In Search of the Elusive Lumbar Spine Pain Generator

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Studies show that four out of five adults will experience at least one episode of severe back pain during their lifetime. Back pain is the second most common reason for visits to primary care physicians and urgent care facilities in the United States, surpassed only by cough and the common cold. Although 80-90 percent of low-back pain episodes resolve within six weeks, many patients experience repeat occurrences or persistent symptoms for more than three months. Back pain is the No. 1 disability in patients under age 45.

Despite being commonly ascribed as the etiology for back pain, bulging discs are not always the cause. “That which bulges does not necessarily cause pain, and that which causes pain does not necessarily bulge,” say many spine specialists. Furthermore, motion segment instability does not inevitably imply pain. Numerous structures containing nociceptors in the lumbar region also make accurate diagnosis extremely difficult. Confounding variables such as work-related injuries, litigation, secondary gain and cultural and psychosocial issues can render the etiology of back pain unidentifiable.

With advances in CT, MRI and three-dimensional reconstruction technology, our ability to visualize the human spine has never been greater. Minimally invasive procedures have greatly enhanced treatment and artificial disc surgery will likely do the same.

Despite this technological progress, back pain remains the great nemesis of physicians throughout the world. The reason: inadequate diagnosis, or failure to identify the true “pain generator.” Although previously considered simply a catchy phrase, the idea of the pain generator is now receiving significant attention.

In years past, a diagnosis of lumbar spondylosis or degenerative disc disease was the common endpoint in the diagnostic algorithm for back pain. In contrast, we now have the ability to specifically pinpoint likely offending pain generators, and in many cases tailor management to resolve them.

Guidelines for management

The following are basic guidelines to help physicians identify the etiologies of lumbar spine pain.

Lumbar spine pain falls into two general categories: purely axial, and radicular or radiating. In patients with purely midline or lateralizing low-back pain, common and uncommon etiologies should be considered. These include pain originating from osseous structures (vertebral compression fractures, pars defects, or vertebral instability), soft tissue (ligaments, tendons, muscles and cartilaginous structures), joints (facet joints, intervertebral discs, sacroiliac joints) as well as tumors, infection or other infiltrative processes.

In patients with radicular pain, nerve root lesions (compressive lesions from adjacent discs, hypertrophic facet joints, facet joint cysts, faulty hardware positioning, bony foraminal encroachment caused by spondylolisthesis or spondylosis, congenitally short pedicles, nerve sheath tumors, granulation tissue and arachnoiditis), spinal nerve compression and peripheral nerve lesions should be considered. Not all radiating pain originates from the spine, and common etiologies such as femoral neuropathy, meralgia paresthetica, peroneal neuropathy, asymmetrical neuropathies, lower limb joint pathology and vascular pathology are often mistaken for radicular pain in patients with and without radiographic evidence of degenerative disc and joint disease.

Where to begin

Accurate assessment of lumbar spine pain should begin with a thorough history, addressing location, duration of symptoms, quality, intensity and exacerbating and ameliorating factors. Red
Total Disc Arthroplasty: The Next Big Thing?

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In June, DePuy Spine, Inc., went before the FDA seeking approval for the Charité Lumbar Disc Replacement, and received preliminary approval contingent on development of an appropriate training program. Over the next two years, other companies are expected to seek FDA approval for at least three other lumbar discs and three cervical discs based on trials under way.

The era of disc replacement surgery has clearly arrived. But what does this mean? Why do we need disc replacements? Who is a candidate for this surgery? What are the results? What are the risks?

Though we don’t yet know all of the answers, our patients are already asking the questions. Many physicians will find that their patients know more about disc replacement than they do. A Google search using the phrase “lumbar disc replacement” at the time this article was written yielded 28,300 hits, and that number surely has risen.

This article is an introduction to total disc arthroplasty, the goal of which is to reduce pain and disability while preserving motion.

Alternative to fusion?

Fusion has long been regarded as a treatment for pain associated with joint degeneration. Hip and knee fusion, while not common, was effective and the only surgical treatment until the advent of joint replacement. Currently, standard surgical treatment for refractory chronic low back pain is fusion. It is effective in carefully selected patients with success rates of 60-80 percent. The cost of this success, however, is the risk of accelerated degenerative change at adjacent segments. The idea of disc replacement as an alternative to fusion is not new. Fernstrom is credited with the first clinical description of a prosthesis in 1964. Although his steel ball placed into the disc space was not a clinical success, it did encourage others to continue their work.

