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Removal of a Protruded Thoracic Disc Using Microsurgical Endoscopy

A New Technique

Daniel Rosenthal, MD,* Raul Rosenthal, MD,† and Anna de Simone, MD‡

Study Design. The first clinical implementation of a microsurgical endoscopic technique for removal of thoracic disc herniation is described.

Objective. To decompress the spinal cord with a ventral approach, combining microsurgical and endoscopic techniques, while reducing the "approach-related trauma."

Methods. A detailed description of the preoperative preparation as well as the surgical technique is given. Advantages and disadvantages of the microsurgical endoscopic technique are discussed and compared with other surgical procedures described in the literature.

Results. A herniated disc at T6–T7 was removed and the spinal cord was decompressed. The patient recovered completely and was discharged at the seventh postoperative day. He returned to work 4 weeks later.

Conclusions. The microsurgical endoscopic technique allows spinal cord decompression with a substantial reduction in surgical trauma. It may shorten bed confinement and allow early return to active life. Application of this technique in other areas is being studied. [Key words: disc herniation, dorsal spine, endoscopic surgery, spinal cord compression, ventral approach to the spine] **Spine 1994;19:1087–1091**

Thoracic disc herniation is a rare cause of spinal cord compression that presents a variety of nonspecific symptoms leading to a wrong or delayed diagnosis.[10,13–16,18,23,25,29] Until the early 1960s, numerous reports indicated that thoracic disc herniation had a subtle onset, required a complex therapy, and had a poor prognosis.[3,11,18] Arseni and Nash[3] noted that the condition of about 50% of their patients deteriorated or remained unchanged after surgical decompression via a dorsal approach (laminectomy). In the following years, a variety of techniques, such as the costotransversectomy[6,13,21] (and its modification,[12] the arthropediculectomy[5,23]) and the transthoracic[8,22,24,25] approaches, were reported to be suitable for removing thoracic disc herniation without manipulating the spinal cord. However, these techniques entail the use of thoracotomy or wide bony resection of vertebral structures to reach the ventral part of the spine. Better imaging techniques (computed tomography and magnetic resonance imaging) and the development of new surgical procedures have substantially improved the prognosis of thoracic disc protrusion.[2]

We report on a new microsurgical endoscopic technique (MET) that permits disc removal while substantially reducing the "approach-related" trauma.

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Surgical Technique and Postmortem Studies

Fresh, unautopsied cadavers were used for the study. After the body was placed in a left lateral decubitus position (Figure 1), the intervertebral space to be operated upon was located under endoscopic and fluoroscopic control. We prefer a dextrolateral approach because the aorta and the heart are displaced to the left paravertebral area, improving spinal visualization and reducing the risk of complications. Four trocars (Ethicon, Hamburg, Germany) then are inserted in a triangular fashion along the middle axillary line, converging to the disc space (Figure 1). A rigid endoscope with a 30° angle optic (Karl Storz, Tüttlingen, Germany) with a single chip camera attached to it (Karl Storz, Tüttlingen, Germany) were introduced through one of the trocars, leaving the other three as working channels (Figure 1).

Surgery began by splitting the parietal pleura, starting at the medial part of the intervertebral space and extending up to the costovertebral process. The segmental arteries and the sympathetic nerve was mobilized out of the operation field and preserved. Part of the posterior aspect of the vertebral body and the proximal portion of the costovertebral process were drilled off, improving visualization of the spinal canal. Bone and disc removal were restricted to the posterior third of the intervertebral space and the costovertebral area so stability was not compromised. Removal of the disc and the posterior longitudinal ligament, using special forceps and rongeurs, then were performed. The instruments must be about 33 cm long to reach the spine comfortably. If fusion is required, bone can be harvested from the ribs, iliac crest, or fibula; the positioning of the patient makes this possible. When surgery was finished, chest tubes were placed and set under water-sealed suction.

