Posterior Microscopic Discectomy with CO_2 Laser

Han Joong Keum, Oon-ki Baek, and Sang-Ho Lee

Introduction

Thoracic disc herniation is a potentially disabling condition that is technically difficult to manage, is associated with various complications, and unfamiliar to many surgeons. The choice of surgical approach for symptomatic thoracic disc herniation has been determined by several factors including the size of the herniation, its relationship to the midline sagittal plane, and degree of calcification. The variety of available techniques indicates that a single method may not be practical for every case, and the surgeon may need to tailor the technique based on the morphology of the herniation as well as the symptom presentation of the patient.

The ideal surgical approach should provide proper visibility of the cord, enable complete access to the herniation, cause minimal morbidity to the patient, and have easily reproducible results. However, one such approach is not available for thoracic disc herniations. A number of operative techniques including the transthoracic, lateral extracavitary, and posterolateral approaches have been introduced to allow the surgeons to safely remove herniated discs [1–3]. Transthoracic and extracavity approaches provide good access to the herniation, a lack of surgical and anatomic familiarity, and also potential complications risks including cerebrospinal fluid leak control, postthoracotomy pain, and cardiopulmonary complications may influence the selection of this approach [4–6]. The posterolateral approaches have the least risk of complications, but provide poor access to the central areas of discs [7].

Posterior discectomy using posterolateral trajectories have been typically favored for smaller, noncalcified, and/or laterally displaced herniations. These surgical techniques include laminotomy and medical facetectomy, transfacet pedicle-sparing, and transpedicular approaches [8–10]. Laminectomy alone has been largely abandoned because of poor clinical outcomes [11, 12]. Modifications of these techniques have enabled easier access and less manipulation of the neural structures when undergoing a posterolateral approach. Furthermore, with the introduction of CO_2 laser into the operative field has enabled removal of thoracic disc herniations which were previously inaccessible.

H. J. Keum (✉) · S.-H. Lee
Department of Neurosurgery, Chungdam Wooridul Spine Hospital, Seoul, Korea
e-mail: hanj@wooridul.co.kr

O.-k. Baek
Department of Neurosurgery, Wooridul Spine Hospital, Seoul Gimpo Airport, Seoul, Korea
e-mail: baekok@wooridul.co.kr

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Indications

Soft or calcified, paracentral to laterally displaced disc herniations can be removed through the posterolateral approach. Although soft disc herniations have been treated more frequently with an endoscopic approach, open discectomy is still considered a better option in calcified discs or larger disc herniations causing neurological deficits or myelopathic symptoms.

Surgical Technique

The patient is placed in a prone position on the operating table under general anesthesia. After identifying and marking the target level, a longitudinal incision of approximately 3 cm long is made, centered over the disc space. Subperiosteal dissection is done to expose the posterior elements on the affected side. After identification of the correct facet joint, the operating microscope is introduced into the operative field. An interlaminar laminotomy is conducted using a high-speed drill that includes partial removal of the superior and inferior arches, as well as 2–3 mm of the medial aspect of the facet joint (Fig. 1). Kerrison punches are used to enlarge the hemilaminotomy medially to the lateral edge of the dural sac. The superior and medial borders of the pedicle associated with lower vertebral body area palpated with a probe. This provides exposure of approximately 5 mm of the lateral portion of the disc, which is sufficient to undertake the discectomy. Partial removal of the caudal pedicle may be removed to further expose the disc space. Epidural bleeding is controlled with bipolar cauterization after identification of the dural edge and exiting nerve root. Any free fragments of disc material can be removed and the disc space is entered lateral to the thecal sac below the exiting root. The disc is further removed using angled curettes and disc forceps. The more medially located disc herniations, down-biting curettes may be used to push down the herniated fragments before removal to avoid cord manipulation. The introduction of CO_2 laser for discectomy, however, can reduce the amount of bone resection needed and can reduce the needed for retraction and possible injury to the spinal cord (Fig. 2).

