FEASIBILITY AND SURGICAL TECHNIQUE OF PERCUTANEOUS TRANSFORAMINAL DISCECTOMY FOR THE TREATMENT OF LUMBAR DISC HERNIATION

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Abstract. *Percutaneous transforaminal endoscopic discectomy (PTED) is an alternative minimally invasive technique for the treatment of lumbosacral radicular syndrome resulting from lumbar disc herniation. The latter is performed with the help of local anesthesia and sedation in an awake patient with the advantage of direct feedback. Access to the target is lateral and follows a safe trajectory through the Kambin triangle. The main advantages of this surgical technique are the possibility of early discharge within 2 hours after its completion, negligible blood loss, lower risk of infectious complications, convenience in patients with obesity, reduced risk of epidural fibrosis. There are currently no large randomized trials of good quality demonstrating the advantage of PTED over open interlaminar access established in practice. In the worst case, endoscopic discectomy is not known to pose additional risks to patients. The operative technique with a clinical case and a discussion about the applicability of the new approach for the treatment of lumbar disc herniations are presented.*

Key words: *lumbar disc herniation, surgical treatment, percutaneous transforaminal endoscopic discectomy*

INTRODUCTION

Lumbosacral radicular syndrome is one of the most common health problems in humans, with between 12.2% and 43% having had such complaints in their lifetime. It is one of the leading causes of temporary disability, disabling pain and significant deterioration in quality of life compared to and surpasses in this respect non-specific low back pain [11, 16]. In most cases, radiculopathy is the result of a disc herniation with direct compression of the nerve root. Treatment options are conditionally divided into conservative or surgical approaches.

Surgical removal of a disc herniation in the lumbar spine is standardly performed by open interlaminar access and discectomy under optical magnification [10]. In recent years, minimally invasive techniques have been introduced and improved, one of which is percutaneous transforaminal endoscopic discectomy (PTED) [3]. Patients are under local anesthesia and extirpation of the disc sequestration is performed by direct endoscopic control. Its benefits compared to the institution of routine surgical technique are: reduced costs associated with surgical treatment and shortened hospital stay; easier removal of intra- and extraforaminal disc herniations; the intended formation of fibrosis as a result of iatrogenic trauma; negligible blood loss; reduced risk of infection; and last but not least, it is suitable for the growing number of patients with obesity [9].

Although PTED is increasingly used, the effectiveness and risk of complications indirectly related to its long-term cost are still being discussed [5]. The purpose of this publication is to present the operative technique and the feasibility of percutaneous transforaminal endoscopic discectomy for the treatment of lumbar disc herniation as an alternative to open interlaminar access under optical magnification.

SURGICAL TECHNIQUE

Anatomical features

Percutaneous transforaminal access occurs through the Kambin triangle [7]. It is a three-dimensional anatomical space that leads to the dorsolateral aspect to the lumbar intervertebral disc. Under fluoroscopic control in lateral projection, its boundaries are the upper edge of the lower vertebra caudally, the upper articular process of the lower vertebra dorsally and the exit nerve root under the pedicle of the upper vertebra cranially and ventrally. This space is defined as the safe area to the intervertebral lumbar disc.

The endoscopic image is from the anterolateral part of the dural sac against the disc sequestration and the leveling nerve root. The most important guideline for this procedure is the superior articular process (SAP) of the target vertebra. This is the purpose of the guide needle, access tools, working cannula and endoscope [1].

Positioning and Planning

The patient is positioned on the abdomen with pads of the chest and pelvis to release the abdomen, which reduces the compression on it and indirectly the venous pressure. The C-arm isocenter for fluoroscopic control is adjusted to the level of surgical intervention to provide anteroposterior and lateral projection without the need to move the X-ray device [2]. The access trajectory is mediocaudal and varies from 20° to 50° for the levels from L2 to S1 relative to the axial plane. The skin incision is between 8 and 13 cm from the midline [14]. In disc herniations at the L5-S1 level, preoperative planning with MRI or CT is mandatory due to the risk of high position of the iliac crest and inability to access.

Anesthesia

The intervention is performed under vigilant sedation and local anesthesia in order to provide feedback to the patient against the background of good analgesia. After determining the entry point, the latter is infiltrated with a local anesthetic (e.g. lidocaine 2%). Using a needle, the SAP is reached and the position of the tip is verified in two projections. A local anesthetic is infiltrated onto the SAP via the needle in the final destination. The patient is further anesthetized and sedated with opiates (e.g. fentanyl) and benzodiazepines (e.g. midazolam).

Surgical access and discectomy

Through the same needle, a leading one is introduced under fluoroscopic control and with a tip positioned on the SAP. After the last skin incision, about 15 mm, a dilator and serial drills with increasing diameter (optimally 8 mm) are introduced sequentially

until the epidural space is reached through the Kambin triangle [1]. The ruptured cannula is positioned along the dilator with a tip on the posterior longitudinal ligament. The opening of the beveled working cannula should point dorsally to the dural sac, Fig. 1. An endoscope with 30° optics is introduced after a preliminary check for technical consistence of the system. Constant irrigation with hyperosmolar saline is important to wash away blood, debris and achieve hemostasis.

