TECHNICAL NOTE

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Percutaneous Endoscopic Thoracic Discectomy : Posterolateral Transforaminal Approach

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Objective : Development of diagnostic tools has resulted in early detection of thoracic disc herniations(TDH) even when the herniated disc is soft in consistency. In some of the cases, it is considered better not to opt for surgical treatment due to the unduly high morbidity and potential complications associated with conventional approaches. The authors have applied percutaneous endoscopic thoracic discectomy(PETD) technique to soft TDHs in order to avoid the morbidity associated with conventional approaches.

Methods : Eight consecutive patients (range, 31 to 75 years) with soft lateral or central TDH (from T2-3 to T11-12) underwent PETD between May 2001 and June 2004. The patient was positioned in a prone position with intravenous sedation and local anesthetic infiltration. The authors introduced a cannula into the thoracic intervertebral foramen using endoscopic foraminoplasty technique. Discectomy was performed with mechanical tools and a laser under continuous endoscopic visualization and fluoroscopic guidance. Functional status was assessed preoperatively and postoperatively using the Oswestry Disability Index(ODI).

Results : The mean ODI scores improved from 52.8 before the surgery to 25.8 at the final follow-up. In cases of myelopathy, long tract signs showed improvement. The mean operative time was 55 minutes, and no patient required conversion to open surgery.

Conclusion : The technique allows a smaller incision and less morbidity. Soft TDH is amenable to this minimally invasive approach in selected patients with myeloradiculopathy.

KEY WORDS : Lateral or central soft disc herniation · Myeloradiculopathy · Percutaneous endoscopic discectomy · Posterolateral approach · Thoracic disc herniation.

Introduction

Symptomatic thoracic disc herniation(TDH) is a rare condition, representing less than 1% of all disc herniations in most series[1,4]. The routine use of magnetic resonance(MR) imaging has resulted in a significant increase in the early detection of soft disc herniation in the thoracic spine before it gets calcified[5,11,15,18]. Considering the degree of symptoms and nature of lesion (soft), conventional approaches carry relatively higher morbidity compared to their benefit[7,14,17]. To date, many surgeons have reported several minimally invasive techniques, but all of them require general anesthesia[8,11-13].

We have a considerable experience in percutaneous endoscopic lumbar discectomy(PELD) using a rigid working channel endoscope, and bone cutting technique (foraminotomy) through an endoscopic cannula[2]. The foraminotomy technique needs to be modified to insert the cannula into the thoracic foramen as the thoracic intervertebral foramen is smaller than that in lumbar area. Here, we report the modified foraminotomy technique and clinical application of percutaneous endoscopic thoracic discectomy(PETD).

Materials and Methods

Between May 2001 and June 2004, eight consecutive patients underwent PETD (Table 1). There were three males and five females with a mean age of 50.5 years (range, 31 to 75 years). The mean duration of symptoms was 10.2 months (range, 2 weeks to 36 months). All patients were evaluated by preoperative radiographs, MRI, and computed tomography

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Table 1. Clinical Characteristics and Outcome of Patients undergoing Percutaneous Endoscopic Thoracic Discectomy procedure

Case No.	Age (yrs)	Sex	Level	Location	Presentation	Functional outcome	
						Preop. ODI	Postop. ODI
1	31	M	T2-3	Central	Myelopathy	31	16
2	34	F	T11-12	Lateral (Left)	Leg symptoms	27	16
3	75	F	T7-8	Lateral (Left)	Leg symptoms	71	33
4	73	F	T10-11	Central	Myelopathy	58	40
5	54	M	T3-4	Central	Myelopathy	73	27
6	46	F	T11-12	Lateral (Right)	Leg symptoms	42	24
7	60	F	T10-11	Lateral (Right)	Leg symptoms	78	28
8	31	M	T5-6	Central	Myelopathy	42	22

ODI = Oswestry Disability Index

(CT) with or without myelography of the thoracic spine. Of the eight disc herniations, single level herniation was seen in four patients : one each at T2-3, T3-4, T5-6, T7-8, respectively, and two level herniation in two patients : at T10-11 and T11-12, respectively.