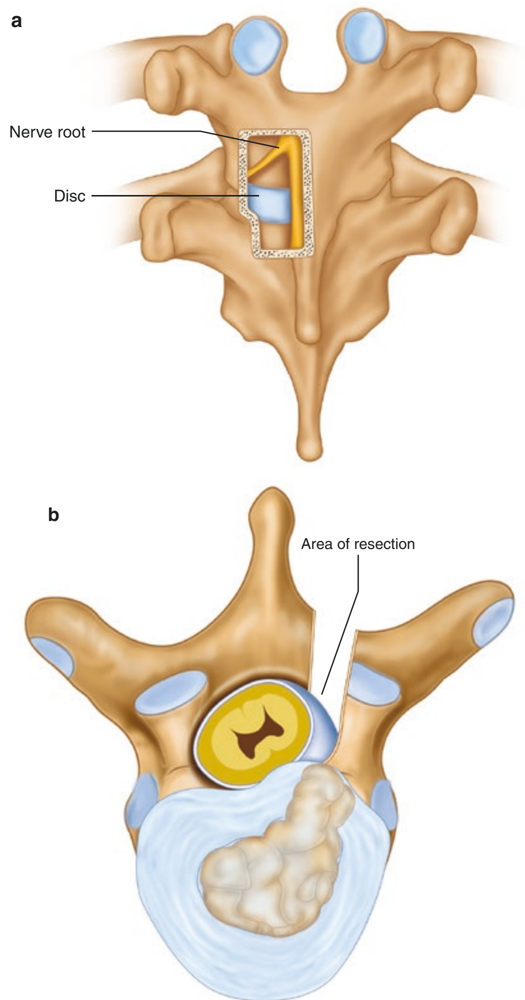

Fig. 1 Drawing of the area of bone resection required to expose the disc and the lateral edge of the thecal sac. A unilateral intralaminar laminotomy is done, including the superior and inferior laminar arches, as well as of the medial 2–3 mm of the facet joint. (**a**) Posterior view. (**b**) Axial view

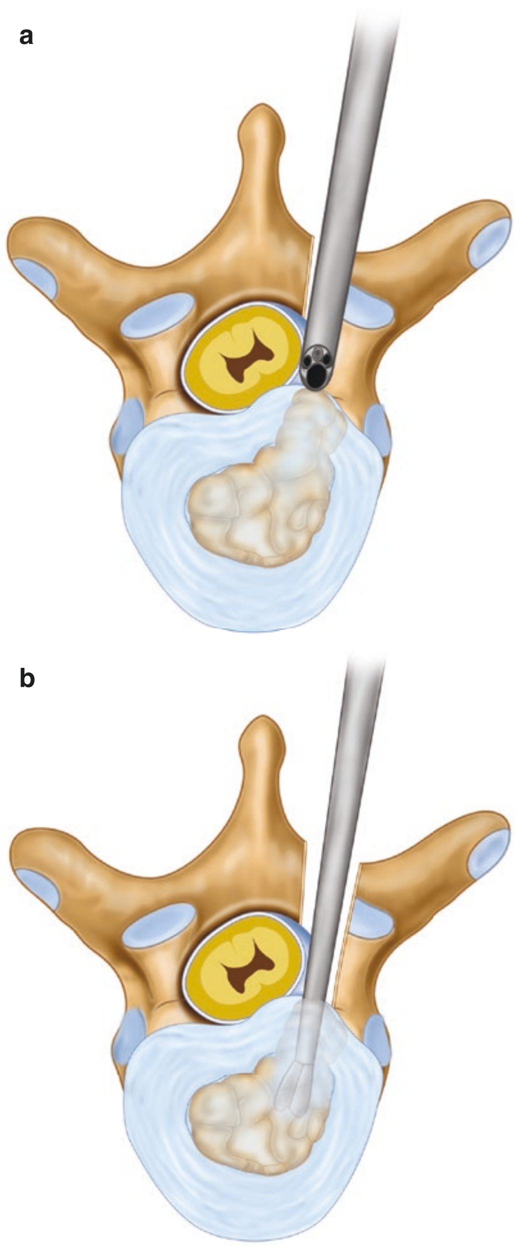

Fig. 2 Comparison of the discectomy using laser and pituitary rongeurs. (**a**) The pinpoint laser of <0.5 mm diameter enables discectomy in small operation field with minimal nerve retraction. (**b**) Conventional discectomy using mechanical instruments may require considerable neural manipulation and extensive bone resection

Application of CO_2 Laser for Discectomy

The usefulness of CO_2 laser as a surgical tool for removal of soft and calcified disc herniations has been reported in various situations [13–16]. The most significant benefit is the ability of pinpoint disc ablation with minimal retraction in a narrow surgical field. Compared to pituitary forcep which has a width of at least 5 mm, the diameter of the laser beam is less than 0.5 mm, which enables precise cutting and evaporation of the herniated disc within a very small operation field. Also, the CO_2 laser can effectively remove calcified disc or osteophytes with no risk of inserting any instruments. Another advantage of the laser is that sophisticated tissue dissection is possible without damage to neural elements. Inflammatory fibrous adhesion or even scarring from a previous operation can be delicately dissected using CO_2 laser and can reduce the risk of dural tear, intraoperative bleeding, and trauma to normal tissue. The most important disadvantage of laser surgery is the risk of thermal injury to neural tissues. Excessive laser application to the dural sac or nerve root may cause some profound or even irreversible neurologic sequelae.

