

Lumbar Disc Replacement: A Panacea or Potential Nightmare?

By Thomas C. Schuler, M.D., F.A.C.S.

The management of back pain has long been a problem for mankind and for health care providers alike. Even Hippocrates employed traction racks in an initial attempt to solve painful spinal conditions. In 1911, the first spinal fusion was performed for tuberculosis. In the 1930s, lumbar disc surgery was first employed by creative physicians trying to treat a possible spinal origin of painful compression of leg nerves. It was not until the 1950s, that spinal instrumentation was first utilized in the treatment of scoliosis. This landmark effort was pioneered by Dr. Paul Harrington. In the 1960s, 1970s and 1980s, the technology used to treat spinal disorders evolved at a tremendous rate, however the ability to assess the success of surgical procedures and patient outcomes after surgery failed to progress at a similar rate. With the exception of spinal trauma, a predictable and reliable treatment algorithm for back pain eluded surgeons. Success rates and outcomes from surgery have become measures of effectiveness. Now into the 21st century, a new emphasis has been placed upon diagnostic techniques designed to better identify the source of back pain while modifications to existing surgical techniques have allowed less invasive approaches and more predictable results. Specifically, such changes have altered the need for fusion surgery. Fusion is generally defined as the surgical stabilization of a painful motion segment of the spine. In patients with a collapsed disc, inflammatory changes in the end plates and chronic back pain (that has been unresponsive to rest, exercise, medications, cortisone injection therapy and the simple passage of time) stabilization procedures with interbody fusion have proven to be both effective and

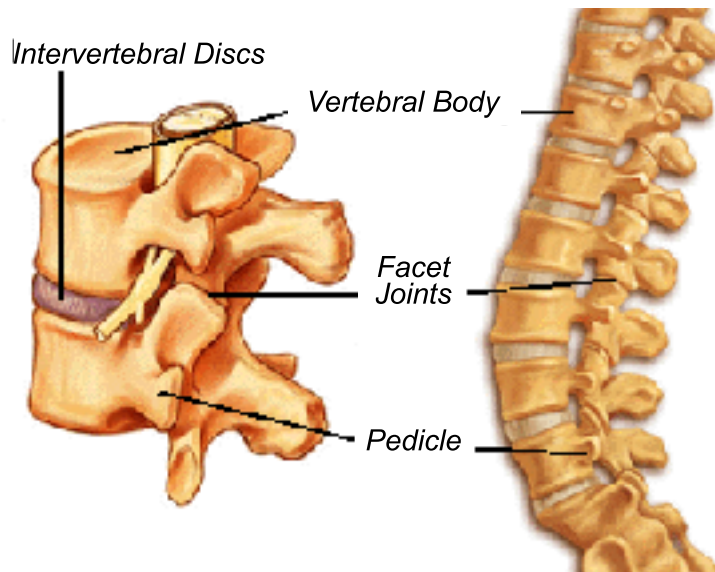
successful. Using modern instrumentation combined with genetically engineered bone morphogenetic protein (BMP-2), patients with intractable back pain (as the result of one or two degenerating discs) can now be offered a cure for their pain. Although highly effective, fusion or healing of bone across a previously mobile spinal joint results in loss of motion at that level, as well as transfer of bending stress to the discs above and below the fusion. The aspect of fusion surgery which is most troubling to patients is this loss of motion, irrespective of their pain situation. When even an untrained eye looks at a spine, it is clear that the spine is designed for motion. Therefore, the concept of eliminating motion to eliminate pain seems counter-intuitive. It seems more reasonable to replace degenerating discs, arthritic facet joints and worn out ligaments to restore the normal motion and function of the spine.

Unfortunately, this concept has been incorrectly oversimplified in both the comments of some physicians and the presentations from different media sources. The public perception is, quite simply, that motion is good and stabilization or fusion is bad. Much of the excitement surrounding total lumbar disc replacements (TDR), also known as arthroplasty or artificial discs, in the lumbar spine is based upon the erroneous belief that the only goal of surgery should be to keep the spine moving. In theory, this sounds reasonable. I believe that one should understand the facts before agreeing with such a simplistic view.

In the lumbar spine, there are five discs. Each disc sits as a shock absorber between two spinal bones called vertebral bodies. This disc is surrounded by ligaments connecting the vertebral bodies and



adding additional support. The disc and its surrounding ligaments allow for movement to occur in multiple planes. This bone-disc-bone complex is often referred to as the motion segment. For example, normal motion across a single segment in the lumbar spine usually measures approximately five to seven degrees from forward bending (flexion) to arching of the back (extension). Other movements, such as lateral (side) bending and rotation (twisting) may occur as isolated motions or combination (coupled) motions such as flexion – rotation. The extent of such movements depends upon both the integrity of the bones and ligaments but also upon the flexibility of the surrounding muscles. Based upon the elasticity of the disc and forgiving nature of the surrounding ligaments, the spine can achieve an incredible variety of positions.



