Treating LUMBAR Back Pain

by Elmer G. Pinzon, MD, MPH

Injection techniques play a major role in the management of disorders of the musculoskeletal system.

Lumbar Discography & Therapeutic Intradiscal Procedures

Pain is the most complex problem modern medicine faces today and is the primary complaint prompting medical consultation. Compartmentalization of pain problems into physiological, physical, and psychosocial categories may be useful diagnostically, but must be synergistically joined to achieve therapeutic success. The interventional physiatrist (often the physical medicine and rehabilitation musculoskeletal and spine specialist) is a valuable and often most crucial member of the pain management team. Injury and tissue-specific therapeutic exercise programs must form the basis of physical rehabilitation and functional restoration protocols. The program can combine a core of sedentary exercises coupled with injury-specific exercises. Importantly, the protocol must expand to encompass psychotherapeutic intervention in chronic pain conditions. Neuromuscular reconditioning must be included to ensure a function-specific, task-oriented program. Essentially and most importantly, the program must be geared to enhance and foster functional recovery in the affected patient.

Diagnostic Discographic Injections

Lumbar discography remains a controversial diagnostic technique.[1-12] To appreciate the historical controversy surrounding discography is to understand that its inception was a tenuous one, tainted by admonitions, suppositions, and contradictions. Proponents believe discography uniquely shows internal disc anatomy and identifies clinically symptomatic, or painful discs.[7,10,13-15] In 1934, Mixter and Barr first called attention to the pathoanatomy of the herniated lumbar disc and its relationship to radicular dysfunction from neural compression.[16] A neurogenic cause of discogenic pain independent of a neurocompressive paradigm was established in 1940 when Roofe revealed the innervation of the annulus fibrosus.[17] Subsequently, four years later Knut Lindblom demonstrated the presence of radial annular fissures by injecting cadaveric discs.[18] Vanharanta applied this basic scientific knowledge to demonstrate and explain pain provocation in mid to outer annular fissures.[19] In 1952, Pierre Erlacher established the correlation of the nucleogram to nuclear anatomy by investigating cadaveric discs using contrast material and histological stains.[20] Indications and the technique for lumbar discography was described in 1952 by Cloward and Busaid.[21] Wiley studied 2,517 discal injections and reported a concrete and viable role for discography in the diagnostic evaluation of patients with axial pain and no definite disc prolapse on myelography.[22] Since the initial procedure was performed, improved technique, technological advances, and a better understanding of pain have provided much needed refinement of discography as a potentially valuable diagnostic test.

The presence of degenerative disc changes does not necessarily correlate with clinical symptoms or a painful disc. Provocative testing for concordant pain is the most important aspect of discography and provides information regarding the clinical significance of the disc abnormality.[7,10,13-15] There is literature documentation to suggest that the presence of outer annular ruptures is the best predictor of a painful degenerative disc rather than the degree of disc deterioration.[6,23,24] CT discography has been shown to have higher sensitivity and specificity than CT, myelography, and CT myelography for internal disc disruption (IDD, a chemically-mediated abnormality of the nucleus pulposus or annulus fibrosus without disc contour defects), herniated nucleus pulposus (HNP), recurrent disc herniation, and foraminal disc herniation.[25-28] CT discography interpretation is highly reproducible for grading annu-

lar degeneration and disruption.[29] The presence of a "high intensity zone" (HIZ) on magnetic resonance imaging (MRI) has been shown to correlate 100 percent with an outer annular rupture by CT discography imaging, although 54 percent of discs with annular ruptures did not show a HIZ on MRI.[29] The sensitivity and specificity of an HIZ in identifying discs that exactly reproduce discographic pain was 82 and 89 percent, respectively. Although MRI with gadolinium may be more accurate than CT discography in distinguishing recurrent disc herniations from postoperative scar tissue; CT discography is more sensitive than myelography, CT, or CT myelography.[30,31] At the present time, MRI does not appear to be as sensitive or specific as CT discography in determining whether or not a disc is symptomatic.[7,8,12] Discography and CT discography have been abnormal despite normal MRI scans, and they have shown asymptomatic discs in the presence of significantly abnormal MRI studies.[6,7,12,13] Therefore, although MRI can reliably detect disc degeneration and in certain cases predict painful annular ruptures, many believe that only provocative discography can consistently determine the presence or absence of symptomatic annular ruptures.[6,7,10,13,14]

