Percutaneous Microdecompressive Endoscopic Cervical Discectomy with Laser Thermodiskoplasty

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Abstract

Objective: To study the surgical outcome of outpatient percutaneous microdecompressive endoscopic cervical discectomy with lower energy laser for shrinkage of disc material (thermodiskoplasty).
Method: Since 1994, 200 patients with herniated cervical discs have presented at the authors' clinic, with unilateral radicular pain. The diagnosis was confirmed by MRI or CT, and EMG.
Results: At an average follow-up of 25 months, 94.5% of the cases had good-to-excellent results. Eleven patients (5.5%) remained symptomatic, with persistent neck and upper extremity pain associated with paresthesias. There were no significant postoperative complications. Average time before returning to work was 10 days.
Conclusions: Percutaneous microdecompressive endoscopic cervical discectomy with laser thermodiskoplasty has proven to be a safe and efficacious minimally invasive procedure.
Key Words: Percutaneous microdecompressive endoscopic cervical discectomy, laser thermodiskoplasty, minimally invasive surgery.

CONVENTIONAL OPEN CERVICAL DISCECTOMY, with or without bony fusion, is considered the standard treatment for cervical disc protrusion (1). However, open discectomy with fusion is associated with significant local inflammation, graft donor site pain, and a lengthy period of convalescence (2, 3). In contrast, percutaneous microdecompressive endoscopic cervical discectomy (4) is minimally invasive and offers decreased morbidity, requires no bone graft (a cause of secondary symptoms) and promises a shorter recuperation. The purpose of this study is to evaluate the surgical outcome of outpatient percutaneous microdecompressive endoscopic cervical discectomy with lower energy laser for shrinkage of disc material (thermodiskoplasty).

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Materials and Methods

Patient Population. Since 1994, 200 consecutive patients (26–72 years of age) with 360 nonextruded cervical disc herniations have presented at the authors' clinic. The levels of involvement were 1 at C2–3, 34 at C3–4, 92 at C4–5, 104 at C5–6, 127 at C6–7, and 2 at C7–T1. The indications for surgery were: (a) neck pain with radiation down the arm; (b) symptoms and signs of sensory loss, tingling, numbness, muscle weakness, and/or decreased deep tendon reflexes; (c) MRI or CT findings of nonextruded disc herniation consistent with the signs and symptoms; (d) positive electromyography and/or nerve conduction studies; and (e) no improvement after 12 weeks of conservative therapy.

Preoperatively, non-steroidal anti-inflammatory agents were given to all of the patients. Thirty cases (15%) were treated with epidural steroid injections, 25 (12.5%) with oral steroids, 74 (37%) with muscle relaxants, 35 (17.5%) with aspirin, 10 (5%) with tranquilizers, and 64 (32%) with narcotics or prescription analgesics.

Some patients received more than one form of treatment.

The contraindications to any surgical intervention were acute or progressive degenerative spinal cord disease and neurological or vascular pathologies mimicking a herniated disc. Since 1994, 42 other patients underwent open cervical operations for (a) advanced spondylosis with disc space narrowing, (b) significant bony spurs that could block percutaneous entry into the disc space, (c) cervical spinal canal stenosis or lateral recess stenosis, and (d) an extruded disc or free fragment.

Surgical Technique. Under local or general anesthesia, the patient was placed in a supine position with the neck extended by placing a rolled towel under the shoulders. A soft strap was placed over the forehead for stabilization. The shoulders were gently distracted downward with tape. C-arm fluoroscopy was used in anteroposterior and lateral planes to direct the placement of a spinal needle onto the disc surface. Initially, at the point of entry adjacent to the medial border of the right sternocleidomastoid muscle, firm pressure was applied digitally in the space between the muscle and the trachea and pointed toward the vertebral surface. The larynx and trachea were displaced medially and the carotid artery laterally. The esophagus was made more prominent with the insertion of an endotracheal tube. The pulse of the carotid artery was augmented with sympathomimetics. The anterior cervical spine was palpated with the fingertips, and a #18-gauge spinal needle was passed into the disc space. The position was confirmed fluoroscopically.

