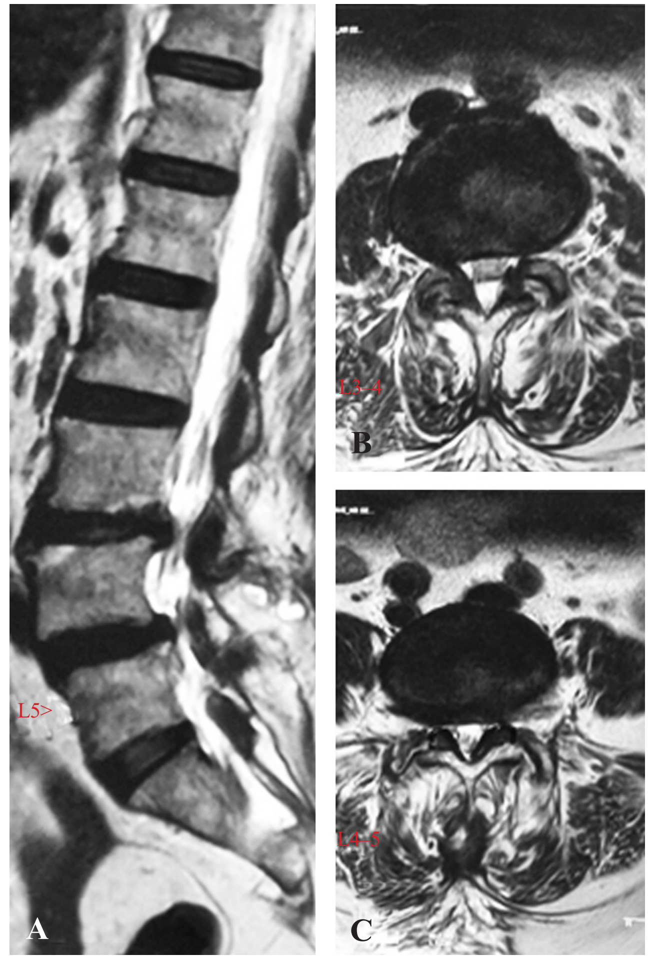

Fig. 1. (A) Magnetic resonance imaging (MRI; sagittal cuts) showing L3–L4 and L4–L5 lumbar canal stenosis with spondylosis. **(B, C)** MRI (axial cuts) at the level of L3–L4 and L4–L5 showing bilateral lateral recess stenosis with significant flavum hypertrophy.

Nomenclature of endoscope and camera rotation

A standardized degree–degree system outlines the rotational positioning of the endoscope shaft and camera head during endoscopic decompression procedures (LE-ULBD).

First degree–endoscope shaft rotation

Describes how the endoscope shaft's angle changes from the surgeon's viewpoint, where 0° is the neutral lateral entry. Clockwise turns (away from the surgeon, toward the dura) increase the angle, potentially up to 135°, while counter-clockwise turns decrease the angle toward neutral or negative values.

Second degree–camera head rotation

Refers to the rotation of the camera head around the optic's axis, which adjusts the top view on the screen. A

Table 1. Summary of all ipsilateral and contralateral maneuvers with nomenclature and its applications

Maneuver	Endoscope–camera rotation	Visual representation (Endoview)	Key anatomical focus	Indications/applications
0–0 Position (neutral)	0° (Endoscope), 0° (Camera)	Lateral entry, optic facing medially	Ipsilateral lamina, IAP, inferior border of cranial lamina	Initial docking; effective for ipsilateral decompression; limited contralateral access due to instrument obstruction.
90–0 (cranial tilt)	90° (Endoscope), 0° (Camera)	Cranial tilt, optic facing caudally	Ipsilateral caudal lateral recess, IAP, flavum, lateral border of the traversing root	IAP resection, flavum removal, and lateral root decompression on ipsilateral side to medial to caudal pedicle
90–0 (caudal tilt)	90° (Endoscope), 0° (Camera)	Caudal tilt, optic facing cranially	Ipsilateral cranial lateral recess, lamina-IAP junction, superolateral flavum, shoulder of the traversing root	Lamina-IAP junction burring and decompression of the traversing root.
180–180 (inverted view)	180° (Endoscope), 180° (Camera)	6 o'clock entry, optic directed medially	Contralateral lateral recess, contralateral IAP, overhanging flavum	Access to contralateral pathology; visualization of dead interlaminar space, flavum, and IAP.
135–135 (cranial tilt)	135° (Endoscope), 135° (Camera)	Cranial tilt, optic facing medially	Contralateral caudal lateral recess, lateral border of the traversing root, caudal pedicle	Decompression of contralateral root and flavum removal while maintaining native anatomical orientation.
135–135 (caudal tilt)	135° (Endoscope), 135° (Camera)	Caudal tilt, optic facing medially	Contralateral cranial lateral recess, shoulder of the traversing root, upper discal margin	Decompression of contralateral root and flavum removal at the upper discal margin, maintaining native anatomical view.