Between July and November 1992 and with the help of the Pathology Department of the University Hospital, Frankfurt am Main, we were able to standardize the approach. Twenty-eight thoracic discs were removed in six cadavers under con-

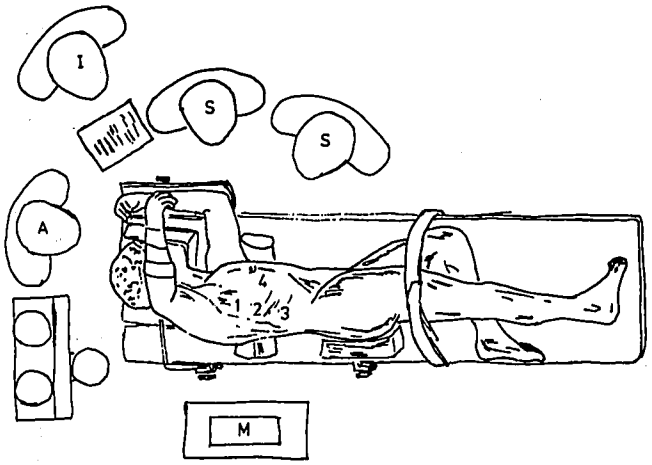

Figure 1. Position on the operating table and distribution in the operating theater. The surgeons (S) and nurse with the instruments (I) are standing in front of the patient. The monitor (M) is placed at the back. The "working channels" (1, 2, 3) converge toward the spine. The channel for the optical system (4) is situated ventrally.

the spinal canal was 2.17 hours. The last six discs and posterior ligaments were removed in a mean time of 1.38 hours.

Clinical work was started after the technique was standardized, skills were developed, and the approach was performed safely.

Case Report. Upon admission to the hospital, a 30-year-old man was complaining of bilateral pain at the T7 level, gait disturbances, and numbness in the genital region that had begun 4 weeks earlier.

Cerebrospinal fluid examination showed no abnormality. Plain x-rays of the dorsal region were normal. The MRI examination revealed a clear, ventrally located intraspinal and extradural mass between T6–T7 (Figure 2, left). The preoperative diagnosis was thoracic disc herniation. Somatosensory- and motor-evoked potentials showed a slight increase in latencies on both sides.

After analyzing the clinical and radiologic findings, we decided to remove this lesion using MET. Consent to use the new approach was obtained from the patient before surgery and after detailed information was provided.

Using MET, a herniated, sequestrated thoracic disc was removed. The postoperative course was uneventful. The patient was able to walk 24 hours after surgery, without body jacket. The chest drainages were removed on the second postoperative day (after 200 cc of serum was drained). The postoperative control MRI showed that the spinal canal was completely decompressed and free of disc material (Figure 2, right).

Upon discharge, he was still complaining about numbness in the genital region, although it had improved compared to the preoperative status). No other deficits were observed. The wounds were closed and the sutures were removed on the sixth day. Somatosensory- and motor-evoked potentials still showed a slight increase in latency. He was discharged on the 7th postoperative day.

The first follow up examination took place 6 weeks after the patient's discharge. Clinical symptoms and somatosensory-evoked potentials had normalized. The patient had been working for 2 weeks without problems.

■ Discussion

Pathophysiologic Considerations

The first surgical treatment of thoracic disc herniation was reported by Adson[18] in 1922, who performed a laminectomy and disc removal. The results obtained in subsequent years were disappointing and helped to document that the dorsal approach has an unpredictable