The European experience with disc implants is approaching 20 years; the North American experience is much shorter. The first successful disc arthroplasty was developed by Buddner-Janz at Charité Hospital in Berlin. The initial design was problematic, and the current implant is in its third generation (Charité SB III).

Early reported trial results indicate disc replacement is probably as effective at reducing pain and disability as is fusion. Disc replacement also seems to preserve motion. Longer-term European studies have not yet shown a clear benefit in terms of adjacent segment degeneration, but these trials involve only seven to 10-year results. The FDA will base its approval on current trials that will include two-year results. Two other lumbar implants with two-year data will come up for approval in the next year (ProDisc II, Spinal Solutions, and Maverick, Medtronic Sofamor Danek).

The good news is that each of these FDA trials is a randomized, controlled trial with fusion as the control group. The bad news is that the purported benefits of disc replacement are changes in long-term outcome, well beyond two years. The trials will have only provided a partial answer when the implants are approved.

Indications, contraindications

It is clear that disc replacement will not be a panacea for low back pain and that not all patients who are surgical candidates will be candidates for disc arthroplasty. The main indication will be refractory mechanical low back pain of discogenic origin. Another relative indication will be treatment of adjacent segment degeneration above an existing fusion. Patients requiring decompressive laminectomies for spinal stenotic symptoms will not be candidates due to the loss of the stabilizing influence of the posterior tension band. Patients with scoliosis or spondylolisthesis also are not candidates, since disc replacement is not likely to positively affect the deformity. Osteoporosis is a relative contraindication due to the risk of implant subsidence. In early studies, patients with significant facet joint degeneration did not do as well.

References

Technically challenging

Disc replacement is technically challenging and for many surgeons will involve a major change in their usual operative practice. All current discs are placed through the anterior approach, which is unfamiliar to many spine surgeons. Most spine surgeons will require an access surgeon, such as a general or vascular surgeon, to expose the spine. Those surgeons familiar with the anterior lumbar approach for anterior lumbar interbody fusions will have an initial advantage over those who have previously done only posterior lumbar procedures.

All other arthroplasties have demonstrated a finite lifespan. For hip and knee replacement, this is typically 15 years. Most hip and knee replacement patients are in their 60s or older, so a 15-year implant life is sufficient. Revision knee and hip arthroplasty, although challenging, is relatively routine. Patients undergoing disc arthroplasty will be much younger (30s to 50s) and revision anterior surgery at the lower lumbar level is very difficult. Therefore, the question of implant longevity is of vital importance.

The greatest potential benefit of disc replacement is likely to be in the decreased risk of adjacent segment degeneration. Conversely, the greatest surgery-related problem is likely to be late implant failure due to wear or loosening.

Chairman’s Column

We are pleased to present you with the inaugural issue of The Spinal Column, the physician newsletter of The Cleveland Clinic Spine Institute. The Spine Institute, officially established in 2003, encompasses the full scope of spinal services at The Cleveland Clinic, bringing together the expertise of our specialists in neurosurgery, orthopaedic surgery and medical spine. The Spine Institute integrates research, clinical practice and education with the goals of improving patient care, developing unique technologies and sub-specializations and promoting cross-fertilization of ideas among staff. The Institute represents a unified organizational structure to academia and industry and a streamlined approach to service delivery.

The journey to the establishment of The Cleveland Clinic Spine Institute began more than a decade ago under the leadership of orthopaedist Gordon Bell, M.D., and then neurosurgeon Iain Kalfas, M.D. The program has matured, and today we enjoy the excitement of our newly formed, restructured and expanding team.

Among the Spine Institute’s accomplishments to date:

Patient Care We have implemented effective triage methods to increase patient access and satisfaction. Several new multi-specialty clinics, in which surgeons and non-surgeons collaborate to comprehensively care for patients in a multidisciplinary manner, allow medical and surgical patients to receive focused attention from appropriate providers. Unique treatment options, including manipulation, interventional pain management and minimally invasive surgical techniques are now available.

Education The Spine Institute’s strong commitment to education is evident in its programs. They have had significant impact on the local, national and international spine communities. Fellowship programs provide exposure to medical and surgical treatments of the spine. Each year, the Spine Institute trains four one-year surgical fellows, two medical fellows and one two-year spine fellow. Also, at least three graduating orthopaedic and neurosurgical residents from each of the last several classes have entered the field of spine surgery. Starting the next academic year, the medical spine fellowship program is doubling in size, to four fellows.