Lumbar discography uniquely tests for concordant pain reproduction in addition to investigating the internal disc structural integrity. In cases of IDD and indeterminate nuclear changes on MRI, discography can be beneficial.[7,8] The major indications for lumbar discography include: 1) surgical planning of a lumbar fusion, 2) identifying the presence or absence of a painful disc among multiple degenerative discs, 3) testing the structural integrity of an adjacent disc to a known abnormality such as spondylolisthesis or fusion, and 4) evaluating a suspected lateral or recurrent disc herniation.[6,25,30-35] In addition, discography is an integral part of intradiscal therapeutic procedures (e.g., intradiscal thermal annuloplasty, annular denervation, percutaneous laser microdiscectomy). According to the 1988 Position Statement on Discography by the Executive Committee of the North American Spine Society: "Discography is indicated in the evaluation of patients with unremitting spinal pain, with or without extremity pain, of greater than four months' duration, when the pain has been unresponsive to all appropriate methods of conservative therapy…"[14] Although controversial, the concept of discogenic pain is described as a centralized, nonradicular pain produced during certain provocative activities. Patients can also have diffuse, nondermatomal lower limb pain that is associated with the lower back pain but not typically in isolation.[36] Lumbar discography is believed to identify the presence or absence of symptomatic discs in patients with chronic low back pain. Therefore, proponents argue that the value of discography lies in its ability to provocatively test the discs for reproduction of discogenic back and leg pain.[6,7,10,13,14,37]

In appropriately trained hands, the risk of complications from lumbar discography is very low. Potential complications most commonly from discography include discitis, nerve root injury, subarachnoid puncture, chemical meningitis, bleeding, and allergic reactions.[20,38-43] These adverse events can be minimized by pre-treating individuals with contrast dye allergies, using non-ionic contrast dye, and using meticulous sterile technique. Prophylactic antibiotics (intravenous, intradiscal, and oral) may substantially further decrease the risk of infection.[39,40]

Causes of Low Back Pain

Causes	Common Diseases
1. Degenerative	Degenerative joint disease (DJD), osteoarthritis, lumbar spondylolysis Facet joint disease, facet DJD Degenerative spondylolisthesis Degenerative disc disease Diffuse idiopathic skeletal hyperostosis
2. Inflammatory (noninfectious)	Spondyloarthropathies (ankylosing spondylitis) Rheumatoid arthritis
3. Infectious	Pyogenic vertebral spondylitis Intervertebral disc infection Epidural abscess
4. Metabolic	Osteoporosis or osteopenia Paget's disease of bone
5. Neoplastic	Benign €Spinal (benign bony tumors of spine) €Intraspinal (meningiomas, neurofibromas, neurilemomas, low-grade ependymomas) Malignant €Spinal (malignant bony or soft tissue tumors, metastasis) €Intraspinal (metastasis, high-grade ependymomas, astrocytomas, meningeal carcinomatosis)
6. Traumatic	Fractures or dislocations Sprains (lumbar, lumbosacral, sacroiliac)
7. Congenital or developmental	Dysplastic spondylolisthesis Scoliosis
8. Musculoskeletal	Acute or chronic lumbar strain Mechanical low back pain Myofascial pain syndromes Fibromyalgia, tension myalgia Tension myalgia of the pelvic floor, coccygodynia Postural abnormalities, pregnancy
9. Viscerogenic	Upper genitourinary disorders Retroperitoneal disorders (often neoplastic)
10. Vascular	Abdominal aortic aneurysm or dissection Renal artery thrombosis or dissection Stagnation of venous blood (nocturnal back pain of pregnancy)
11. Psychogenic	Compensation neurosis Conversion disorder
12. Postoperative and multiply on back	

TABLE 1. *Causes of low back pain.*
Braddom, RL. Table 39-1, Causes of Low Back Back Pain. *Physical Medicine & Rehabilitation*. WB Saunders Co., Philadelphia, PA. 1996, p. 815. Taken with permission and acknowledgements.

Therapeutic Intradiscal Procedures

The application of lumbar discography in diagnosing internal disc disruption (IDD) has provided the spine specialist with information in order to consider various non-surgical and surgical treatment options. Four methods of therapeutic intradiscal procedures used for internal disc disruption and contained disc herniations include: IntraDiscal ElectroThermal (IDET) Annuloplasty, Percutaneous Laser Disc Decompression (PLDD), Percutaneous Radiofrequency (RF) Annular Neurolysis, and Nucleoplasty.[44-52]