A 2–3 mm skin incision was made, and a narrow guide wire was passed through the needle. The needle was then removed. A blunt trocar was introduced over the guide wire down to the interspace, followed by a cannula. A trephine inserted through the cannula cut the annulus in a circular fashion. Minicurettes loosened and removed disc material prior to introduction of a suction-irrigation system and the discetome with a guillotine-cutting blade (Fig. 1). The instruments included a probe, grasper forceps, and laser fiber (Fig. 2). Movement in a critical fan sweep maneuver, a 25° rocking excursion of the cannula hub from side to side, increased the removal up to a 50° cone-shaped area within the disc space (Fig. 3). The procedure was closely monitored with the fluoroscope (Fig. 4) and an endoscope (Figs. 5A, B). The holmium: yttrium-aluminum-garnet laser with right angle or side-fire probe facilitated the discectomy. In addition, nonablative levels of holmium laser energy (500 joules) or thermodiskoplasty added shrinking of collagen and fibrocartilage; the tightening effect further decompressed and hardened the herniated cervical disc.

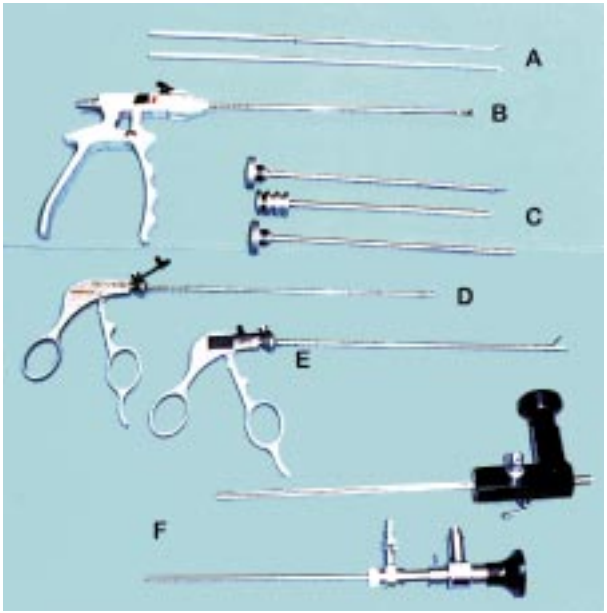


Fig. 1. Minimally invasive spine surgery instruments: **(A)** minicurettes, **(B)** discectome, **(C)** discectomy dilator/cannula/trephine, **(D)** cutter forceps, **(E)** grasper forceps, and **(F)** endoscopes.

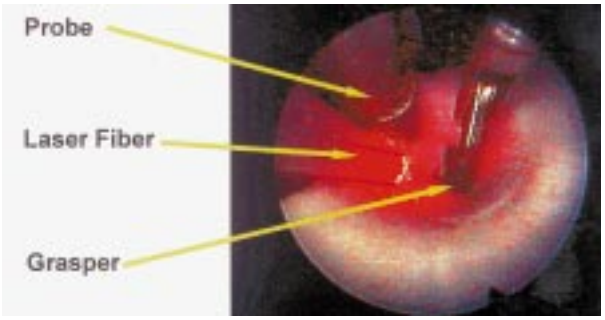


Fig. 2. Three microdiscectomy instruments working inside of disc space.

Results

Preoperative MRI (Fig. 6A) reveals a bulging herniated disc. Fig. 6B illustrates postoperative changes in this disc space. Follow-up averaged two years, with a range of 9–45 months. Eleven patients (5.5%) had persistent slight-to-mild neck and upper extremity pain that required analgesic medication, while 189 (94.5%) had good-to-excellent recovery with minimal or no pain and resumption of a fully active lifestyle. There were no postoperative complications of wound infection, or arterial or nerve compromise. Of the 198