IAP, inferior articular process.

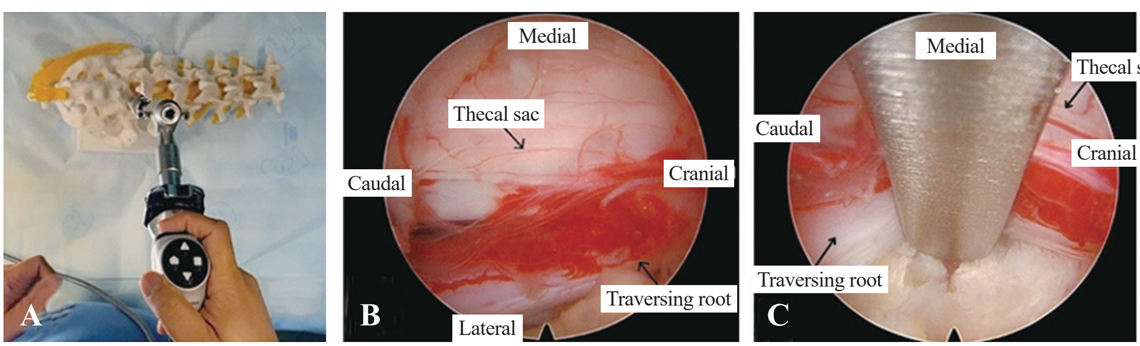

Fig. 2. 0–0 (Neutral view) maneuver: showing neutral position of endoscope with camera also in neutral position **(A)**, interlaminar endoscopic view showing thecal sac and traversing root **(B)**, and entry of the instrument from 12 o'clock position **(C)**.

0° position places dorsal anatomy at the top. Clockwise rotations (90°, 180°, 270°) modify the orientation to improve surgeon ergonomics and visualization.

Endoscopic maneuvers using the above nomenclature for ipsilateral and contralateral decompression

We outline six key endoscopic maneuvering positions according to the proposed degree–degree nomenclature, facilitating accurate and reproducible approaches to both ipsilateral and contralateral pathology during LE-ULBD posterior stenoscopic lumbar decompression (PSLD) (Table 1).

Ipsilateral maneuvers

0–0 (Neutral view)

The endoscope enters laterally with its optics facing medially, with the camera in an upright position. This setup offers optimal visualization for ipsilateral bone work, including the inferior cranial lamina, ipsilateral lamina, and inferior articular process (IAP). However, it provides limited exposure on the contralateral side due to instrument positioning (Fig. 2).

90–0 (Caudal tilt)

Using the same endoscope rotation, tilting caudally directs focus to the cranial part of the ipsilateral recess, aiding in visualization of the lamina-IAP junction, superolateral flavum, and shoulder of the traversing root (Fig. 3).

90–0 (Cranial tilt)

Rotating the endoscope 90° medially while keeping the camera upright improves visualization and access to the caudal ipsilateral lateral recess. This position is ideal for IAP removal, flavum dissection, and exposing the traversing nerve root axilla (Fig. 4).

