

Endoscopic surgery in lumbar spine diseases

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Endoscopic techniques for lumbar spine surgery have evolved into a safe and effective alternative to conventional microsurgical procedures. Minimally invasive procedures offer significant advantages by reducing approach-related muscle and tissue trauma, perioperative blood loss, postoperative pain, and length of hospital stay. The introduction of tubular endoscopic systems has facilitated the use of bimanual microsurgical techniques, enabling precise decompression of neural structures with a favorable learning curve. This article outlines the use of the EasyGO! endoscopic tubular system in degenerative disease of the lumbar spine, with a particular focus on the technical nuances of the approach. Endoscopic lumbar decompression using the tubular system represents safe and effective option for the treatment of degenerative spinal pathologies.

Keywords: endoscopic spine surgery, minimally invasive spine surgery, tubular endoscopic system, EasyGO!, microendoscopy, lumbar stenosis, lumbar disc herniation

Introduction

Low back pain due to degenerative diseases is one of the most common reasons for consulting a doctor in the country. In the western neutralized country, the degenerative spinal disease is more common because of the aging population as well as less activity. On the other hand, the intervertebral disc prolapse is more common in the non-industrialized countries because of the work conditioning as well as heavy weight and less practice of sports.

When M.G. Yasargil and Caspar published in 1977 about using the microscope to perform microdiscectomy and medial facetectomy through a small incision, resulting in reduction of postoperative pain and fibrosis, the microsurgical procedure became the gold standard in the treatment of degenerative spinal disorders.

The development of instrumentation systems has contributed to the advancements in herniated intervertebral disc removal for lumbar spine conditions. These developments have been particularly significant, particularly in the 1990s, when significant progress has been seen in the fields of endoscopic optics and digital cameras. These technological advances have facilitated minimally invasive procedures through small incisions, allowing for more precise and effective treatment.

In comparison to the traditional conventional surgical procedure, the endoscopic surgical procedures is less traumatic for the muscle as well as for all the tissues; also, it reduces the duration of stay in the hospital, which is a very important factor in the industrial countries. Moreover, there is a significant reduction in the blood loss as well as the postoperative pain complaints (1).

In recent years, almost all cases of degenerative spinal disease can be treated minimally invasively, including minimally invasive decompression or discectomy. In this chapter, we will introduce the steps of endoscopic surgical therapy of degenerative spinal disease using the second-generation tubular endoscopic system. The bimanual microsurgical technique, which is employed in the tubular endoscopic system, is the primary advantage of the tubular system. This technique enables a more expeditious learning curve in comparison to other systems (2, 3).

Instrumentation

In this chapter, the author will describe the use of the endoscopic tubular system dilators (**Figure 1**) and trocars (**Figure 2**) Easy Go, which consist of various lengths



FIGURE 1 | Dilators in different lengths and diameters.



FIGURE 2 | Different trocars.



FIGURE 3 | Endoscope holder.

and diameters of trocars (**Figure 2**), endoscope holders (**Figure 3**), and working attachments.

This system has three different colored trocars (**Figure 2**): orange which has a diameter of 15 mm; green, with a 19 mm diameter, and black, which has a 23 mm diameter. Depending on the surgical site, the author uses, in most cases, the green trocar; off course, with obesity, the black trocar can be used.

The trocar should be fixed to the fixation arm via a snap-in mechanism at the proximal end of the fixation arm (**Figure 4**). The apparatus was then affixed through the distal end of the arm at the surgical table.

The endoscope is composed of three distinct components, each with a specific length. The author predominantly utilizes the middle component. This endoscope features a

90-degree angle and is connected to the endoscopy unit in a position that is distant from the surgical field (see **Figures 4** and **5**). The endoscope is fixed to the trocar via a small groove and a small fixation screw, ensuring its stability during the procedure.

Operative technique

In this chapter, the author will delineate the surgical steps involved in performing a lumbar spine decompression using the Easy Go. The author will cover the operating technique, patient positioning, planning the surgical approach, and intraoperative tips and tricks to perform the surgery and achieve the surgical goal without complication.