Four patients (T2-3, T3-4, T5-6, and T10-11) had long tract signs and sensory-motor disturbances consistent with myelopathy. Their TDHs were located centrally or paracentrally. The rest four patients complained of unilateral leg symptoms, mainly sensory in nature, and back pain. In these patients TDHs were located on the lateral or lateral to foraminal area. Careful examination revealed ipsilateral leg weakness with increased deep tendon reflexes than contralateral side.

Surgical procedures

The patient was placed prone on a radiolucent operating table with conscious sedation. One patient with T2-3 disc herniation was placed in a lateral swimmer's view position on a flat table with a chest pad. The others were positioned in the knee-flexion and hands-up posture like a routine PELD position. Under fluoroscopic guidance, the affected disc level and pedicles were marked on the skin. The lateral coordinates of skin entry point were determined from on preoperative CT or MR scan by extrapolating a line from mid-pedicular annulus to lateral margin of facet and extending it upto the skin surface (Fig. 1).

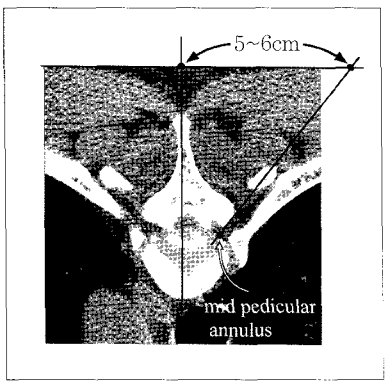

Fig. 1. Preoperative computed tomography for determining the entry point.

The skin entry point was approximately 5 cm from the midline. The latitude of the skin entry point was selected on the lateral view of fluoroscope at the operating table, just parallel to the upper end plate (Fig. 2). The pathway from the skin to the facet was infiltrated with 1% lidocaine, and 18-gauge long spinal needle was inserted into the foramen touching the outer surface of the annulus. 1~1.5cc (then less than 2) of 1% lignocaine was injected and a guide wire was inserted into the epidural space through the needle.

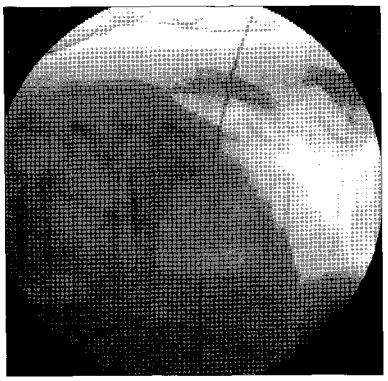

Fig. 2. Intraoperative fluoroscopic lateral view demonstrating the entry point, which is parallel to the upper end plate.

Fig. 3. Fluoroscopic anteroposterior view demonstrating a beveled cannula facing medioinferiorly and the tip of the cannula compresses annulus just lateral to mid-pedicular line.

After removal of the needle a cannulated obturator was passed over the guidewire to the posterolateral margin of facet. A beveled cannula was passed over along the obturator, till the beveled opening was facing medially and inferiorly and the tip of the cannula compressed the annulus just lateral to the mid-pedicular line on fluoroscopic anteroposterior(AP) view (Fig. 3), just like grasping the superior facet with beveled opening (Fig. 4A).