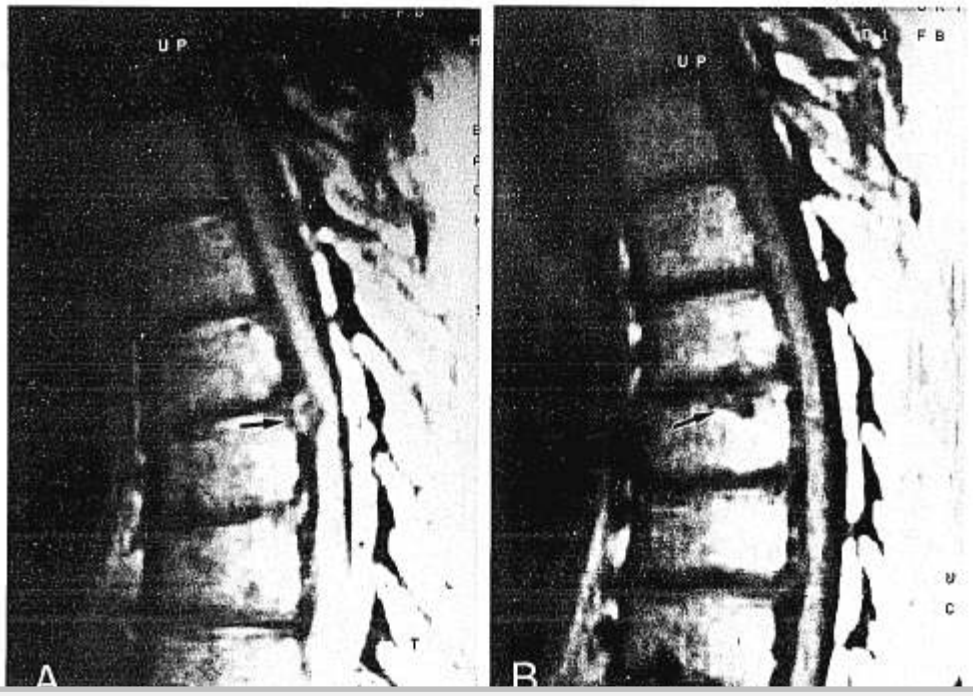

Figure 2. (**A**) Preoperative MRI shows the herniated disc between T6–T7 and spinal cord compression (arrow). (**B**) Postoperative MRI: The spinal cord is decompressed. The gap between T6–T7 (arrow) shows where the intervertebral space was entered. The spinal cord is decom-

outcome and is exceedingly risky, probably because spinal cord retraction is required to reach the disc, which is situated anterior to the spinal cord.[27]

Experimental and clinical reports demonstrated that compressive lesions situated ventrally in the thoracic spine frequently were followed by poor results when surgical treatment was attempted using the dorsal approach.[4,9] A logical explanation for this is that the spinal canal is narrower at the thoracic level and manipulation leads to microcontusions that worsen the already compressed and ischemic, probably causing secondary damage. Deficits in blood supply through the segmental arteries also were discussed. Doppman and Girton[10] found neurologic deterioration in all patients in whom ligature or thrombosis of a segmental artery occurred. On the other hand, Currier[9] described abundant collateral circulation around the neural foramina, routinely ligating the segmental vessels unilaterally, without adverse effects. A combination of microcontusions and alterations in microcirculation probably is the more appropriate explanation for this phenomenon.

Indications for MET

Laminectomy has been practically abandoned and replaced by ventral, ventrolateral, or dorsolateral approaches, which have improved results because of the reduction in spinal cord manipulation.[5,8,12,17,18,22,23,25] Early surgical decompression is accepted as the treatment of choice,[2,9] and a wide variety of techniques has been described for this purpose.[5,6,8,12,21,23–25] All require either bony removal of vertebral structures (causing or worsening instability) or a thoracotomy to gain access to the ventral spinal canal and minimize cord manipulation.

The posterolateral, lateral, and transpedicular techniques have been criticized because of postoperative instability in some cases,[12,19] insufficient visibility over the midline,[19,27] and sectioning of muscle or ribs to improve visibility.[19]

During the last 10 years, 16 patients with thoracic disc protrusions have been successfully treated at our department using the transthoracic approach. Although Arce and Dohrmann[2] reported that the best results are obtained with this technique, it has become unpopular for discectomy and is reserved only for special indications, such as vertebral body resection and fusion.[27] The need for a second surgical team (thoracic surgeon),[12] insufficient exposure of the thoracic spine,[19,28] and respiratory complications derived from thoracotomy[20] are considered to be its main disadvantages by most authors.[19,20,27,28]

Microsurgical endoscopy permits the same approach as the transthoracic route, except for thoracotomy. With appropriate instruments, any lesion situated ventrally and compressing the cord probably can be re-