IntraDiscal ElectroThermal (IDET) Annuloplasty

IDET annuloplasty using an intradiscal catheter (SpineCath™) is a novel addition to the interventional physician's armamentarium of treatments for patients with painful degenerative disc disease and IDD.[44,49,52,60-67] IDET provides a new outpatient treatment option for patients who would not be recommended for, or who do not elect, other more invasive treatments, such as lumbar disc surgery (i.e., discectomy or fusion). The intradiscal catheter has been approved by the Federal Drug Administration (FDA) for use in treating symptomatic patients with annular disruption of contained lumbar herniated discs.[44] This new technology has been developed to safely treat intervertebral discs in a minimally invasive manner and still provide physicians with a definitive approach to addressing internal disc disruption. The intradiscal catheter delivers controlled thermal energy directly to the annular wall and disc nucleus via a resistive heating coil; which then aims to create temperature controlled coagulation and shrinkage of intradiscal collagenous tissue. The system was developed to thermocoagulate annular tissue, thermally modulate intradiscal collagen tissue, cauterize granulation tissue, and also is able to reduce nuclear volume in small, contained disc herniations. The steerable catheter design allows for precise intradiscal navigation for percutaneous spinal intervention. Performed under light sedation, the catheter is inserted through a 17-gauge introducer trochar needle and is easily positioned with fluoroscopic guidance. Since this procedure is significantly less invasive than other disc surgeries, the result is a percutaneous outpatient procedure that is no more invasive than a lumbar discogram. The initial success rate for the procedure, depending on patient selection, has been noted to be around 60-75 percent.[44,60-67]

The disc itself is a virtually avascular structure that allows heat to be held in the tissue with relatively little fluctuation during treatment. Adjacent structures are protected from thermal injury by the vascular circulation outside the disc that quickly dissipates any heat conducted beyond the disc. Temperature and power control give the IDET catheter the optimal ability to deliver focused energy at the point of contact. Heat is transferred by conduction from the catheter to the adjacent disc tissue. Temperature sensors deliver feedback to the generator that adjusts power levels as necessary to reach and maintain set target catheter temperatures. Optimum treatment temperatures are followed as previously documented in temperature mapping experiments done in the cadaveric and in vivo validation studies.[60-62] These mapping studies indicated that optimal temperature levels (80-90 degrees C) are reached for achieving collagen modulation and for nociceptor destruction in the outer annular wall (47-49 degrees C); while maintaining low epidural temperature levels (maximum 40.6 deg C) to avoid damaging myelinated nerves. The generator then controls the intradiscal catheter temperature accurately and precisely to maintain the optimum treatment temperature. These validation studies also documented an average total disc volume reduction, due to morphologic changes in the outer disc surface was 12.7 percent (range: 10-16.7 percent); and it was estimated that in the area of treated tissue alone (tissue reaching at least 60 degrees C), there was an approximate 40 percent decrease in disc tissue volume.[60-62]

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The indications noted for the IDET annuloplasty procedure include back pain and mild referral leg pain due to symptomatic (painful) internally disrupted disc with annular fissures (documented through discography) and symptomatic (painful) contained disc herniation without significant radicular symptoms.[60-62] Other potential IDET candidates include: 1) patients with discogenic pain after a previous discectomy, 2) disc space volume >50 percent, 3) some multi-level degenerative disc disease involvement, and 4) discogenic pain above or below a previous fusion. The procedure is contraindicated in patients with the following: 1) severe radicular symptoms due to frankly herniated discs or sequestered discs on MRI, 2) compressive pathology due to significant spinal stenosis; 3) segmental instability; and 4) severely collapsed discs (>50 percent). The complications are similar to those noted in the discography section.[49]

Percutaneous Laser Disc Decompression (PLDD)/LASE Method

The PLDD procedure has been around for more than a decade in one form or another using different laser types, technology, and methodology.[45,49,53-56] The LASE method (Clarus Medical) of PLDD is relatively new (within six years) with an endoscopically visualized fiberoptic scope and utilizing the Holmium YAG laser.[45-49] The technique is designed to reduce the bulging nucleus enough to eliminate the pressure it is placing on the surrounding nerve. A miniature endoscope with a laser fiber is inserted into the disc, leaving an incision through the skin that is less than .25 inch. The LASE endoscope allows the physician to view the bulging nucleus tissue and remove it with the laser fiber. In turn and in theory, by removing the affected nuclear disc tissue, the pressure on the nerve root is reduced or eliminated along with the resultant pain. More than 12,000 LASE procedures have been performed since inception.[45,49] While primarily indicated for leg pain caused by a contained disc herniation, LASE is secondarily indicated for disc decompression. Multiple studies have shown that around 80 percent of properly selected patients with

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contained herniated discs, with lower back and leg pain, may benefit from this procedure.[45,49,53-56] The essence of the procedure is that it performs an outpatient discectomy without the risks of routine surgery. The procedural recovery time is approximately one to two weeks. Although not a panacea, the procedure is less indicated in primarily axial back pain of discogenic etiology, lumbar stenosis due to degenerative conditions, or failed back surgery syndrome with perineural scar tissue. The complication and risks are similar to those noted for the IDET and lumbar discography procedures.[45,49]

