

ILLUSTRATIVE ORIGINAL SURGICAL VIDEO

Minimally invasive tubular microdiscectomy: a video-based guide

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Tubular microdiscectomy (TM) offers a minimally invasive alternative to open lumbar discectomy. Using a small port, surgeons can access the herniated disc with minimal tissue disruption and achieve effective neural decompression. This video-based article provides a comprehensive step-by-step guide to TM, from patient positioning to final decompression, emphasizing strategies for safe and effective outcomes.

Keywords: minimally invasive spine surgery, tubular microdiscectomy, lumbar disc herniation, surgical video, operative technique

Introduction

Tubular microdiscectomy (TM) has become a preferred minimally invasive spine surgery (MISS) technique for managing lumbar disc herniation. Level I evidence demonstrates its advantages over conventional open discectomy (OD), including effective decompression, minimal tissue trauma, quicker recovery, reduced analgesic requirements, and shorter hospital stays. Here, we present a structured operative workflow with safety-focused strategies to optimize outcomes and minimize complications (1).

Background

Caspar and Yasargil pioneered microneurosurgery for lumbar discs, introducing microdiscectomy. By minimizing incision size and sparing paraspinal structures, microdiscectomy reduced approach-related morbidity while maintaining surgical efficacy. TM, first described by Foley et al. (1), refined these principles by introducing a tubular retractor (TR) system. The TR, placed over sequential dilators, creates a muscle-splitting pathway to the spine. This system allows surgeons to use both hands effectively for procedures such as discectomy, laminotomy, foraminotomy, and complex fusions.

Methods

The surgical procedure is illustrated using high-definition (HD) intraoperative video footage and a stepwise technique for TM using a modified retractor system, covering patient positioning, incision marking, retractor docking, microscopic discectomy, and root decompression. Key strategies such as maintaining optimal visualization, minimizing muscle trauma, careful handling of neural structures, and preventing durotomy are emphasized throughout. Technical pearls and potential pitfalls are discussed in each step to enhance procedural safety (2, 3).

Surgical steps

The patient is positioned on Wilson's frame on an operating table under general anesthesia (GA). The use of Wilson's frame allows suspension of the abdomen, preventing raised intraabdominal pressure, in turn reducing the blood loss during surgery and opening of the interlaminar space. Care should be taken to position the patient as far as possible towards the caudal end of the table so that the base of the operating table does not obstruct the fluoroscopy unit.