The lateral aspect of the superior facet was cut to enlarge foramen with a round cutter (as in lumbar endoscopic foraminotomy), and the foraminal annulus was also cut simultaneously (Fig. 4B). Then an obturator was introduced into the disc and the cannula was tapped again to obtain the intradiscal position. At the thoracic spine, the posterior vertebral bodyline on C-arm lateral view did not represent true anterior margin of the thecal sac, because of the pear shaped body of thoracic vertebra. Thus, every step of decompression was done under direct endoscopic view. The posterior portion of the bulging annulus was removed first to avoid blurring of vision from epidural bleeding and excessive epidural irrigation, which was the cause of severe headache during the procedure. Therefore, a side-firing Holmium yttrium-aluminum-garnet (Ho:YAG)

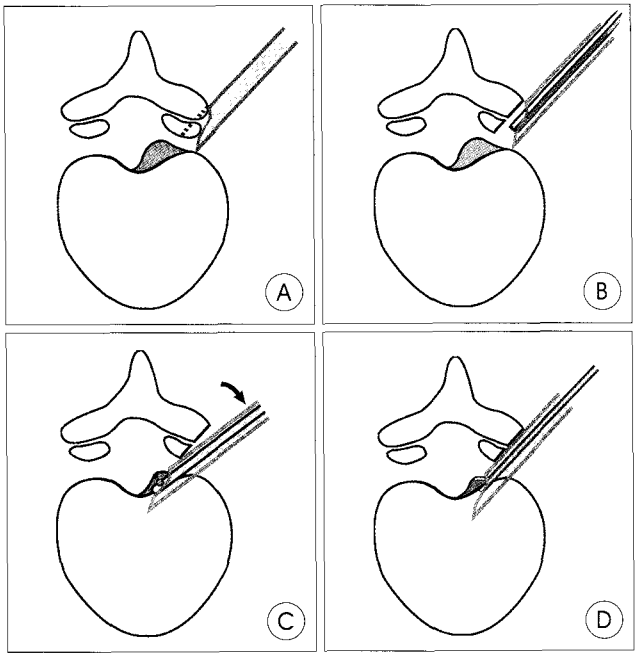

Fig. 4. Schematic drawings of the procedure. A : The image that beveled cannula facing superior facet before cutting it. B : The lateral aspect of superior facet and foraminal annulus are cut using a round cutter. C : Thoracic disc herniation(TDH) is removed by a side-firing laser. D : Remained TDH is removed by forceps.

laser was very useful to constrict the superior and inferior slope of the herniation to lessen the height of dome of herniation.

After initial decompression, the cannula was drawn back slightly or tilted posteriorly to expose the foraminal epidural space, then the remaining extruded portion of TDH was pulled down into the disc space and removed by laser ablation or endoscopic forceps (Fig. 4C, D). At the end of the decom-pression, the free movement of the thecal sac was checked by changing the irrigation pressure which was accomplished by alternately blocking and releasing the irrigation flow into the working channel endoscope. A subcuticular suture was placed and sterile strip was used.

Results

In this series, the mean operative time was 55 minutes, and no intraoperative complications were seen. The mean hospital stay was 2.5 days (range, 1 to 6 days). Five patients were discharged within one day. The postoperative course was uneventful in all the patients. Oral analgesic therapy was not extended beyond one month after the operation. The mean follow-up was 2.25 years (range, 1 to 4 years). During the follow-up period, long tract signs improved in all the cases of myelopathy. Functional outcomes were assessed by the Korean version of Oswestry Disability Index(ODI)[9]. At the final follow-up, mean ODI score was dropped to less than half of the preoperative score (52.8 preoperatively to 25.8 at the final follow-up). In one patient with T10-11 central TDH, the ODI score was not reached to the mean value (58 preoperatively to 40 at the final follow-up). All patients experienced resolution of their symptoms, but did not show complete recovery.