Generally, the patient is always under general anesthesia with endotracheal intubation. Here it is very important to take care of decompression of the abdomen by using



FIGURE 4 | Fixation arm and optic fixed on the trocar.



FIGURE 5 | Camera.



FIGURE 6 | Patient position on the table.

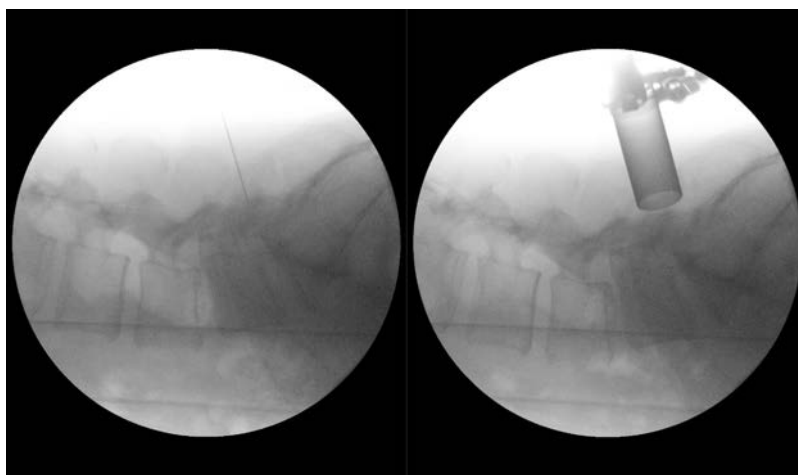


FIGURE 7 | Insertion of the localization needle and dilators.



FIGURE 8 | Dilatation using different diameter dilators.

sufficient decompression pillows, which leads to decreasing the intra-abdominal pressure (**Figure 6**). Increased intra-abdominal pressure leads automatically to congestion of the veins in the operating site, especially the epidural veins, leading to increased intraoperative bleeding.

It is imperative that the patients be positioned centrally on the operating table to ensure optimal ergonomics for the surgeon. The distal end of the fixation arm is securely fastened to the surgical table. The fixation arm's positioning relative to the surgical table is contingent upon the targeted segment. In the L5/S1 segment, the fixation arm is to be positioned in a manner that ensures the connection between the trocar and the proximal end of the fixation arm utilizes the snap-in mechanism in a caudal-to-cranial direction. This configuration is necessitated by the orientation of the L5/S1 intervertebral disc, which is invariably oblique to

the midline. In contrast, the connection between the trocar and the proximal end of the fixation arm is oriented from cranial to caudal in other lumbar segments. The C-arm must be in apposition to perform lateral X-rays without disturbing the surgeon.

Following the completion of adequate skin preparation and the application of draping, it is imperative to ascertain the functionality of the instruments utilized, namely the drill and the bipolar system. The localization needle is then employed in conjunction with lateral fluoroscopy to ascertain the intended surgical trajectory. The insertion of the localization needle is a critical component of the procedure.

The needle must be oriented parallel to the intervertebral disc, that is, perpendicular to the targeted lamina. The insertion of the localization needle represents a critical step in this procedure. It is paramount that the needle be positioned parallel to the intervertebral disc, which is to say, perpendicular to the targeted lamina. The strategic placement of this needle is essential, as it ensures that the surgeon can achieve sufficient decompression and utilize the full diameter of the trocar to access the target segment (**Figure 7**).

After accurately positioning the localization needle, a skin incision approximately 2 cm in length should be made, typically about 2 cm from the midline. It is crucial at this point to ensure the muscle fascia is properly opened, as many beginners tend to neglect this step and attempt to insert the dilators forcefully to penetrate the fascia.

The next phase of the procedure involves serial dilation of the soft tissues and intrinsic muscles, guided by continuous



FIGURE 9 | Fixation of the trocar, endoscope holder, and endoscope.