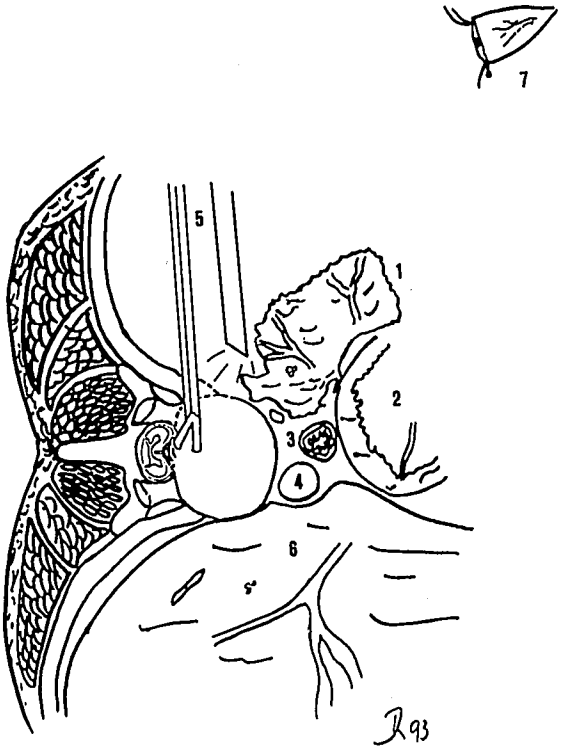

Figure 3. Horizontal view at the T6 level. The patient is in the left lateral decubitus. 1, right lung (collapsed); 2, heart and pericardium; 3, esophagus; 4, aorta; 5, forceps and endoscope; 6, left lung; 7, surgeon.

Preoperative Considerations

Patients who will undergo surgery using MET need to have their pulmonary function optimized. For patients with asthma or emphysema, pulmonary functional status should be improved before surgery is considered. Marked respiratory deficit can be a contraindication for MET because unilateral ventilation may worsen hypoxemia.

Advantages and Difficulties

One problem to consider is that microsurgical endoscopy does not differ much from the hazards neurosurgeons are familiar with during microsurgical operations. Some abilities, however, need to be acquired. The surgeon needs to look at the monitor in front of him or her with his or her head tilted up in a 90° angle while coordinating hand movements. Placing the surgeon and his or her assistant ventrally facilitates orientation and coordination. Nevertheless, we believe a period of practice and adaptation is mandatory.

The advantage of the left lateral decubitus position is that the spine can be reached while avoiding direct contact with the aorta, esophagus, and the pericardium, because these structures are displaced to the left paravertebral area (Figure 3). Because of the intubation associated with using a Robertshaw-type tube (Mallinckrodt Laboratories, Athlone, Ireland) and intraopera-

without further lung retraction. Reducing trauma to the thoracic wall and to the lung parenchyma may prevent a variety of complications.[7,20] This was confirmed in our patient by an insignificant intraoperative blood loss (100 ml), reduced consumption of analgesics in the postoperative period, and a considerable reduction in the amount of bed confinement after surgery.

The lack of instruments suitable for MET may complicate surgery. We have used a variety of instruments that were designed for abdominal laparoscopic surgery. Some prototypes and further applications for MET are now being developed at our department.

MET ensures disc removal. It permits a wide exposure of the thoracic spine by changing only the insertion site of the trocars. A review of the literature[1,2] showed that out of 258 patients, only 12 (4.6%) had a disc protrusion above T4, and 24 (9.3%) below T12, making MET suitable for over 80% of patients. Under experimental conditions, we were able to reach the spine successfully from T4 to T11. Clinical experience will undoubtedly show us the real potential of this method. Herniated soft disc (medial or lateral) or calcified protrusions can be removed without compromising the spinal cord.

In case fusion is needed, bone grafts can be brought into the thoracic cavity by dilating the holes made by the trocars. As a result of early mobilization, the incidence of thrombosis decreases as well. This is significant, especially in elderly and high risk patients.

Finally, by getting the same benefits as with other surgical procedures—early release and return to work (reducing hospitalization time up to 50%)—this technique helps decrease therapy costs.