Research We are especially proud of the Spine Research Laboratory, where studies in spinal biomechanics, pathogenesis of disc degeneration, microelectromechanical systems (MEMS) and nanotechnology are being conducted. A spinal cord injury research project, in collaboration with researchers from Case Western Reserve University, Cleveland, and a rapidly maturing clinical outcomes research program also are under way.

The Cleveland Clinic Spine Institute is clearly moving ahead in multiple arenas; the future is indeed bright. We look forward to continued clinical research and education collaborations on many fronts. For additional information about the Spine Institute, please feel free to contact me at 216/445-5514, or our administrator, Kathy Huffman at 216/445-8442. To refer patients, call 216/444-2225 or 800/223-2273, ext. 42225.

Sincerely,
Edward Benzel, M.D.
Chairman, Cleveland Clinic Spine Institute
flags, such as fever, unexplained weight loss, recent trauma, bladder or bowel dysfunction, history of carcinoma, disturbance of gait, saddle anesthesia, progressive neurologic deficits, age of onset less than 20 or greater than 55 years of age and comorbid conditions, should be investigated.

Physical examination should assess for structural abnormalities, reproducibility of pain, neurologic deficits, evidence of systemic pathology and the patient’s response to pain. Range of motion and resulting pain, tissue texture changes, strength, reflexes and sensation even in patients with mild symptoms should be evaluated. Provocation of nerve root tension signs produces a fairly accurate diagnosis of significant radiculopathy. Finally, physicians should assess the appropriateness of the patient’s reaction to pain using Waddell’s Test. The presence of two or more of the following findings correlates with poor surgical outcome: overreaction during exam, lumbar pain elicited with axial loading from examiner’s hand pressing on patient’s head, negative exam findings during distractions, lack of reproducibility, severe pain during superficial palpation, or non-anatomical motor or sensory distributions.

Diagnostic tools
Although easy to obtain and relatively inexpensive, standard X-ray studies should not be ordered within the first four weeks of acute back pain in the absence of red flags or high suspicion for fractures, tumors or other bony pathology. With persistent back pain unrelieved by several weeks of conservative care or in the presence of significant red flags, high suspicion for fracture, evidence of neurologic changes, night pain and or weight loss, X-rays are clearly indicated.

Radiographic findings must be carefully correlated with physical exam findings and not relied upon too heavily in order to prevent inadvertent misdiagnosis and inappropriate treatment. MRI or CT should be ordered in the presence of red flags, persistent neurologic changes, neurogenic claudication suggesting spinal stenosis, symptoms suggesting significant spinal pathology and when interventional procedures or surgery are being considered. Bone scans can help diagnose acute compression or occult fractures and bony destructive lesions.

In clearly evident radiculopathy, electrodiagnostic studies need not be ordered. But many times EMG/nerve conduction studies help differentiate between nerve root, peripheral nerve lesions and underlying neuropathy in patients with radiating pain. They should not be ordered within the first two weeks of symptoms.

Interventional spine specialists narrow in on pain generators and treat pain using selective nerve blocks, facet joint blocks, medial branch blocks, sacroiliac joint injections and discography.

When to refer
Referral to a spine specialist is warranted if initial evaluation and work up are inconclusive; in patients whose pain persists beyond two to four weeks despite conservative care with NSAIDS, analgesics and therapy; in patients with progressing or persistent neurologic symptoms; or in the presence of ominous signs and symptoms suggesting serious spinal pathology.

No single aspect of back-pain management is more important than the accurate diagnosis of the pain generator. Without it, even the most advanced treatments cannot be appropriately applied. Only after the pain generator has been identified should any aggressive surgical or irreversible treatment measures be taken. It is time we adopt a more systematic approach to the diagnosis of back pain.
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The Cleveland Clinic Spine Institute staff are recognized experts in the latest treatments of a wide range of back and neck problems. The U.S. News & World Report has ranked the Cleveland Clinic orthopaedic and neurosurgical services among the ten best in the nation for 13 years in a row in its annual “America’s Best Hospitals” survey. The Cleveland Clinic Foundation has been designated as one of the top six hospitals in America since 1990 by U.S. News & World Report.

For referrals to the Cleveland Clinic Spine Institute, call 216/444-BACK (2225)