Case Illustration

Case 1

A 43-year-old male patient presented with a sudden onset of excruciating back pain and left side dominant leg pain, especially at the anterior aspect of the thigh, and walking difficulty which began 2 weeks prior to admission. On magnetic resonance imaging (MRI), a left centrolateral soft disc herniation with spinal cord compression at the T11/12 level was identified. The patient underwent posterolateral approach for removal of the thoracic disc herniation using CO_2 laser.

Postoperative MR images showed decompression of the spinal cord. The patient had complete resolution of his symptoms (Figs. 3).

Case 2

A 33-year-old female presented with longstanding thoracic back pain and walking difficulty, along with numbness and weakness in both lower extremities. On MR imaging, a calcified right paracentral disc herniation with spinal cord compression at the T11/12 level was identified. The patient underwent a posterolateral approach for removal of the thoracic disc herniation using CO_2 laser along with down-bite curettes. Partial pediculectomy was done to widen the operation field. Postoperative MR imaging showed decompression of the spinal cord and gradual resolution of all her symptoms were seen (Fig. 4).

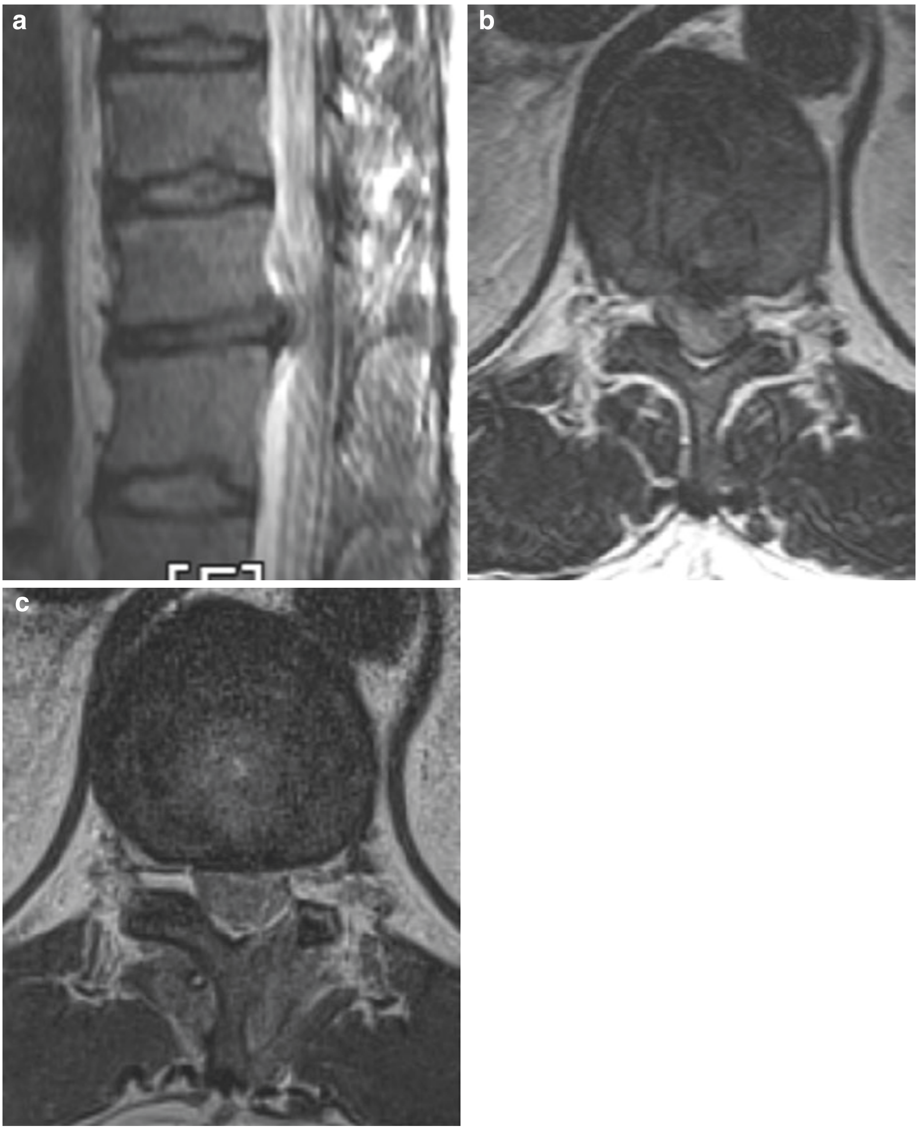