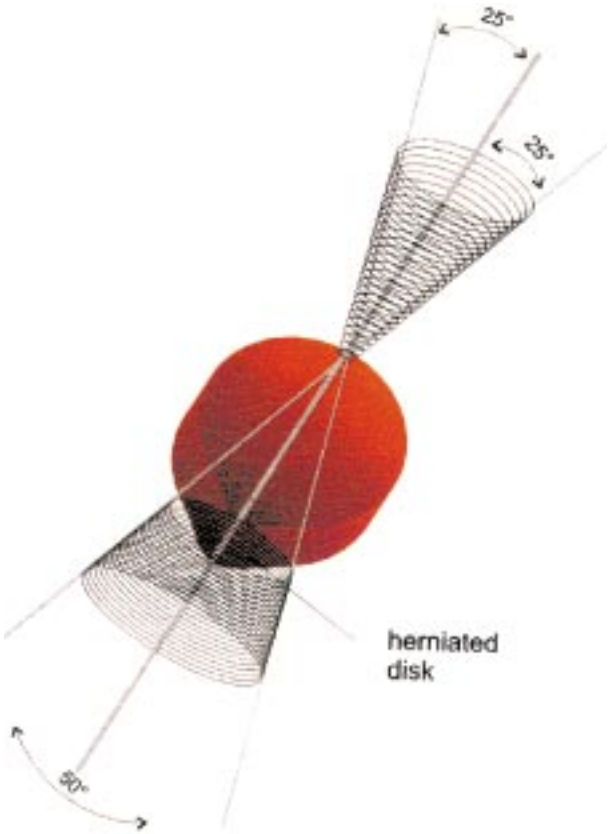


Fig. 3. Critical fan sweep maneuver in cone shape.

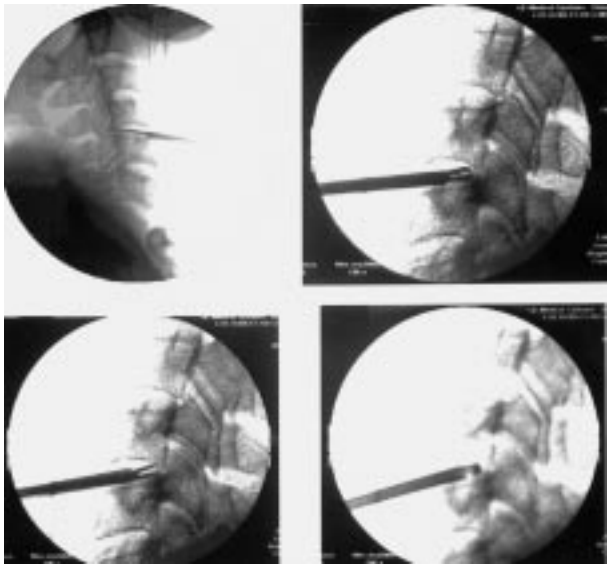
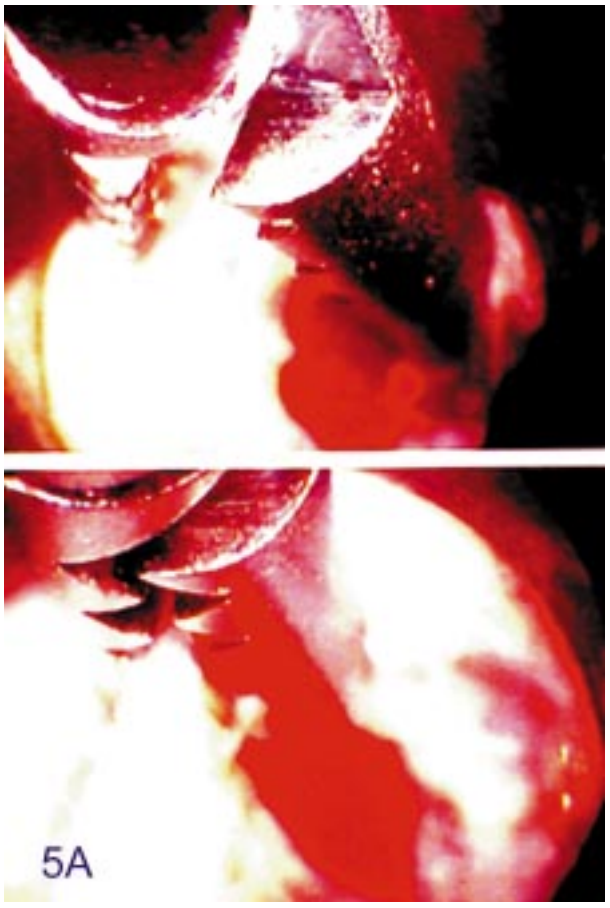


Fig. 4. X-rays of curette (upper left), cutter (upper right), grasper (lower left), and discectome (lower right) in disc space.



