

Percutaneous Transforaminal Endoscopic Discectomy for Lumbar Disk Herniation

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Abstract: Percutaneous transforaminal endoscopic discectomy (PTED) is a minimally invasive technique to treat lumbar disk herniation from a lateral approach. Performed under local anesthesia, the incision size for PTED is around 8 mm with no paraspinous muscle cutting or detachment from their insertion. PTED has been associated with less blood loss, faster rehabilitation, and less scarring of tissue than conventional open microdiscectomy. High-quality randomized controlled trials comparing PTED with open microdiscectomy have not been conducted yet. However, PTED has been proven to be an effective technique allowing patients to return home only 2 hours after surgery. By the means of this article and video (Supplemental Digital Content 1, <http://links.lww.com/CLINSPINE/A1>), we would like to show the spine surgeon the PTED technique for the treatment of a single-level lumbar disk herniation.

Key Words: lumbar disk herniation, percutaneous transforaminal endoscopic discectomy, spine surgery

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INDICATIONS FOR PERCUTANEOUS TRANSFORAMINAL ENDOSCOPIC DISCECTOMY (PTED)

The indications for PTED are the same as for conventional open microdiscectomy (OM), which is sciatica caused by lumbar disk herniation. Even recurrent disk herniation and foraminal stenosis caused by extruded disk fragments are relatively easy to decompress. However, cranial or caudal sequestration of the disk fragments makes the procedure more challenging. PTED is contraindicated in patients with isthmic spondylolisthesis or with severe congenital canal stenosis.

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OPERATING ROOM SET-UP

Instruments/Materials Required

- Radiolucent table.
- Intraoperative fluoroscopy (C-arm).
- Wilson frame.
- TV monitor.
- Safety drills (from 4 to 9 mm) (Fig. 1).
- Endoscope with working channel.
- Guidewires and Tom Shidi needle (maxMorespine, Unterföhring, Germany).

Positioning

As PTED is performed under local anesthesia, the patient does not need full support for the prone positioning on a Wilson frame (Fig. 2). Alternatively, PTED can also be performed when the patient is in lateral position. An important advantage of the prone position is that spine surgeons are familiar with the anatomy as they are used to operate in this position. Another advantage is that in the prone position the patient is more stable resulting in less movements during the procedure than in lateral position. An advantage of the lateral position is the possibility to perform a straight-leg test intraoperatively. Another advantage of the lateral position may be a bigger safety zone for the dura because the gravity moves the dura toward the contralateral side. Furthermore, less bleeding may occur in the lateral position because of less intra-abdominal pressure. The best position to perform PTED, whether it is dorsal or lateral, is disputed and the choice is a matter of preference of the performing surgeon. We prefer to perform the procedure in prone position.

Good positioning of the C-arm saves a lot of operation time and radiation exposure. The C-arm is positioned carefully as such that one can switch from anteroposterior (AP) to lateral view by only using the C-arm axial rotation function. This way you will immediately have a true AP with the endplates and the joint space perpendicular to the x-ray beam and true lateral view with both superior articular processes (SAP) projecting as one.

SURGICAL TECHNIQUE

We use light sedation with dexmedetomidine or a combination of propofol and remifentanyl for the convenience of the patient. Be aware that the amount of



FIGURE 1. The instruments used for PTED. In the left tray the Tom Shidi needle and forceps are shown. In the right tray the safety drills (from 6 to 9 mm) and the working cannula are shown. PTED indicates percutaneous transforaminal endoscopic discectomy. full color online

administered sedation should still allow the patient to respond to nerve root manipulation.

Step 1: Marking

The level of disk herniation is identified by using the C-arm and a K-wire. The angle should be approximately 40–50 degrees in craniocaudal direction to the SAP of the lower level (AP view) for level L5–S1 and 30–40 and 25–25 degrees for levels L4–L5 and L3–L4, respectively. Alternatively, in AP view, a line can be drawn from the tip of the SAP to the middle of the superior endplate (Fig. 3).

