Book Review

Percutaneous Lumbar Laser Disc Decompression

Steven D. Waldman, Pain management, 2rd rev, Philadelphia: Saunders, 2011. 1482-590p

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Introduction

Since 1934, when open diskectomy was first introduced at Massachusetts General Hospital, millions of diskectomies have been performed in the United States, with the rate now approaching 500,000 operations per year. The search for a less invasive approach to laminectomy/diskectomy began in the 1960s with chymopapain-Lyman Smith 1964, microdiskectomyby Yasargi in 1968, percutaneous diskectomy introduced by Hijikata in 1977, endoscopic monitoring of disk removal by Leu in 1982, endoscopic diskectomy was first used by Schreiber and Suezawa in 1986, and improved by Mayer, Brock, and Mathews, arthroscopic diskectomy by Kambinin 1983, nucleotome introduction by Onik in 1984, percutaneousnon-endoscopic laser diskectomy by Ascher in 1986, Michael L. Whitworthand Choy2 in 1987 and endoscopic laser diskectomy byMayer in 1992 and Savitz in 1994, and the subsequent refinement of endoscopic laser methods by Yeung. In 2000 to 2001, newer minimally invasive methods of diskectomy were introduced, such as coblationnucleoplasty followed by disk decompression.

History of Laser Disc Decompression

Lasers were first reported to be clinically used in the intervertebral disk in 1975 as part of an open thoracic discectomy using a CO2 laser. Animal models for use of the same laser during canine anterior cervical open discectomy did not occur until 1984. In the 1980s, several lasers were available for treatment of ocular disorders including the argon, carbon dioxide, and excimer (XeCI) laser. The road to published science behind percutaneous diskectomy with a laser began in 1989 when an excimer laser was used on cadaveric disk tissue, even though the first percutaneous discectomy had occurred several years earlier in 1986.

Neodymium-Doped Yttrium Aluminium Garnet(Nd: YAG) laser was applied in laboratory applications and clinically from 1986 to1990, and was first introduced to the scientific literature by Yonezawa in 1990. The KTP laser (green) was used at least as far back as 1990 for diskectomy. The early 1990s saw a proliferation of other laser development with the introduction of Ho:YAG, Er:YAG, and excimer lasers for widespread use in medicine and dentistry. Because of practical considerations, the Ho:YAG became the tool of choice for most physicians performing laseriskectomy. This is largely due to the fact that a fiberoptic waveguide can be employed instead of a mirror system, the penetration depth into tissue is very low giving fine control of tissue modulation and ablation, and the laser output power available is very high-up to100 watts. Much of the history of development of lasers for diskectomy was not published until many years later, partially due to financial considerations tied to patent and techniquedevelopment. The most expansive description of one author's quest to develop laser for intradiskal therapy is found inChoy's book Percutaneous Laser Decompression. Choy pioneered the development of laser coronary angioplasty with an argon laser, having performed the first such surgeryin September, 1983.From 1984 to 1986 Choy and his colleagues worked on the basic science and animal models before introducing the laser for human diskectomy. The initial experiments, published much later, included proving the hypothesis that a minimal volumetric decompression of a pressurized disk using a laser would result in a disproportionately greater reduction in intradiskal pressure. An Nd: YAG laser at 1064 nm was used to deliver 1000 J energy to create 20-mm by 6-mm elliptical tracks in the nucleus of fresh cadaver disks loaded to 260 to 410 kPa (37 to 59 psi). Control disks were used in which the laser was not turned on. Next, different lasers were examined as to their capability of disk ablation.

At 900 J energy, the mass of disk ablated ranged from 120to nearly 200 mg disk tissue. Er:YAG, Nd:YAG (1318 and1064 nm, respectively), CO2, argon, excimer, and Ho:YAG lasers were evaluated. The most effective in disk ablation was the pulsed CO2 laser and erbium laser, but all other lasers were nearly as effective. However, the Ho: YAG lasers of that time were very weak compared to later lasers. For practical purposes, the Nd:YAG 1064 nm was chosen by Choy for percutaneous laser disk decompression (PLDD) owing to the availability of fiberoptic waveguides and the high powers available with the Nd: YAG. Other experiments were conducted using bovine disks demonstrating temperature rises of less than 2°C in the neural foramina, the anterior surface of the spinal canal, and 1 cm away from the laser tip directly in the line of fire of the laser. Next, experiments with mongrel dogs where employed under IRB approval. PLDD was performed through an 18-gauge needle with 1000 J energy delivered. The dogs were subsequently sacrificed and on autopsy, there were no extra-diskal injuries. Clinical use in humans began in February 1986 in Austria.

Techniques of Laser Diskdecompression

Different techniques of laser disk decompression are available, some of which have elaborate systems of instrumentation. The basic approach to all laser disk decompression is through placement of a needle or cannula via a posterior-lateral transforaminal entry into the intervertebral disk. Once the needle or cannula has entered the inner annular fibers, a laser is advanced into the disk and activated to decompress the nucleus pulposus. This may be achieved with fluoroscopic guidance, rigid endoscopic guidance, or flexible endoscopic guidance. The laser tip may be a rigid end-firing laser wand,a rigid side-firing laser wand, or a fiberoptic waveguide laser tip (polished or cross-cut). Laser choices include Ho: YAG, Nd: YAG (two wavelengths), KTP, Er:YAG, multidiode, and tunable diode. Generally, a Ho: YAG laser is preferred, although the new multidiode laser is much less expensive. After laser disk decompression, generally the needle is withdrawn, but the cannula often remains for further mechanicaldissection of the disk using long instrumentation through an endoscope.

LASE System

The LASE disk access needle system consists of a straight (2.8-mm, 12 gauge) and curved needle (3.0-mm for L5-S1).The needle is inserted into the safe zone. When the disk is contacted, a small trephinemay be placed through the needle to assist with annulotomy. If the angle of the straight needle placed at L5-S 1 is too acute to the sagittal plane (I8 to 30 degrees), the straight needle will have its final placement too far lateral in the disk. In such cases, the beam is angled more cephalad (no longer in a direct plane with the disk) then more lateral oblique to permit use of the 3.0-mm curved cannula. The curved cannula is advanced over the superior iliac crest; then a steep inferior angle is selected to guide the needle tip to the lateral-anterior border of the SAP of S1. The needle is subsequently advanced over the trephine into the inner annular fibers and a needles topset screw is tightened to fix the maximum needle ingress. With the 1.7-mm diameter endoscope connected to a light source and camera (preferably CCD 3 chip), white balancing is performed. Rotor pump pressurized irrigation is turned on with an irrigant of normal saline or normal saline mixed withbacitracin 50,000 U per 3 L is infused through the irrigation port of the wand.

Conclusion

This book review shows Level II-2 evidence for percutaneous lumbar laser disc decompression with 1C/strong recommendation. Thus, laser disc decompression may provide appropriate relief in properly selected patients with contained disc herniations.