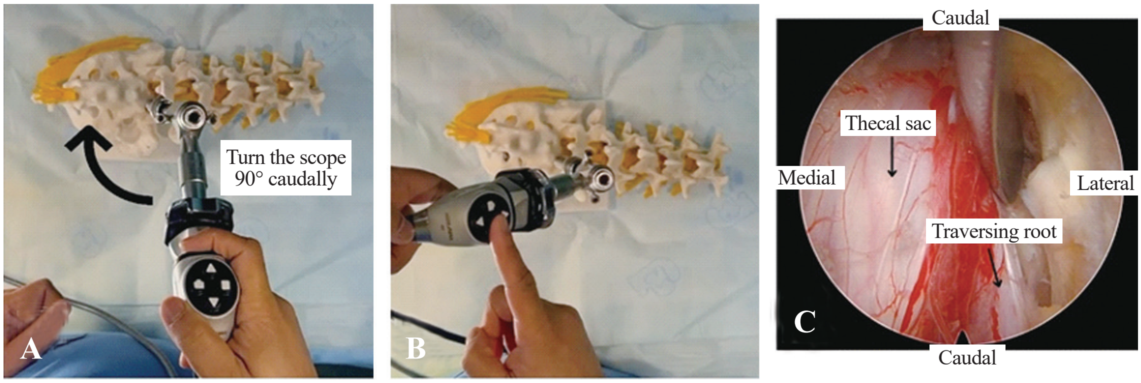

Fig. 3. 90–0 Caudal maneuver: endoscope in neutral position with arrow indicating the movement of endoscope **(A)**, 90° caudal rotation of scope with camera in neutral rotation **(B)**, and interlaminar endoscopic view showing thecal sac and traversing root and entry of the instrument from 12 o'clock position **(C)**.

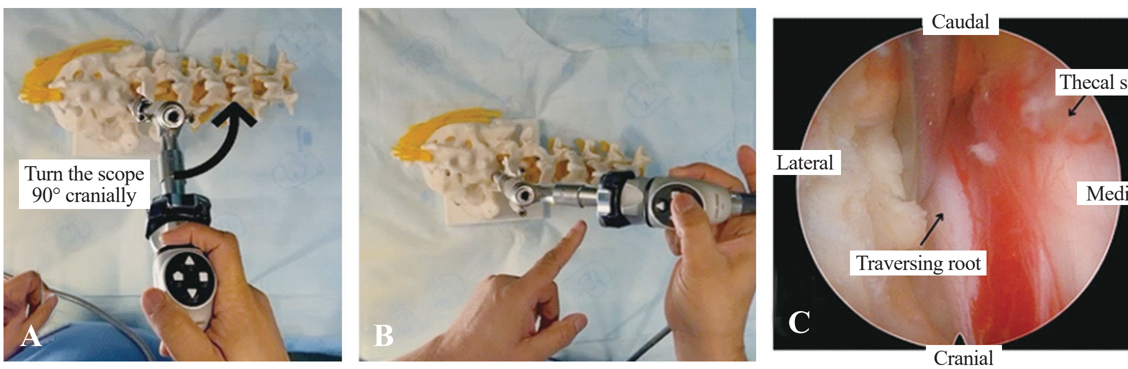

Fig. 4. 90–0 Cranial maneuver: endoscope in neutral position with arrow indicating the movement of endoscope **(A)**, 90° cranial rotation of scope with camera in neutral rotation **(B)**, and interlaminar endoscopic view showing thecal sac and traversing root and entry of the instrument from 12 o'clock position **(C)**.

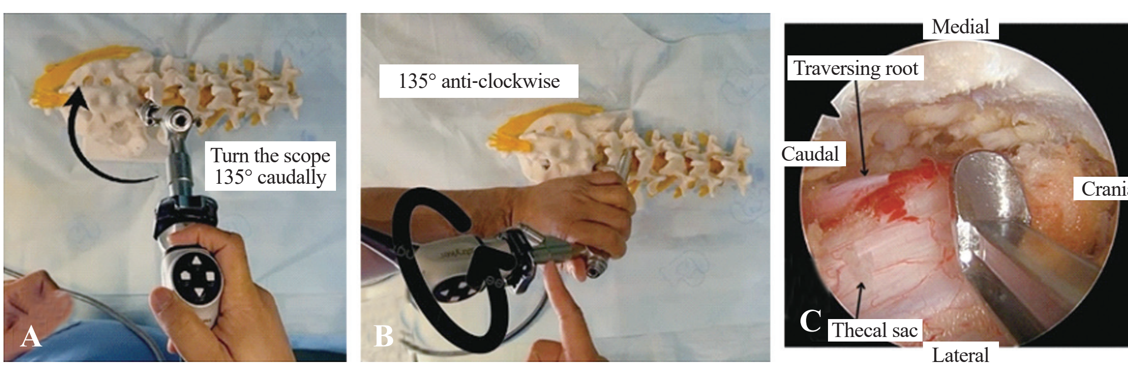

Fig. 5. 135–135 Caudal maneuver: endoscope in neutral position with arrow indicating the 135° caudal movement of endoscope **(A)**, 135° cranially rotated scope with 135° anti-clockwise camera rotation **(B)**, and interlaminar endoscopic view showing thecal sac and traversing root and entry of the instrument opposite to the arrow cranio-laterally **(C)**.