■ Conclusions

MET is a modification of the thoracic approach that allows complete disc removal with a substantial reduction in surgical trauma (fewer wound and pulmonary complications). It shortens confinement to bed (reducing the risk of thrombosis) and reduces the postoperative period (early discharge). A training period is obligatory, although it should be learned easily by those familiar with microsurgical techniques.

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References

1. Alberico AM, Sahni KS, Hall JA Jr, Young HF. High thoracic disc herniation. Neurosurgery 1986;19:449–51.
2. Arseni C, Nash F. Thoracic intervertebral disc protrusion: A clinical study. J Neurosurg 1960;17:418–30.
3. Bennett MH, McCallum JE. Experimental decompression of spinal cord. Surg Neurol 1977;8:8:63–7.
4. Carson J, Gumpert J, Jefferson A. Diagnosis and treatment of thoracic intervertebral disc protrusion. J Neurol Neurosurg Psychiatry 1971;34:68–77.
5. Capener N. The evolution of lateral rachotomy. J Bone Joint Surg. [Br] 1954;36:173–9.
6. Cherniak NS, Barker WC. Cardiopulmonary function in tuberculosis. In: Gordon BL, ed. Clinical Cardiopulmonary Physiology. New York: Grune & Straton, 1969.
7. Crafoord C, Hiertonn T, Lindblom K, Olsson LS. Spinal cord compression caused by a protruded thoracic disc: Report of a case treated with anterolateral fenestration of the disc. Acta Orthop Scand 1958;28:103–7.
8. Currier BL, Eismont FJ, Green BA. Thoracic disc disease. In: Rothman RH, Simeone FA, eds. The Spine. 3rd ed. Philadelphia: W.B. Saunders, 1992:655–70.
9. Doppman JL, Girton M. Angiographic study of the effect of laminectomy in the presence of acute anterior epidural masses. J Neurosurg 1976;45:195–202.
10. Epstein JA. The syndrome of herniation of lower thoracic intervertebral discs with nerve root and spinal cord compression. A presentation of 4 cases with review of the literature, methods of diagnosis and treatment. J Neurosurg 1954;11: 525–38.
11. Garrido E. Modified costotransversectomy: A surgical approach to ventrally placed lesions in the thoracic spinal canal. Surg Neurol 1980;13:109–13.
12. Hulme A. The surgical approach to thoracic intervertebral disc protrusions. J Neurol Neurosurg Psychiatry 1960; 23:133–7.
13. Kretschmer H, Gustorf R. Zur Problematik der thorakalen Bandscheibenvorfälle. Neurochirurgia (Stuttg) 1979;2: 41–7.
14. Kroll FW, Reiss E. Der thorakale Bandscheibenprolaps. Dtsch med Wochschren 1951;76:600–3.
15. Kuhlendahl H. Der thorakale Bandscheibenprolaps als extramedullärer Spinaltumor und in seinen Beziehungen zu internen Organsyndromen. Ärztliche Wochenschrift 1951;6: 154–7.
16. Lesoin F, Rousseaux M, Autricque A, et al. Thoracic disc herniations: Evolution in the approach and indications. Acta Neurochir 1986;80:30–4.
17. Love JG, Schorn VG. Thoracic—disc protrusions. JAMA 1965;191:627–31.
18. Maiman DJ, Larson SJ, Luck E, El-Ghatit A. Lateral extracavitary approach to the spine for thoracic disc herniation: Report of 23 cases. Neurosurgery 1984;14:178–82.
19. Melamed M, Hipona GA, Reynes CJ, Barker WL, Paredes S. The Adult Postoperative Chest. Springfield, IL: Charles C Thomas, 1977.
20. Ménard V. Étude practique sur le mal de Pott. Paris: Masson et Cie, 1900.
21. Otani K, Nakai S, Fujimura Y, Manzoku S, Shibasaki K. Surgical treatment of thoracic disc herniation using the anterior approach. J Bone Joint Surg [Br] 1982;64:340–3.

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