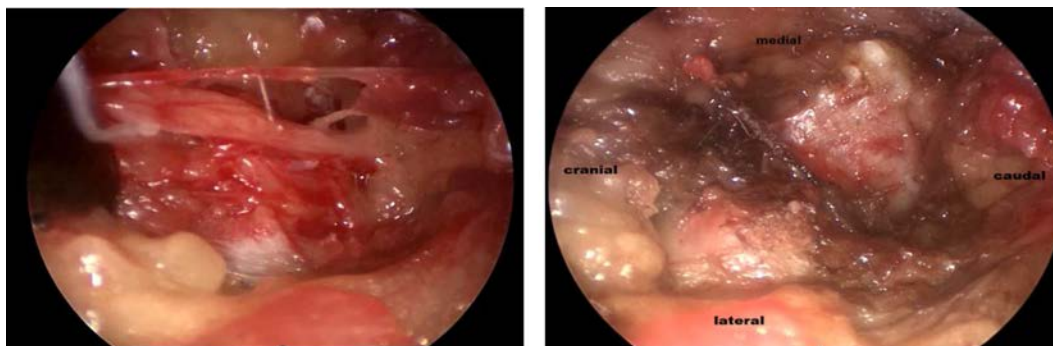


FIGURE 10 | Using the instrument to remove the tissue and expose the bone.

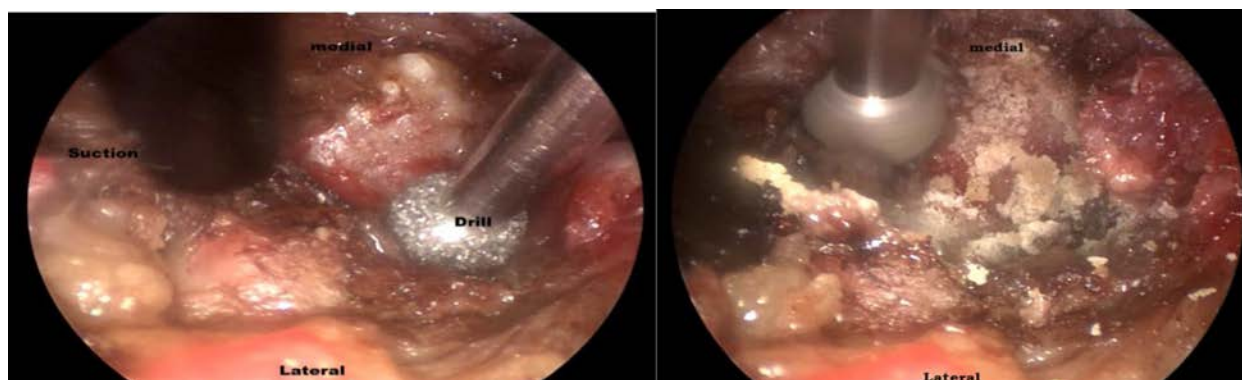


FIGURE 11 | Using the diamond burr to thin the lamina.

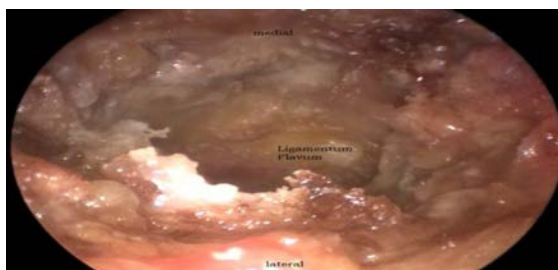


FIGURE 12 | Exposure of ligamentum flavum.

fluoroscopic imaging. This process uses a color-coded dilator set to incrementally increase the tube diameter (**Figure 8**). During insertion of the first dilator, attention should be taken to avoid excessive pressure application, which can cause compression of the neural structure through a widened intralaminar window.

After ensuring the dilators are properly positioned, insert the correct trocar and connect it to the fixation arm's proximal end (**Figure 9**). The endoscope holder must be placed over the trocar through a slight pressure to ensure that the holder is fixed over the trocar. The endoscope holder can be rotated at will on the proximal end of the trocar until it is securely fastened with the turnscrew. After this, the endoscope can be introduced.