Contralateral maneuvers

135–135 (Caudal tilt)

Same rotations with a caudal tilt target the superior contralateral recess, which is essential for removing the superolateral flavum and decompressing around the traversing root's shoulder, ensuring complete nerve clearance (Fig. 5).

135–135 (Cranial tilt)

Rotating both the endoscope and camera by 135°, along with cranial tilting, enhances visualization of the inferior contralateral lateral recess for contralateral decompression and flavum work, all while preserving the native anatomy orientation (Fig. 6).

180–180 (Inverted native view)

Both the endoscope and camera are rotated 180°, en-

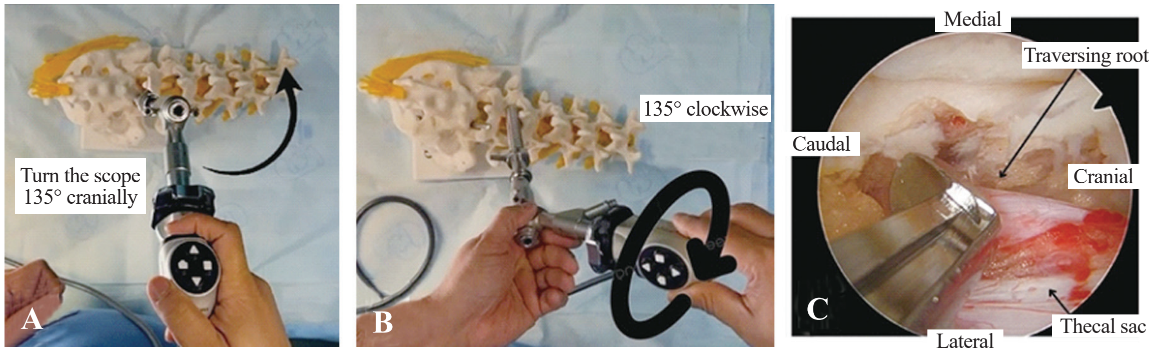

Fig. 6. 135–135 Cranial maneuver: endoscope in neutral position with arrow indicating the 135° cranial movement of endoscope **(A)**, 135° caudally rotated scope with 135° clockwise camera rotation **(B)**, and interlaminar endoscopic view showing thecal sac and traversing root and entry of the instrument opposite to the arrow caudo-laterally **(C)**.

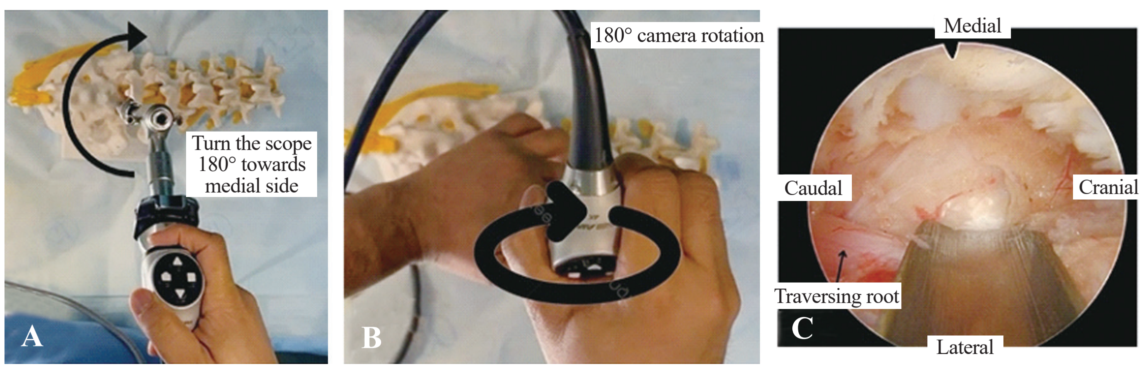

Fig. 7. 180–180 Inverted maneuver: endoscope in neutral position with arrow indicating the 180° cranial movement of endoscope **(A)**, 180° inverted rotated scope with 180° clockwise camera rotation **(B)**, and interlaminar endoscopic view showing contralateral aspect with entry of instrument from 6 o'clock position **(C)**.

abling instruments to approach from the 6 o'clock position. This provides direct access to the contralateral lateral recess, IAP, and overhanging flavum, targeting the anatomical blind spot spots (Fig. 7).