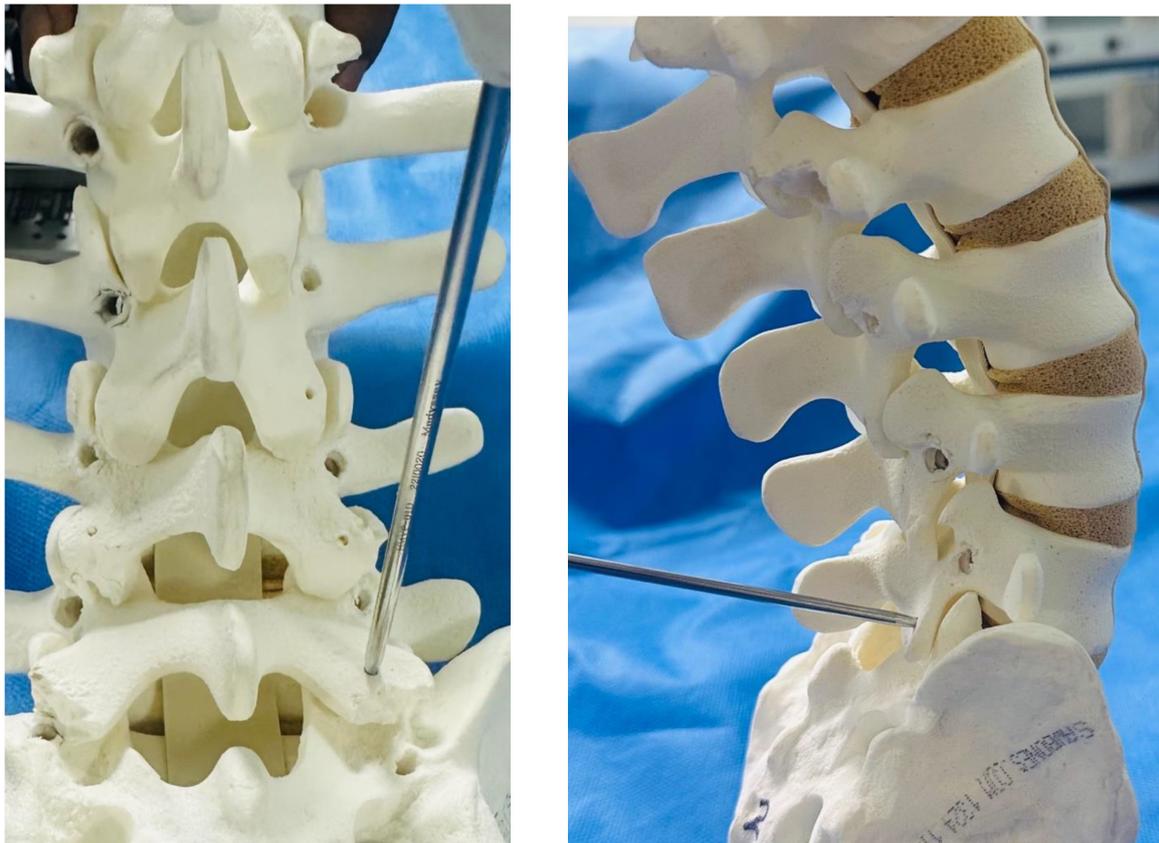


FIGURE 1 | (A) Localization with Jamshedi-AP orientation. **(B)** Sagittal orientation.

A wide area of the dorsal spine is painted and cleaned; the surgeon should stand on the side of the pathology, and the fluoroscopy unit should be brought in draped and under the table. The midline is then marked using fluoroscopy, and a parallel line 15 mm lateral to the midline is drawn where the incision will be marked. A 22-gauge spinal needle is inserted through the skin along the trajectory that bisects the disc space. A 25 mm vertical skin incision is made with the needle mark as the midpoint and is carried to the subcutaneous and fascial planes. A sharp guidewire or K wire is then introduced through the parked Jamshedi needle at the desired level of the pathology with fluoroscopic guidance. The serial dilators are then brought in after the initial dilator is introduced through the K-wire (**Figures 1A and B**). The anatomical landmarks, such as the medial facet, lower edge of the lamina, and spinous process, should be palpable (**Figure 3**) with the tip of the initial dilator. Once the trajectory is reconfirmed the TR is brought in over the final dilator and docked (**Figure 2**). The flexible arm that is fixed on the contralateral side of the operating table is then used to hold the TR.

The Globus TR expands about 22 mm craniocaudally with an additional medial arm for excellent visualization. The microscope is brought into the operative field over the TR. The muscle and soft tissue dissection is done with monopolar cautery, and hemostasis is achieved. Once all the anatomical

landmarks are identified (**Figure 3**), the inferior edge of the upper lamina is defined, and laminotomy is done using a high-speed drill, leaving at least 5–6 mm of pars intact until the superior visualization of the ligamentum flavum. To gain additional exposure, unlike the traditional TR that can be “wanded”—a process in which the largest dilator is reinserted into the TR, the flexible arm is loosened, and the retractor is angled while applying a steady downward pressure to avoid unwanted soft-tissue encroachment on the operative corridor. Globus TR does not require the wanded process, as it has bolts in the craniocaudal arms that open, providing excellent operative field exposure. Flavectomy is done similar to OD to visualize the thecal sac and the traversing root. Foraminotomy is done, and a dural guide or a ball-tip probe is used to check the same, and this completes the dorsal and foraminal decompression. A nerve root retractor is placed to protect and retract the traversing root to expose the annulus. A box-shaped annulotomy is done, and the herniated disc fragments are removed. All of the disc fragments are removed using straight and angled disc or pituitary rongeurs and curettes. After discectomy, a final wash is given in the disc space to wash out any loose fragments. An absorbable gelfoam is placed over the thecal sac and root and the TR is then removed. The fascia is closed watertight, and the skin is closed using an absorbable monocryl suture.