The intervertebral joint is located in the upper part of the field, and the posterior longitudinal ligament in the lower part. The sequester is located in the center. At this stage, the fragments are carefully removed with a set of grasping forceps. The patient reported radiating pain on touching or excessive pressure on the compressed neural root, or local pain on depletion of the local anesthetic effect. Good decompression was assessed by the amount of disc material collected and by direct visualization of the pulsating nerve root. Hemostasis is achieved by positive pressure of the washing solution. After removal of the endoscope, the skin incision is closed with a single suture.

CLINICAL CASE

A 42-year-old man with complaints of about 6 months of low back pain with irradiation to the right leg within S1 dermatome and ineffective response to complaints with non-surgical treatments. The patient underwent surgery in 2018 for a disc herniation at the L5-S1 level, shown in Fig. 2. The classical dorsal interlaminar access is demonstrated in

Fig. 1. Positioning of the working cannula in anterior-posterior (A) and lateral (B) X-ray view

Figure 3 by 3D-reconstruction from postoperative CT examination.

After the initially successful intervention, he had a recurrence of the complaints about 8 months later with debilitating sciatica pain and acute weakness of the right foot corresponding to tibial paresis. MRI examination showed a large recurrence of the disc herniation with significant compression of the S1 spinal

nerve on the right, Fig. 4. A decision was made and PTED was performed at level L5-S1 on the right to avoid fibrosis from the previous access. Sequestration extirpation and decompression of neural structures with excellent clinical effect were achieved. Fig. 5 shows a 3D reconstruction of CT with transforaminal access. The result was demonstrated on a control MRI examination shown in Fig. 6.

Fig. 2. Preoperative MRI with a paramedian right side disc herniation L5-S1 with compression of S1 spinal nerve root – sagittal (A) and axial (B) plane

Fig. 3. 3D-reconstruction based on CT demonstrating (with arrows) the performed interlaminar approach

Fig. 4. Large disc herniation relapse 8 month after first surgery – MRI scan in sagittal (A) and axial (B) plane

Fig. 5. 3D-reconstruction from CT demonstrating the transforaminal approach, despite the obstacle of the high standing of the iliac crest

Fig. 6. MRI control scan demonstrating the extirpated disc fragment and the adequate decompression of the nerve structures on sagittal (A) and axial (B) plane

DISCUSSION

The main goal of PTED is minimally invasive treatment of lumbar disc herniation. The indications for surgical treatment do not differ from the accepted ones and generally include radicular pain resistant to conservative treatment and/or neurological deficit [12]. In most cases in practice, lumbar discectomy is an elective procedure. Causes of emergency intervention are rapidly progressive neurological deficits or cauda equina syndrome.

In experienced hands, PTED can be used to treat all types of lumbar disc herniation [3]. However, this approach should not be the first choice in significantly migrated sequester in the cranial or caudal direction, as well as in patients with large median disc herniations at the L5-S1 level in cases with a highly located iliac crest [8]. Access in concomitant lateral recess stenosis and synovial cyst should preferably be established interlaminar under optical magnification.

Unlike open discectomy and in the context of the above, PTED has a long learning curve. Good three-dimensional anatomical orientation for the intervertebral joint, the ligament apparatus and, last but not least, for the nerve structures is mandatory. This operative technique requires extensive personal experience and is still being evaluated in randomized trials [15]. In this study design, led by Seiger [15], surgeons begin training with corpses, followed by 20 procedures under the direct supervision of an experienced surgeon.

Positioning the patient with a thorax and pelvic support is essential to avoid spinal epidural venous congestion, which would prevent the identification of critical structures, sequestration extirpation, and adequate decompression of the affected nerve root [1]. Moreover, its comfort and sufficient local anesthesia would prevent involuntary movement with potentially serious consequences.

Good decompression of neural structures is largely subjective and is assessed by the amount of disc material removed compared to the imaging findings, as well as the identification of a pulsating nerve root. The effect of the procedure is assessed immediately after reversing the patient in the absence of radiating pain and Lasegue's sign [1].

Communication with patients is essential when performing PTED for the success of the procedure and to avoid complications. It is important for them to understand that they will undergo surgery under vigilant sedation and that they can be discharged without risk between 2 and 4 hours after exiting the operating room [1, 6]. It is necessary to provide the patient with the information that there is still no high-quality evidence that the clinical outcome of PTED is better than open discectomy. At present, however, it is known that the worst-case endoscopic approach has similar results in the treatment of lumbar disc herniation [4, 13].

Potential complications of PTED, with the exception of conversion to a standard surgical procedure, may include dural laceration, nerve root damage, deep or superficial infection, persistent neurological symptoms, and recurrence of the disc herniation. The listed negative consequences are of different frequency with the respective operative technique, but the overall results of the treatment are comparable [1, 13]. On the other hand, PTED from our experience proved to be a good alternative for recurrent disc herniations, in which work was avoided during the existing fibrosis from the previous intervention, demonstrated by the presented clinical case.

CONCLUSION

Lumbosacral radicular syndrome is a widespread problem, which is mainly due to lumbar disc herniation. Some patients do not respond effectively to conservative therapy and require surgical treatment. Percutaneous endoscopic transforaminal discectomy is a good alternative to classical techniques with potential advantages in terms of anesthesia, invasiveness, shortened hospital stay and accelerated restoration with a similar and even lower complication rate. The efficacy of PTED has yet to be evaluated in ongoing randomized trials.

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