Step 2: Incision

The skin incision is marked 12 cm from the midline at level L5–S1. When operating on level L4–L5 or levels



FIGURE 2. Photograph of the patient positioned prone on a Wilson frame. full color online

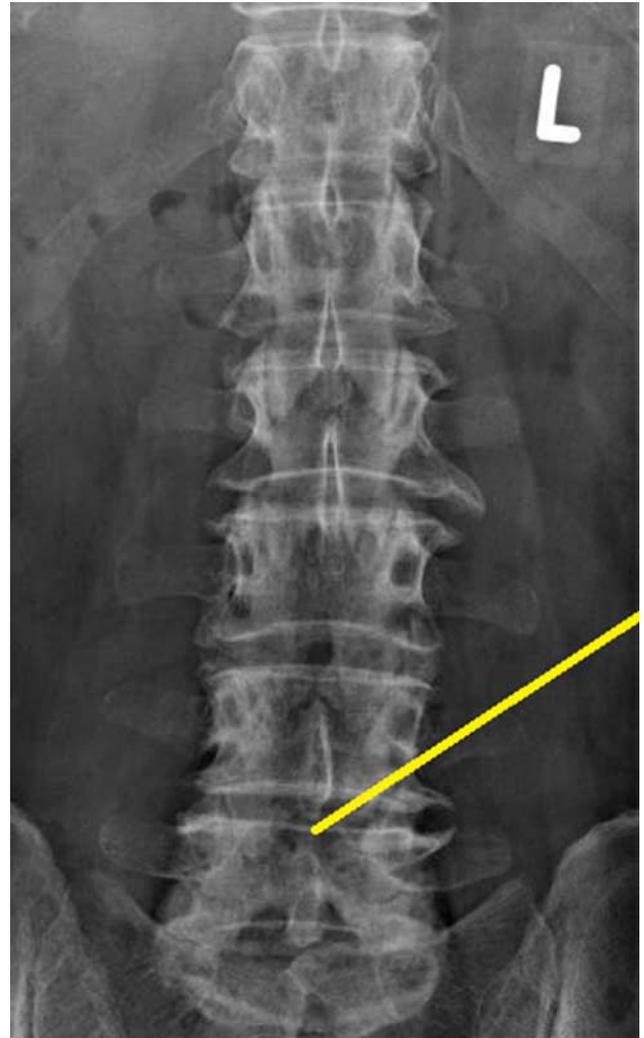


FIGURE 3. Marking of the trajectory from the SAP to the mid-superior endplate in AP view. AP indicates anteroposterior; SAP, superior articular processes. full color online

L3–L4 and L2–L3, the incision should be marked 10 and 8 cm from the midline, respectively.

Step 3: Introduction of the Guidewire

After infiltration of the skin with 2–3 mL lidocaine 1%, an 18-G needle is introduced anesthetizing the trajectory with 8–10 mL lidocaine 1%. The angle should be approximately 55–65 degrees in craniocaudal direction (lateral view), 30–40 degrees in posteroanterior direction (AP view), and 30–40 degrees in the axial view, which is not available with the C-arm. When the SAP is reached 2–3 mL lidocaine 1% is used to anesthetize the facet joint. Note that too much lidocaine on the facet joint can easily anesthetize the nerve root losing direct nerve root feedback from the patient. The guidewire is introduced through the 18-G needle that is removed leaving the guidewire in place (Fig. 4). Following this, a series of cannulated conical rods are introduced for widening of the trajectory up to 8 mm.



FIGURE 4. Anteroposterior fluoroscopy image of the positioned guidewire at level of the disk herniation L5–S1. [full color online](#)



FIGURE 5. Lateral fluoroscopy image with the 8-mm drill placed at level L5–S1. [full color online](#)

Step 4: Introduction of the Tom Shidi Needle

The cannulated Tom Shidi needle is placed over the wire to the SAP. The wire is removed and the sharp Tom Shidi needle is put on the top of the SAP. The needle is cautiously hammered caudally to Kambin’s zone until the medial pedicle line is reached and breach of the cortex is heard by a change of the hammering sound. The sharp needle is then replaced by a blunt needle tip and introduced in the spinal canal toward the disk herniation. The guidewire is then replaced and the Tom Shidi is removed.