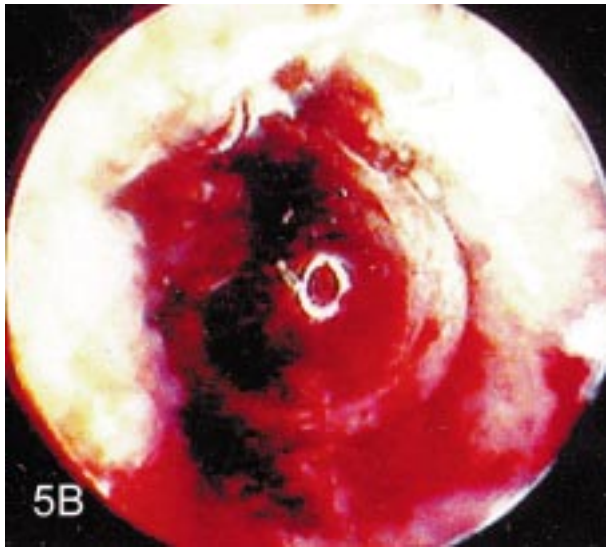


Fig. 5. (A) Endoscopic views of grasper removing disc material. **(B)** Note defect left following discectomy and debulking.

cases (99%) demonstrating muscle spasm preoperatively, 6 (3%) continued to be symptomatic, with some neck stiffness. All 200 patients reported dermatome-specific numbness of the upper extremities and manifested decreased pain and touch sensation; 8 (4%) reported persistent numbness and tingling and 6 (3%) had occasional diminished feeling without objective findings on neurological examination. The average time before returning to work was 10 days, with a range of 3 days to 4 weeks.

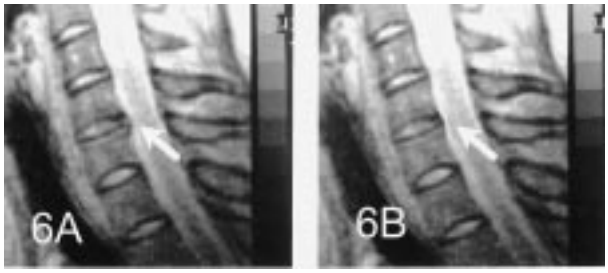


Fig. 6. (A) Posterior protrusion of disc. **(B)** Note shrinkage and tightening of disc material.

Discussion

The current trend of evolution of all spinal surgery has been toward less-invasive techniques. In 1964, Smith (5, 6) introduced chymopapain chemonucleolysis to treat herniated nucleus pulposus. Hijikata (7) and Onik et al. (8) described percutaneous lumbar discectomy. Ascher (9) and Sherk (10) then reported laser discectomy.

Key (11) first described the pathologic findings of two cases of cord compression by "intervertebral substance" in 1838. In the nineteenth and early twentieth centuries, reports of cervical chondromas of the cervical spine were presented. Stookey (12) described the clinical symptoms and anatomic location of cervical disc herniation in 1928. Subsequently, in 1934, Mixter and Barr (13) further implicated cervical disc protrusions. Before 1950, the standard surgical approach to discs in the upper spine was posterior cervical laminectomy. Bailey and Badgley (14), Cloward (2, 3), and Robinson and Smith (15) popularized the anterior approach with interbody fusion in the 1950s. Hirsch (1) in 1960, then Robertson (16) in 1973, recommended cervical discectomy without fusion; results and success rates similar to those with fusion were reported. Fukushima (17) introduced the ventriculofiber in 1973 and further enhanced the foundation for percutaneous endoscopic cervical discectomy (18).

The advancements in miniaturization of microsurgical instrumentation, fiber optics, improved fluoroscopic imaging, high-resolution digital video imaging endoscopy, accumulated experience in percutaneous lumbar discectomy (4, 19–24), and the application of lasers to surgery (9, 10, 17, 25–27) have all facilitated the development of percutaneous endoscopic decompressive cervical discectomy. The development of rigid and flexible endoscopes has provided better visualization of the spinal canal and disc anatomy.

Prior to 1995, the holmium laser (Trimedyne, Irvine, CA) was used in surgery on joint ligaments, skin, and the retina. Since 1995, our method employs the holmium laser at non-ablative lower energy settings (500 joules) to achieve the triad of surgical objectives: lowering intradiscal pressure, debulking the disc, and shrinking the fibrocartilage.

Success rates reported by others (28, 29) were 40% and 77%, respectively. Our success rate of 94.5% reflects careful patient selection, thorough diagnostic evaluation by MRI, CT, and electromyography, and careful correlation with signs and symptoms. In our experience, this minimally invasive outpatient procedure has proven to be safe and effective, with less morbidity, more rapid recovery, and significant economic savings.

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