FIGURE 2 | Serial dilators docking on the facet joint.

Results

This video serves as a practical guide for spine surgeons aiming to refine their minimally invasive discectomy technique.

Discussion

Minimally invasive TM has emerged as a viable and often superior alternative to conventional OD for lumbar disc herniation. Several randomized controlled trials and



FIGURE 3 | Final retractor docked with all the important landmarks as shown.

systematic reviews have demonstrated that TM achieves equivalent or better clinical outcomes while minimizing approach-related morbidity (1).

Advantages of tubular microdiscectomy

Compared with OD, TM offers several key benefits:

Reduced tissue trauma—By splitting rather than detaching paraspinal muscles, TM decreases muscle ischemia, denervation, and postoperative atrophy, leading to faster recovery and reduced long-term back pain (2).

Lower blood loss—The smaller incision and targeted exposure reduce intraoperative bleeding (3).

Shorter hospitalization and faster return to work—Patients undergoing TM consistently show reduced hospital stays and earlier resumption of daily activities (2, 3).

Lower postoperative analgesia requirements—Decreased muscle dissection translates to less postoperative pain and reduced narcotic use (4).

Cosmetic advantage—The incision, usually less than 2.5 cm, leaves a smaller scar and better cosmetic outcome (5).

Reduced infection risk—The minimal exposure and reduced tissue devascularization lower infection rates compared to OD (1).

Disadvantages and limitations

Despite these advantages, TM is not without limitations:

Steeper learning curve—Surgeons require familiarity with TRs, microscope handling in confined spaces, and fluoroscopic navigation (6).

Longer operative time in early experience—Surgeons in the learning phase may initially take longer compared to OD (2).

Intraoperative complications—The risk of durotomy (7–10%) and nerve root injury, although low, remains a concern (6).

Limited visualization in complex cases—TM may be less effective in patients with large central herniations, migrated fragments, or severe spinal stenosis, where wider decompression is required (7).

Overall evidence

Despite these challenges, the body of evidence suggests that TM is at least as effective as OD, with clear benefits in recovery profile and reduced morbidity. A large randomized controlled trial by Arts et al. reported similar neurological outcomes between TM and OD but demonstrated significantly lower blood loss and faster recovery in the TM cohort (2). Lau et al. and Overvest et al. further confirmed that long-term pain and functional outcomes are comparable, while patient satisfaction and return-to-work times favor TM (3, 4).

In summary, TM represents an evolution of surgical technique that prioritizes patient recovery and minimizes collateral tissue injury. While it demands surgical expertise and careful patient selection, its advantages over OD make it a preferred option for lumbar disc herniation in many centers.

Key surgical steps

Positioning: Prone on Wilson's frame with a flexible arm.

Accurate docking: Confirm anatomical landmarks with fluoroscopy before TR placement.

Visualization first: Maintain a clear surgical field after clearing the muscle bulk and identifying the key bony landmarks under the microscope.

Gentle neural handling: Use minimal retraction and avoid prolonged compression of nerve roots.

Stepwise decompression: Sequentially remove disc fragments while preserving normal anatomy.

This HD surgical video presents the operative workflow in sequential steps, highlighting anatomical landmarks, safe tissue handling, and technical pearls.

VIDEO 1 | Illustrative video of tubular microdiscectomy.
<https://youtu.be/Fz3CYYXzWLC>

Transcript outline (video commentary)

1. Patient positioning and incision planning with fluoroscopy.
2. TR docking.
3. Laminotomy and ligamentum flavum removal.
4. Microscopic discectomy and nerve root decompression.
5. Final inspection and hemostasis.
6. Wound closure.

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Conflict of interest

The authors declare no financial or personal relationships with any organizations that could inappropriately influence the content of this article. The mention of specific brand names or products is solely for accurate identification of the surgical instruments used and does not imply endorsement of one product over another.

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