Step 5: Dilatations by Safety Drills

Using the guidewire, a 4 mm disposable cannulated drill is introduced to create the first step in enlarging the neuroforamen. This must be done without bending of the guidewire. With several cannulated drills the foramen is enlarged up to 8 or 9 mm, depending on the patient and anatomic characteristics. The 6–9 mm drills can be used to adjust the trajectory if necessary. All drills are introduced anticlockwise to prevent muscle damage (Fig. 5).

Step 6: Placing of the Working Cannula to Introduce the Endoscope

The 7 mm conical rod is replaced and the working channel is introduced with the tip aiming at the posterior longitudinal ligament avoiding nerve root entrapment. The endoscope with a saline 9% pump connected to the rinsing channel is ready for use.

Step 7: Decompressing the Nerve

After introduction of the endoscope, a rongeur is used to remove all loose fragments (Fig. 6). Bleeding can be easily stopped by increasing the pump pressure. Sometimes a bipolar can be useful. On the screen the facet joint will be seen in the upper part, whereas the posterior longitudinal ligament will be found in the lower part. The nerve root can be found behind the facet joint. The disk fragments are recognized by the yellow color. The fragments are grasped with the rongeur and slowly removed. Sometimes the fragments are too big to pass through the working channel, which can be resolved by removing the disk fragment and endoscope simultaneously. Removing the disk fragments around the nerve can give some radicular pain sensation to the patient, especially when a



FIGURE 6. The vision through the endoscope, placed in the working channel. The disk fragments are visible. [full color online](#)



FIGURE 7. The nerve, S1, has been decompressed. full color online

foraminal stenosis is present. Stepwise, slow removal is warranted. Decompression is considered to be sufficient if the nerve shows pulsations with the heart rate and the amount of removed disk materials matches the disk herniation seen on the MRI (Fig. 7). In our experience when the nerve root is not identifiable, pulsation of the epidural space in combination with the MRI-matched removal of disk herniation is considered to lead to sufficient decompression.

Step 8: Closure

Before taking out the working channel, some local corticosteroids can be left around the nerve root area to relieve the pain, albeit subject to debate. After taking out all the instruments, the skin can be closed with an intracutaneously dissolving stitch.

POSTOPERATIVE PROTOCOL

Two hours after surgery, when no complications occur, patients are allowed to mobilize and are usually discharged. Some patients can experience some numbness around the buttocks or some back pain. Patients are usually scheduled to have a check-up 6 weeks after the

surgery at the outpatient clinic. In our experience, the use of a corset is not necessary after surgery.

Complications

- **Durotomy**
Unintended durotomy may lead to postural headache, nausea, vomiting, photophobia and back pain. A conservative policy usually solves the symptoms. If the patient experiences many symptoms, he can be observed in the hospital overnight.
- **Nerve root damage**
This complication is very unlikely to occur as the patient is awake. If leg pain persists the trajectory should be adjusted. If adjustment is not possible, conversion to OM should be considered.
- **Wound infection**
Most cases of wound infections can be solved by administering oral antibiotics.
- **Transient paresis**
Most cases of transient paresis occur because of the use of local anesthetics and therefore resolve themselves shortly after surgery.
- **Postoperative hemorrhage**
Blood loss during PTED is minimal (< 1–5 mL), so postoperative hemorrhage is very rare. In case of a major hemorrhage leading to radicular symptoms, the spinal canal should be opened to evacuate the hematoma.

PEARLS AND PITFALLS

- Because of the use of local anesthetics, direct intraoperative neuromonitoring is possible. The surgeon can get direct feedback from the patient when he is approaching the nerve.
- Patients can be mobilized directly and can be discharged only 2 hours after surgery.
- Good positioning leading to true AP and lateral fluoroscopy imaging prevents malpositioning of your instruments.
- Caution should be taken to not bend or accidentally remove the guidewire as replacing of the guidewire can increase the operation time unnecessarily.
- PTED has a steep learning curve, making it more difficult to learn than OM. Good training and coaching may overcome several difficulties offering a safe and efficient procedure to patients with lumbar disk herniation.