The next step is to use the bipolar cautery, and graspers are used to remove the tissue to reach an adequate exposure of

the osseous part of the spinous process, the lamina, and the interlaminar space (**Figure 10**).

Disc herniations

After exposing the upper bony lamina and medial facet joint using Cautery and Kerrison with bimanual techniques. Using the diamond burr to initiate the procedure involves thinning the upper lamina and partially resecting the medial facet joint. Once the bony structures are thinned and the ligamentum flavum is exposed, proceed with caution. With the nerve, hook detachment of the ligamentum flavum from the ventral aspect of the upper lamina (**Figures 11 and 12**).

After exposure of the ligamentum flavum is achieved, it should be resected using the Kerrison Rongeurs laterally away from the dura to avoid injury to the neural structures. This step should be carried out in medial to lateral and cranial to caudal directions (**Figure 13**).

The dural sac and nerve root origin are then carefully exposed and decompressed using the small nerve hook and dissector. Depending on local findings, it may be possible to mobilize the nerve root and dural sac medially. Epidural veins should be coagulated with bipolar forceps prior to incision (**Figure 14**).

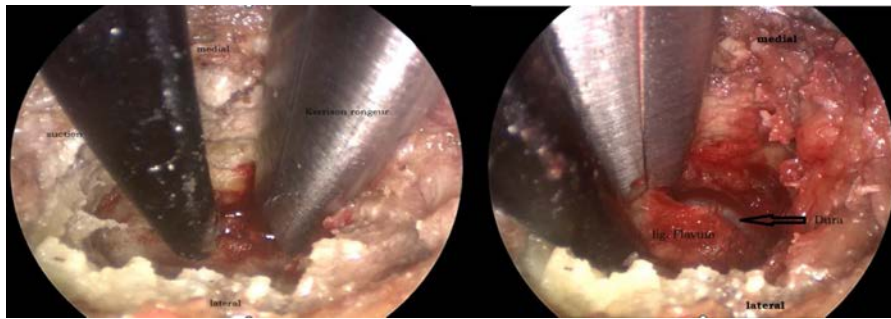


FIGURE 13 | Resection of the ligamentum flavum.

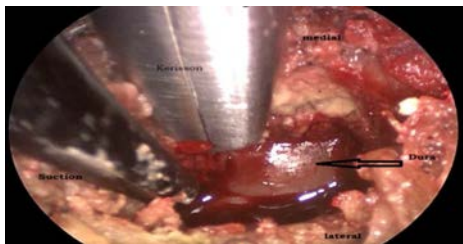


FIGURE 14 | Exposure of dura and nerve root.

Lumbar stenosis

- After positioning the trocar in the target segment and fixing it to the arm, expose the bony lamina as described for disc herniation. In this situation, using the diamond burr to thin the lamina starting from the upper lamina.
- After sufficient exposure of the ligamentum flavum is achieved, then using the diamond burr or the Kerrison to drill the base of the base of the spinous process to perform the undercutting to contralateral (**Figure 15**).
- Resection of the ligamentum flavum using the Kerrison rongeurs lateral away from the dura to avoid injury to the neural structures. This step should be carried out in medial to lateral and cranial to caudal directions (**Figure 13**).
- Residual bony or Ligamentous tissue is removed/drilled to extend decompression.
- If there is intraoperative bleeding, a surgical Gelfoam can be applied to hemostasis (**Figure 16**).
- The decompression direction must always be done cranial to caudal as well as medial to lateral in order to avoid injury to the nerve root.