Discussion

TDHs have often been described as calcified or densely fibrotic lesions causing progressive myelopathy, resulting from continuation of degenerative process in the thoracic spine of middle aged or elderly patients[4]. Many kinds of surgeries have been performed to treat spinal cord compression, though with significant morbidity[7,14,17]. In severity, a classic TDH can only be compared to cauda equina syndrome caused by lumbar disc herniation. Currently, we can detect atypical symptomatic TDH with the aids of MR, CT-myelography[5,11,15,18]. Considering the symptoms and signs in such atypical presentations, the possible morbidity from conventional trans-thoracic approach may exceed the gains from surgery[6,13,14,16,17]. Many surgeons have developed minimally invasive procedures based on posterolateral approach[8,11-13]. Because atypical TDHs are usually non-sequestrated and soft in nature, many posterolateral approaches have been successful. In the treatment of non-sequestrated and soft lumbar disc herniations, posterolateral PELD is recently gaining wider acceptance due to the benefits of minimal invasion and avoidance of the risks of anesthesia. Despite authors' vast experience in PELD, some technical modifications were needed to perform PETD.

To do effective decompression, bigger than 6mm cannula is needed. Below T10-11, large cannula insertion is relatively easy, because rib heads do not cover intervertebral foramen. However, above the middle thoracic level, the intervertebral foramina only permit the passage of cannulae smaller than 3mm. Therefore, the authors applied foraminotomy technique to enlarge the foramen, but with different guiding landmarks from the original technique for lumbosacral area. Unlike the lumbosacral foraminotomy, the purpose of foraminotomy in PETD is the insertion of cannula only and not any foraminoplasty, therefore cutting the lateral portion of facet is enough. Thus, the middle pedicular line on AP view is the last checking point of foraminotomy, as described in surgical procedure. After this image-guided but relatively blind insertion of cannula, every subsequent step of decompression can be done under the direct endoscopic vision (Fig. 5).

Due to the pear shaped body of thoracic vertebra, cannula is located in the posterior annulus, despite the acute insertion angle (about 45 degrees) as compared to lumbar area (about 30 degrees). This cannula position permits constriction of cephalocaudal slope of herniation by simple laser shooting. Then the dome of herniation is brought down into endoscopic view

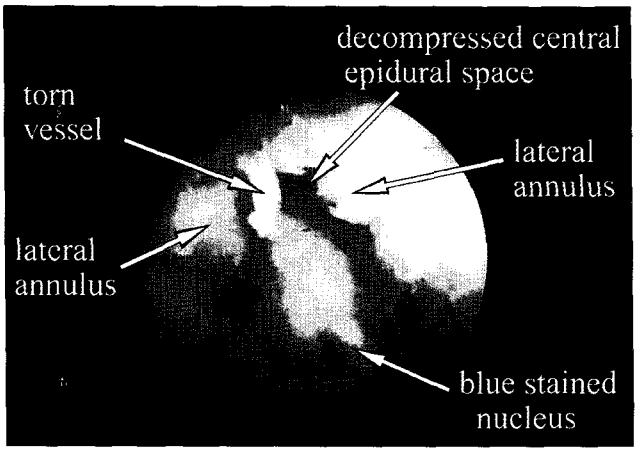

Fig. 5. Intraoperative endoscopic view demonstrating a decompressed central portion of the thoracic disc herniation.

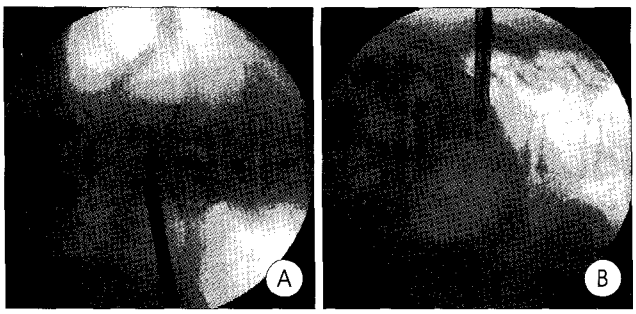

Fig. 6. Central decompression on fluoroscopic anteroposterior view (A) and lateral view (B).