Percutaneous Radiofrequency (RF) Annular Neurolysis

RF, developed in the 1980s by Dr. M.E. Sluijter, proposes a method to denervate the intervertebral disc through thermocoagulation and reported a series of patients who had obtained relief of chronic low back pain with annular denervation.[46-52] It was proposed as a treatment for IDD and painful disc degeneration (PDD). Annular denervation uses the technology used in percutaneous radiofrequency (RF) neurolysis, primarily used to treat spasticity, malignant pain, trigeminal neuralgia, and zygapophyseal joint nerve pain. Dr. Sluijter theorizes that intradiscal placement of a RF probe will globally increase disc temperature and produce neurolysis of the nociceptive fibers found in the outer annulus. Critics argue that the lesion generated by the RF probe will not reach the annular fibers (which technically only covers a 6 mm radius from the probe tip), and so previous studies have noted elliptical or spheroid denervation areas secondary to induced tissue temperature elevation and not from any direct heating effects of the probe itself.[57] Therefore the area of coagulation is dependent on temperature, probe size, and probe orientation.[57-59] Similar to the IDET and PLDD procedures, the RF annular denervation procedure needs further clinical study and consistent clinical results but seems safe for the treatment of IDD and PDD refractory to conservative care. The indications, risks, and complications are similar to the IDET, PLDD, and lumbar discography procedures.[45,49] The risk of infection, hemorrhage, and neurologic insult is obviously considered to be significantly less than compared with any open surgical disc procedure.

Nucleoplasty

Partial removal of the nucleus has been shown to decompress herniated discs, relieving pressure on nerve roots and, in some cases, offering relief from disc pain.[68,69] Thermal energy (heat) has been shown to initiate changes in the collagenous and annular structures of the degenerative disc, often leading to a relief of disc pain.[70-72] Nucleoplasty, a new minimally invasive procedure utilizing patented Coblation technology, for the ablation and coagulation of soft tissue, combines both approaches for partial removal of nucleus pulposus.[73] The Nucleoplasty technique builds upon earlier surgical approaches that helped validate the strategy of intranuclear tissue removal, including chemonucleolysis and Automated Percutaneous Lumbar Discectomy (APLD).[74] Whether through an enzymatic dissolution of the nucleus pulposus with chymapapain, or percutaneous removal of tissue from the nucleus pulposus using the nucleotome, tissue removal was clinically proven in several large research trials to be an efficacious method for treating radicular pain.[68,69] Thermal energy has been shown to initiate changes in the annular and collagenous structures of the lumbar degenerative disc, often leading to relief of intradiscal pain.[70-72] Nucleoplasty builds upon the benefits of these approaches by providing a more controlled, efficient, and practical method of tissue removal, while retaining the underlying proven rationale.[74] Nucleoplasty uses coblation technology, a non-heat driven process, in which radiofrequency energy is applied to a conductive medium (saline) to generate a highly-focused plasma field around the electrode at the tip of the PERC-D/DL wand.[73] The plasma of highly ionized particles has enough energy to break the molecular bonds within tissue at low temperatures (~40 – 70 C). A series of six channels are created in the disc by ablating and then thermally sealing the chanels; in effect removing approximately 1 cc of nuclear tissue, or roughly 10 percent of the nucleus pulposus.[73] Further prospective, controlled, randomized studies are underway to surely demonstrate the benefits, limitations, and clinical outcomes of this procedure.

Conclusion

Injection techniques play a major role in the management of disorders of the musculoskeletal system. Various procedures and techniques have been used over the years, and are being developed for the interventional management of pain. During the 1990s, more novel injection techniques were developed, and traditional injection techniques have been refined concurrent with the technologic advances in imaging modalities and a clearer understanding of the pathomechanics and the physiochemistry of pain. A few of the most common procedures and a few of the newer techniques were mentioned briefly, as options available to the patient in need of pain management. The role of the interventional physiatrist in this assurgency of injection techniques for the diagnosis and management of spinal-based pain syndromes, peripheral joint dysfunction, and soft-tissue abnormalities has become more prominent. Many of the painful states seen by an interventional physiatrist and pain specialist can be helped greatly by using a rehabilitation program that may include injection techniques. Some of these interventional procedures are relatively simple and common to perform, whereas others can be technically challenging and should be done only by a specialist with adequate experience and knowledge to perform these procedures accurately and in a timely fashion. It is important to emphasize that the use of fluoroscopy to aid in proper needle placement is now the standard and norm. Fluoroscopic direction of needle placement increases the accuracy and efficacy of several types of selective spinal procedures. Despite the newly found field of interventional pain management, physiatrists remain rooted in the emphasis of functional assessment and physical medical management. Indeed, it is this concept,

intrinsic and unique to the physical medicine and rehabilitation specialist, which centrally places him or her in an ideal position to be the leader in injectional pain management. Furthermore, the use of appropriate selective injection techniques, combined with a comprehensive, personal rehabilitation plan, is theoretically more beneficial than isolated treatment strategies. ■

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