Fig. 3 Magnetic resonance (MR) image of a soft disc herniation at the T11/12 level. (**a**) Preoperative T2-weighted sagittal MR image demonstrating soft disc herniation. (**b**) A T2-weighted axial image showing centrolateral disc herniation. (**c**) Postoperative T2-weighted sagittal MR showing complete decompression

Fig. 4 Magnetic resonance (MR) image of a calcified disc herniation at the T11/12 level. (**a**, **b**) Preoperative T2-weighted sagittal and axial MR image showing disc herniation. (**c**, **d**) Computed tomography (CT) sagittal reconstruction image showing calcified disc. (**e**, **f**) Postoperative T2-weighted sagittal MR showing complete decompression

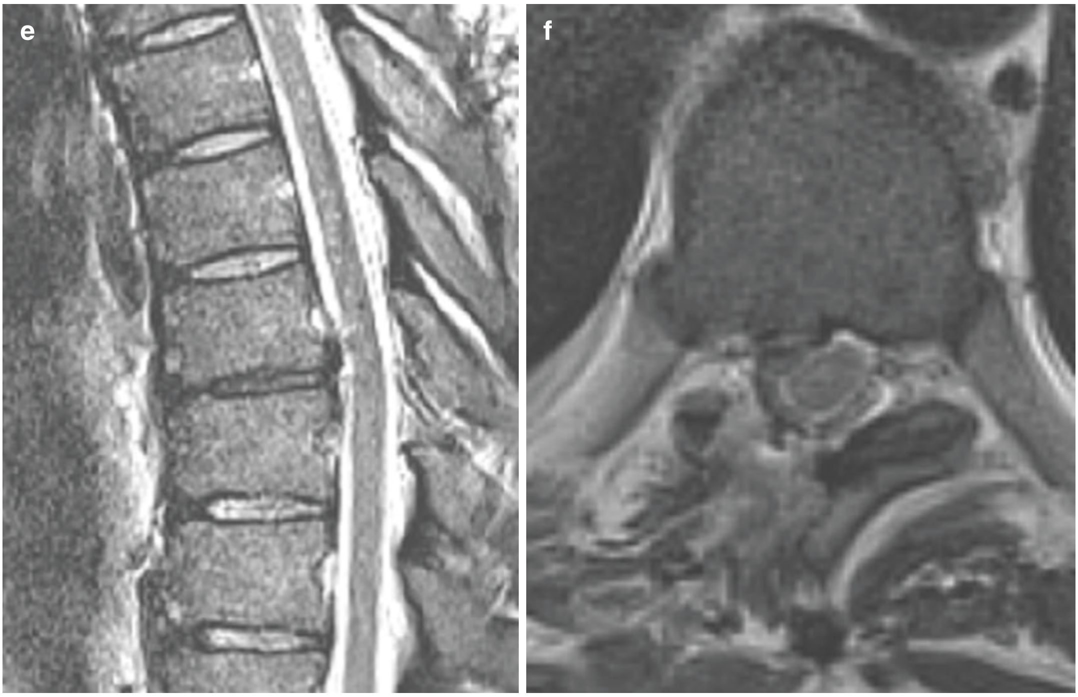

Fig. 4 (continued)

Summary

Posterior discectomy of a thoracic disc herniation through a posterolateral approach can be successfully used for a broad range of thoracic disc herniations, including more central, calcified and large disc herniations. The advantages of this approach include anatomic familiarity, lower morbidity, and infrequent requirement for instrumental stabilization. The use of CO_2 laser for discectomy has further broadened the indication for posterior discectomy while reducing the operation field and nerve manipulation necessary for successful surgery.

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