After decompressing the dura and nerve root, the cannula was taken out, and the wound was sutured and bandaged. Postoperatively, the patient reported relief from leg pain and demonstrated improved walking ability at 6 weeks.

Discussion

Standardization and addressing the learning curve

This study introduces a new standardized nomenclature for describing endoscope and camera maneuvers in lumbar endoscopic spine surgery, specifically for LE-ULBD and PSLD procedures. The system defines exact endoscope shaft and camera rotations to enhance visualization during interlaminar and transforaminal approaches. By improving visual clarity and minimizing unnecessary bone removal, the nomenclature aims to improve surgical outcomes, facilitate intraoperative communication, support surgeon training, and establish a foundation for future research.

Endoscopic spine surgery complexity arises not only from patient anatomy and pathology but also from the technical challenges inherent to minimally invasive techniques [16]. Beginners are advised to start with simpler cases, such as lumbar disc herniations, because of more accessible anatomy. Conversely, lumbar central or lateral recess stenosis requires advanced skills and flexible instruments to carefully remove bone and ligamentous structures [13]. Mastery of endoscopic visualization, including interpreting the monitor display, is achieved through continued practice. Using powered burrs or ablation tools can temporarily impair vision by creating bone dust ("white-out") and bleeding ("red-out"), complicating the surgical field. Poor visualization can jeopardize both patient safety and the thoroughness of decompression, emphasizing the importance of thorough preoperative assessment and tailored intraoperative adjustments based on surgeon experience and equipment.

Despite growing interest in endoscopic spine surgery over the last decade, formal training remains scarce in most residency and fellowship programs [17]. Although only a few academic centers provide dedicated curricula, this situation is gradually evolving. Simulation-based training and educational platforms can improve skill development where structured programs are absent [18]. Some surgeons attend brief cadaveric workshops for initial exposure, but achieving proficiency generally requires performing up to 70 cases [19]. Mentored training with experienced surgeons indicates a learning curve of about 15 cases to attain basic decompression skills. However, early results may still be slightly less favorable compared to traditional open surgery [13,20].

Preventing complications in interlaminar endoscopy

Although endoscopic interlaminar decompression is minimally invasive, it can still lead to complications. Komp et al. [21] found a 3.3% complication rate—excluding transient issues—in their prospective study of bilateral decompression using the full-endoscopic interlaminar method. The study identified temporary postoperative dysesthesia, urinary retention, dural tears, and one case of preexisting foot paresis worsening. Importantly, two patients needed revision fusion due to persistent or worsening symptoms, underscoring the importance of careful patient selection and monitoring for adverse events, even in less invasive procedures.

Kim et al. [22], in their retrospective review, pointed out incomplete foraminal decompression as a significant complication following contralateral decompression with an interlaminar endoscopic approach. Likewise, a review by Kim and Ju [23], analyzing 48 studies on full-endoscopic lumbar decompression, reported common complications such as dural tears, epidural hematoma, dysesthesia, incomplete decompression, persistent pain, motor deficits, and rare instances of cauda equina syndrome. These results highlight the importance of careful patient selection and technical skill to minimize adverse outcomes.

Complete endoscopic interlaminar decompression is recognized as a safe and effective method for treating lumbar spinal stenosis, though it is technically challenging. Complications related to the procedure can be reduced by ensuring better visualization, controlled irrigation, and preserving crucial anatomical structures. The standardized techniques introduced in this study are designed to improve surgical accuracy and consistency. Additionally, these strategies help new surgeons develop their skills more efficiently in endoscopic spine surgery. Widespread implementation could result in enhanced safety, improved patient outcomes, and greater acceptance of the technique.

Key Points

- Novel nomenclature introduced: A standardized degree–degree system is proposed to describe the rotations of the endoscope shaft and camera, enhancing visualization and precision.
- Technical complexity: Endoscopic spine surgery presents a steep learning curve, particularly for complex stenosis cases, because of challenges in visualization and manipulation.
- Need for structured training: There is limited formal training available; gaining surgical skills relies heavily on hands-on experience and cadaveric workshops.
- Visualization challenges: Clear intraoperative visualization is essential, as debris and bleeding are common obstacles to ensuring safety decompression.
- Benefits of standardization: The proposed system enhances communication, training, and consistency, potentially improving outcomes in endoscopic spine procedures surgery.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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