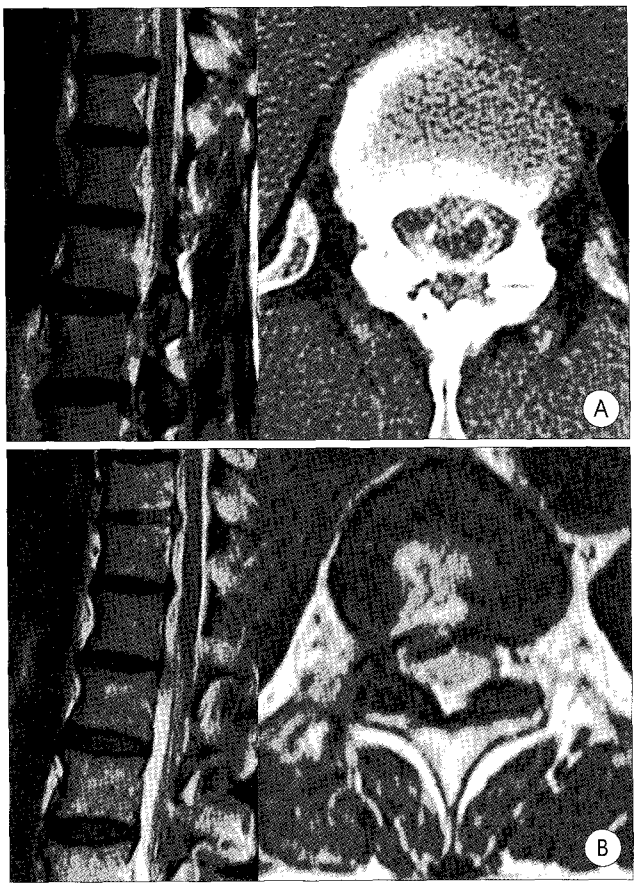

Fig. 7. Comparison of magnetic resonance images(MRI) before (A) and after (B) procedure. A : Preoperative MRI demonstrating a thoracic disc herniation. B : Postoperative MRI showing adequate decompression of the spinal cord.

and pulled into the range of laser by forceps with minimal levering of cannula[3]. Tiny epidural bleeding can be a major obstacle to endoscopic view, direct attack to dome should be postponed till satisfactory internal decompression is accomplished. Pear shaped body of thoracic vertebra and indirect decompression with a side-firing Ho : YAG laser makes it possible to decompress central portion of TDH in upper and middle thoracic area (Fig. 6). Postoperative MRI confirmed adequate decompression of the spinal cord (Fig. 7).

In this series, lesions were located mainly in the high or low thoracic areas. Although we have been accustomed to performing thoracoscopic discectomy, high and low thoracic levels present extra difficulty, according to their side and location of aorta, etc. Therefore, PETD was selected at those levels and the results were promising. In the T7-8 case, one of two mid-thoracic cases, PETD was performed to avoid possible pulmonary complications of old age.

Comparing with other minimally invasive posterolateral approaches[8,11-13], PETD has only one advantage that is full time visual control through endoscope. In other posterolateral approaches, specialized curette or other instruments are inserted between the thecal sac and dome of herniation, without direct visual control of medial side to push down the lesion. In contrast, the dome can be pulled into disc space without any touch of the thecal sac during PETD. This is the reason for the absence of any incidence of cerebrospinal fluid leakage in our series. In addition, effective mid-line decompression can be done without thecal sac retraction (Fig. 6). Nevertheless, the degree of freedom in endoscopic motion is much more restricted than that during other procedures, therefore, sequestrated disc herniation is not indicated for PETD. Hard or calcified disc herniations are not indicated either, because endoscopic instruments are not as strong as those for open procedures. In practical situation, TDH is still very rare condition. However, it is gradually increasing in number due to early diagnosis. Therefore, many authors have developed less invasive procedures to treat these cases of TDH. PETD can be added to the surgeon's armamentarium to treat TDHs.

Conclusion

This study demonstrates the feasibility of the posterolateral transforaminal PETD for soft TDH causing myeloradiculopathy. As the PETD provides direct route to the lesion with less morbidity under local anesthesia.

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