Automated percutaneous lumbar discectomy

Clyde A. Helms, M.D. 1, Gary Onik, M.D. 2, and G. William Davis, M.D. 3

1 Department of Radiology, University of California, San Francisco, California, USA
2 Department of Neurosurgery, Allegheny-Singer Institute, Pittsburgh, Pennsylvania, USA
3 Nashville, Tennessee, USA

Abstract. Lumbar spine disc disease has traditionally been treated surgically by laminectomy and manual removal of the offending disc material. Chymopapain was extensively used to decompress the disc pressure in a relatively noninvasive manner, but has been abandoned due to serious complications, including anaphylaxis and paraplegia. Onik introduced automated percutaneous discectomy in 1985. This procedure has proved safe and efficacious for treating lumbar disc disease without complications. It is performed on an out-patient basis under local anesthesia with minimal rehabilitation time. The success rate reported in a multi-institutional study with one year follow-up is approximately 75%. The majority of failures occur in patients with free fragments or spinal stenosis – both of which can be diagnosed preoperatively with good imaging examinations. Hence, the success rate can be expected to improve if preoperative imaging is relied upon to help choose appropriate patients. Over 30,000 percutaneous discectomy procedures have been performed. The only complication reported, disc infection, developed in fewer than 0.2% of cases. Automated percutaneous discectomy has the potential to treat a vast number of patients with lumbar disc disease who otherwise would have laminectomies.

Key words: Lumbar disc disease – Percutaneous discectomy – Lumbar spine

Chymopapain raised hopes among patients and physicians that a relatively noninvasive treatment for herniated lumbar discs had been found. The associated complications – anaphylaxis, subarachnoid hemorrhage, infection, and transverse myelitis with associated paraplegia – have curtailed use of this procedure. The traditional treatment for herniated lumbar discs – surgical disc removal through a laminectomy – does benefit most patients but still poses the risk of injury to soft tissues, joints, and neural structures. Additionally, the rehabilitation period following surgery can be prolonged. Percutaneous lumbar discectomy by mechanical decompression of the disc has the beneficial effects of chymopapain use without its associated complications. In contrast to the laminectomy, there is no need for general anesthesia, no problem with epidural fibrosis, and no prolonged postsurgical rehabilitation period.

History

In 1975, Hijikata presented a technique for percutaneous nuclelctomy of herniated lumbar discs [7]. In 1978, he reported good-to-excellent results in 80 patients undergoing nuclelectomy through a posterolateral percutaneous approach [8]. This approach involved inserting a cannula against the anulus, making a hole in it, and then removing the disc material with long, grasping forceps. Hijikata subsequently reported his experience with this technique in 100 patients with the same positive results [5]. In 1983 Kambin and Gellman, using a similar approach, reported their results in 9 patients who were all relieved of leg pain with no reported complications [10]. In 1979 Suezawa and Jacob in Switzerland carried out percutaneous nuclelectomies by means of forceps introduced into the
disc space through a long cannula similar to that used by Hijikata in Japan [22]. Between 1979 and 1985, 49 patients underwent this procedure with 70% success. Again no complications were reported. In 1981, Jacobson developed a percutaneous discectomy technique. Using a straight lateral approach, he inserted a 40 French chest tube against the lateral anulus. After incising the anulus with a number 15 blade, he used forceps to grasp and remove the nucleus pulposus. Jacobson obtained good-to-excellent results in more than 30 patients; however, neural complications have limited the use of this technique. In 1983, Friedman, using Jacobson's technique, confirmed that good results were possible but emphasized the potential risk of bowel perforation, interruption of the sympathetic chain, and vascular injury [4]. He subsequently abandoned the procedure.

In all of the previous techniques disc decompression was effected percutaneously by removing the disc material by hand with grasping forceps. Consequently, the procedures have been time-consuming, and the cannulas needed to gain access to the disc space have been large, increasing the potential for nerve injury and disc space infection. Recent papers reporting the results of the various manual techniques have confirmed that these potential problems do occur with a frequency that the authors feel is too high for a percutaneous procedure [6, 9, 11, 14, 20, 21].

In 1985 Onik described automated percutaneous discectomy, in which a reciprocating suction cutter, making up to 200 cuts per minute, separates pieces of disc material [15, 16]. This cutter allows a procedure to be completed in a reasonable time and makes possible the use of a smaller cannula (2.8 mm), thereby reducing the possibility of nerve injury. In addition, since the instrument is placed within the disc only once, the risk of a disc space infection is low.

In 1987 Onik et al. reported their results with 36 patients [17]. The procedure was successful in 31 patients, and there were no complications. This series was part of a multi-institutional study that has now been completed [19]. It reports a series of 506 discectomies performed by 18 different surgeons all over the world. The success rate for patients who met the protocol criteria (N = 327) was 75.2%, while the success rate for those who did not meet the protocol criteria (N = 168) was only 49.4% (11 cases were lost to follow-up). These patients have been followed for a year or more. These results have been confirmed by a separate multi-institutional study in Europe that reported a 72% success rate in over 600 patients [1].

The patient selection protocol has now been broadened considerably, and over 2500 physicians have already been trained to perform this procedure. Over 30000 patients have now undergone the procedure with no reported complications other than a 0.2% rate of disc infection. Davis has reported a 78% success rate in 200 consecutive cases [3]. The majority of failures were due to free fragments and spinal stenosis, suggesting that good preoperative imaging and diagnosis might yield an even higher success rate.

**Patient selection**

The success rate of this procedure depends largely on proper patient selection. To participate in the initial multi-institutional study, a patient had to have sciatica confined to one leg (with leg pain greater than back pain) as the major complaint. Patients had to satisfy at least half of these criteria as well: (a) a history of paresthetic discomfort in the specific dermatomal distribution, (b) positive findings on a straight leg raising test, (c) cross-over pain or positive bow string sign, and (d) the presence of two of four possible neurologic findings (wasting, weakness, sensory alteration, and reflex alteration). In addition, computed tomographic (CT) scans or magnetic resonance (MR) images of all patients had to show a herniated nucleus pulposus in an area consistent with the specific findings. Myelography was not necessary. Patients were required to undergo at least 6 weeks of conservative therapy without success and must otherwise have been candidates for laminectomy.

Patients were excluded from the multi-institutional study if they had a history of previous lumbar surgery, previous chymopapain injections, or a workmen’s compensation claim. Patients were also excluded for any other cause of back pain revealed on the CT or MRI study: severe degenerative facet disease, lateral recess stenosis, evidence of a free fragment, or other evidence of spinal stenosis.

Since the initial multi-institutional study protocol has been broadened to include other operators, the patient selection protocol has naturally been broadened. Patients originally ineligible because of mild spinal stenosis, multilevel discs, workmen’s compensation claims, and prior surgery have now undergone the procedure with varying results. In general, the results in patients who do not satisfy the criteria of the original protocol have been less satisfactory, as one might expect.

We feel strongly that patients with free fragments, marked central canal stenosis, and extreme-