A Simple Technique of Accessing the L5-S1 Disc Space for Transforaminal Endoscopic Spine Surgery

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ABSTRACT

Transforaminal endoscopic spine surgery is increasingly used to treat a range of spinal conditions. The success of the surgery requires an accurate insertion of the guide needle and a precise placement of the working cannula and endoscope. However, such a precise placement is challenging for many surgeons to achieve when the pathology is located at the L5-S1 level. On the basis of our years of experience with performing transforaminal endoscopic spine surgery, we have developed a simple technique to help surgeons safely access the L5-S1 level. The technique has been proven intuitive and easy for experienced as well as inexperienced surgeons to learn. The key steps of the technique involve identifying an appropriate entry point on the skin and choosing an accurate trajectory angle for insertion. The purpose of this chapter is to report how to easily identify the entry point and choose a trajectory angle depending on the patient’s anatomic characteristics.
Since the early 1990s, transforaminal endoscopic spine surgery has been widely used to treat a range of spinal conditions.\textsuperscript{1–7} The success of transforaminal endoscopic excision demands an appropriate insertion and a precise placement of the working cannula and endoscope from the entry point on the skin to the foraminal window at the optimal trajectory. For the disc levels from L1–2 to L4–5, experienced endoscopic surgeons can achieve such a precise insertion and placement without much difficulty. As a result, the endoscopic transforaminal approach is routinely applied to access the spine from L1–2 to L4–5. However, accessing the L5–S1 disc space through the transforaminal approach can be challenging, especially in patients with a high iliac crest, and performing endoscopic discectomy at the L5–S1 level through the transforaminal approach often requires various degrees of lateral facetectomy and/or foraminoplasty.

Because pathologies located at the L5–S1 level is common, surgeons long for a technique with which they can easily and safely access the L5–S1 pathologies. In the past decade, a few surgeons have reported their techniques of accessing the L5–S1 disc space through a transforaminal approach.\textsuperscript{1,9} Yeung and colleagues\textsuperscript{10} even developed a protocol to help surgeons achieve the optimal needle placement. Despite all the efforts, many surgeons unfortunately still consider the published techniques difficult to learn and use.

On the basis of our years of experience with treating L5–S1 disc tears, disc herniations, spinal stenosis, failed back surgery, and spondylolisthesis, we have developed a simple posterolateral technique of accessing the L5–S1 space for transforaminal endoscopic spine surgery. Feedbacks from our endoscopic surgery training courses have confirmed that the technique is easy for surgeons to learn and master. The purpose of this chapter is to describe the details of the technique.

### OPERATIVE TECHNIQUE

The preparation step of this technique is similar to that of the traditional endoscopic transforaminal approach. Procedures using this technique are performed under local anesthesia with the patient in a prone position on a radiolucent table and a bolster to reduce lumbar lordotic curvature.

#### Step 1: Adjusting the c-arm

Orient the c-arm fluoroscope to the position where the x-ray beam is parallel to the inclination plane of the L5–S1 disc (Fig. 1) and the L5–S1 disc is parallel to the floor on fluoroscopic view.

#### Step 2: Identifying the intersection point of the midline and the traverse line crossing the L5–S1 disc

Under fluoroscopic guidance, with the assistance of a radio-opaque metal rod, first draw the midline on the patient’s skin surface. Then turn the metal rod into a transverse position at which the medal rod crosses the anatomic center of the L5–S1 disc and is parallel to the inclination plane of the L5–S1 disc, and draw a transverse line (Fig. 2). Mark the intersection point of the midline and the transverse line.

#### Step 3: Identifying the entry point on the skin

Along the transverse line, on the same side of the midline as the pathology, use a soft ruler to identify a point that is 12 cm away from the intersection point identified in step 2. Mark the point on the skin surface (Fig. 3). This point will serve as the initial entry point.
Step 4: Inserting a guide needle

After delivering local anesthetic to the area of the entry point, insert a guide needle to the entry point at a 25°-30° angle from the floor. Carefully push the needle towards the center of the L5-S1 disc (Fig. 4).

In male patients with a high iliac crest, the entry point and insertion angle often need to be slightly adjusted under the guidance of anteroposterior (AP) and lateral views. In general, the distance between the entry point and the intersection point of the midline and the transverse line is about 12 cm for females and 7-9 cm for males. A flatly inclined L5-S1 disc in patients with a high iliac crest may require certain degrees of resection of the facet joint.

During the insertion process, if the needle experiences resistance from the iliac crest, the surgeon needs to pull out the needle, move the entry point on the skin medially along the transverse line drawn at Step 2, and reinsert the needle at about 25°. This may need to be repeated multiple times until the needle can successfully pass the iliac crest. If the needle experiences resistance from the facet, the surgeon needs to slightly pull back the needle and increase the trajectory angle to allow the needle to pass the facet and reach the foramen. As the tip of the needle gets close to the L5-S1 foramen, use lateral view to make sure the needle can safely enter the target area. If necessary, adjust the trajectory angle accordingly (Fig. 5).

After the needle has safely reached the ideal position (Fig. 6), the endoscope cannula can be safely placed.

DISCUSSION

Because each patient’s spine is slightly different, the entry point and the insertion trajectory often need to be adjusted during the insertion process. To avoid potential nerve root damage, our technique requires the patient to stay awake under local anesthesia and light sedation.

Under the AP view, using a narrow metal rod as a radio-opaque guide, the midline is fairly easy to draw. But to accurately draw the transverse line that crosses the anatomic center of the L5-S1 disc and that is parallel to the inclination plane of the L5-S1 disc, the surgeon needs to orient the c-arm to make sure the x-ray beam is parallel to the L5-S1 inclination plane (Figure 1). Because this line is used to locate the initial entry point, it is important that the line is drawn accurately.
Based on our experience, an appropriate entry point is located on the transverse line and is about 12 cm away from the intersection point of the midline and the transverse line for most female patients, and about 7-9 cm for male patients, and an appropriate trajectory angle is about 25°-30° from the floor. Surgeons need to keep in mind that the parameters are not absolute. They can and should be adjusted according to each patient’s unique anatomic characteristics. According to our experience, 12 cm and 25° serve as good starting parameters for most female patients, and the surgeon needs only little adjustment to successfully insert the needle into the target position. But for many male patients, the surgeon may need to do more adjustment. For patients with a high crest iliac crest, the entry point generally should be less than 9 cm away from the intersection point of the midline and the transverse line, and the trajectory angle should be larger than 25°.

The main attractiveness of this technique is that it is simple and intuitive. Drawing two lines and measuring one distance are all a surgeon needs to start the procedure. Compared with previously reported techniques, this technique is easy for experienced and less experienced endoscopic surgeons to learn. The positive feedbacks from surgeons in our training classes have confirmed the attractiveness of the technique.

Because the insertion process of this technique is under the fluoroscopic guidance, to ensure insertion success, this technique requires the surgeon to have adequate experience with reading fluoroscopic images. For surgeons experienced with pain management, this generally is not a problem. But for orthopaedic surgeons who are not accustomed to performing surgery under fluoroscopic guidance, this technique may pose some challenge.

**CONCLUSION**

Using 12 cm and 25° as the initial insertion parameters provides a simple and an intuitive way of identifying the entry point and insertion trajectory to safely access the L5-S1 disc space. The parameters serve as excellent starting
points for most female patients. For male patients with a high iliac crest, the surgeon needs to adjust the parameters accordingly under fluoroscopic guidance. Compared with previously reported techniques, this technique is simple, intuitive, and easy to learn.

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AUTHORS’ DISCLOSURES

The authors declare no conflict of interest.

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