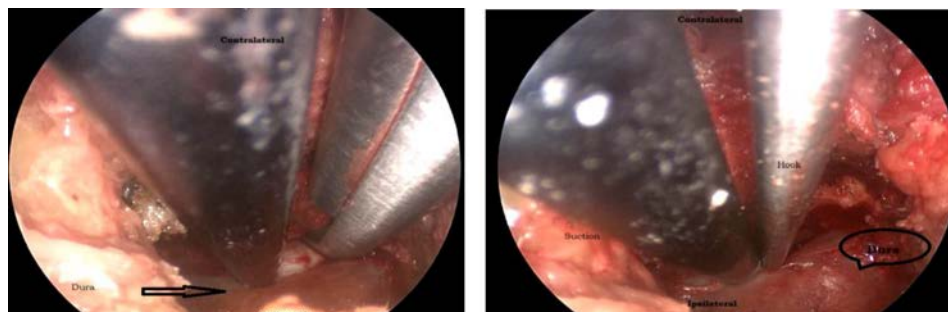


FIGURE 15 | Contralateral decompression.

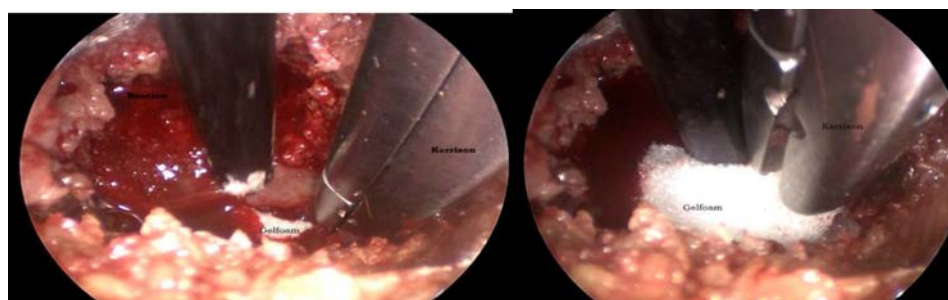


FIGURE 16 | Gelfoam application.

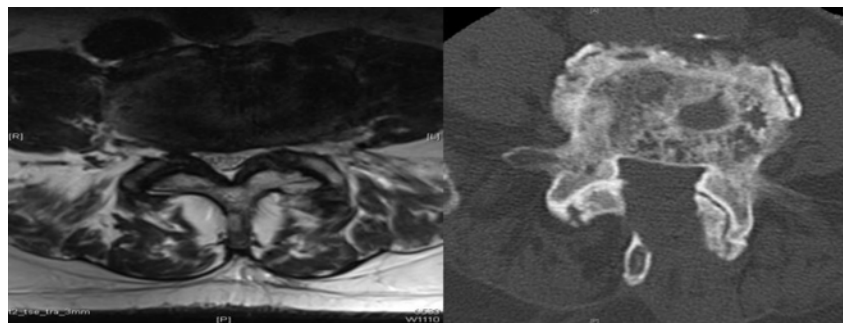


FIGURE 17 | Preoperative and postoperative study.



FIGURE 18 | Sagittal (left) and axial (right) T2-weighted MRI of the lumbar spine demonstrating a large sequestered mediolateral disc herniation at L2/3 on the left, causing compression of the L3 nerve root.

- Radiological examinations like CT and/or MRI can be done in order to evaluate the achieved decompression (Figure 17).

Video Case Report

A 52-year-old patient presented with newly developed, left-sided leg pain for 2 months, most consistent with the L3 dermatome. Symptoms occurred suddenly after gardening. The MRI shows a large mediolateral L2/3 disc herniation on the left with severe recess stenosis (Figure 18). Due to therapy-refractory pain, surgical intervention was indicated. The patient underwent an endoscopic sequestrectomy at L2/3 using the EasyGO system (Video 1). Postoperatively, the leg pain resolved completely, and the patient was discharged in good condition the following day.

VIDEO 1 | Endoscopic sequestrectomy at L2/3 on the left side using the EasyGO! System.
<https://youtu.be/yCJ1PkplzMM>

Disclosure

Prof. Joachim Oertel acts as a consultant to Karl Storz company. The other authors declare no competing interests. The mention of specific brand names or products is for methodological clarity only and does not constitute endorsement. This study was not funded, and Karl Storz company had no role in the study design, data collection, analysis, or manuscript preparation.

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