It is also important to realize that each motion segment has two paired facet joints, located at the back of the spine, which must move in conjunction with the disc. These facet joints have cartilage surfaces and capsule. This capsule is lined by a substance called synovium. The synovial lining produces a lubricating fluid for the joint. When a disc deteriorates as a result of the aging process, these facet joints often deteriorate as well. When disc replacement surgery is currently performed, these two facet joints are not replaced. By coupling a brand-new disc with the same old facet joints, there are significant stresses placed upon these joints which may already be showing signs of degeneration. The cartilage surfaces wear out, the synovial lining stops producing fluid and the joints may become arthritic, painful and stiff. Current disc replacement surgery involves replacement of a living, flexible, shock-absorbing motion structure with a metal or plastic device which lacks the ability of the natural disc to repair itself, moves in multiple directions and limits stress on the facet joints. If you think about it, normal spinal motion is like a three-legged table with

the disc as one leg and the facets as the two other legs. Artificial disc replacement does nothing for two thirds of the joints involved in a given motion segment. Only one third, the anterior (front) portion, is being replaced while the two posterior components of this triangular complex are not addressed. If instability is already present due to incompetence of the facet joints, disc replacement will only worsen the instability present at this level. Finally, interbody fusion procedures allow the surgeon to correct posture and spinal alignment. In cases of scoliosis or loss of normal posture due to degeneration, the artificial disc may simply adopt an abnormal alignment once placed into the disc space instead of correcting it. In cases of severe degeneration with significant loss of disc space height, an arthroplasty device may be wedged in to the collapsed space; however the fit is so snug that the device does not function properly. In essence, the device never moves (as planned) and never heals (like a fusion would).

When fusion surgery is done properly in the lumbar spine, the results are generally excellent. We

are able to restore disc space height, normal posture and take pressure off the lumbar nerve roots which form the sciatic nerve. Obviously, losing motion in the spine is not an ideal treatment, however fusion is a truly time-proven and successful technique. When fusion is accomplished in such a way that preserves the surrounding muscles, ligaments and joints, an excellent result is obtained with minimal stress transfer from the fused levels to the adjacent discs and facet joints. Unlike the arthroplasty techniques, once a fusion procedure heals, it is completely healed. It will not dislodge. It will not wear out. A fusion does not have to be revised or redone in a few years.

Aside from some of the obvious positives of spinal disc arthroplasty, there are some concerns which are just as obvious. One such concern is the theoretical life expectancy of these devices. Most of the research information to date attempts to simulate wear and tear on a disc prosthesis by subjecting it to millions upon millions of cycles of bending. Despite these simulated decades of wear, there is clearly no frictionless surface. Wear does occur; highly polished and shiny surfaces will grind themselves back to dullness if given adequate time and repetitions. Experience shows that knee replacements and hip replacements are usually revised at least once in a fifteen year time frame. Although revision hip and knee surgery can be complicated, revision surgery performed upon the anterior aspect of the spine can be technically challenging for the surgeon and life-threatening for the patient. Performing the initial anterior (front) approach to the lumbar spine entails moving the major arteries and veins which reside within

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the abdomen. Once a salvage surgery is entertained, these vessels have now scarred to the front of the spine and their mobilization becomes extremely difficult. Attempting to remove this scar tissue to allow for mobilization of the vessels carries with it a significant risk. This seems a potentially high price to pay for the theoretical advantage offered by motion preservation devices. As far as I am concerned, the advantage of motion preservation remains unproven.

When someone develops low back pain as a result of a degenerative condition in the low back, it is rare for that condition to involve only the disc. In the patient who has pure disc pathology with normal facet joints, then disc replacement treatment may provide a desirable, motion-sparing alternative to fusion. This is theoretically even more important to the patients who have multiple levels of disc degeneration with normal facet joints. Unfortunately, patients with multiple levels of disc degeneration in conjunction with normal facet joints are usually the youngest patients in our office, generally ranging between the 20's and 40's. These are the people who will need the longest life expectancy from an implant in order to obtain the best result. If we perform a disc replacement on somebody in their twenties or thirties and we expect to get ten to fifteen years maximum out of that disc replacement before it needs to be revised, then that means that we are revising these disc replacements in patients in their thirties or forties. At the time of revision, they are undergoing a significant and life-threatening operation. If these same patients had undergone a fusion procedure performed with modern technology, it is unlikely that any further surgery would ever

be required to revise or replace that fusion. Finally, since there is no frictionless surface, all motion devices lead to formation of wear debris, small particles which may be deposited near the device. Research in total hip replacements has clearly shown implant loosening as an effect of this wear debris. Loosening in the hip joint may be painful, but it is not life threatening. Loosening in a spinal implant is a much more serious condition.

Cervical disc replacements are much more attractive for a number of reasons. First, the weight-bearing characteristics of the cervical spine make it much better suited to arthroplasty. Devices are likely to last longer under decreased loading conditions and less likely to require revision surgery. Second, revision surgery for cervical arthroplasty does not carry with it the same risks as lumbar revision procedure. This is the part of the spine where motion seems more important and where disc replacement seems to make more sense. Unfortunately, artificial cervical discs face some of the same challenges as lumbar discs in attempting to determine exactly which patient should receive the implant.

Having performed both cervical and lumbar disc replacements on my patients, I have witnessed the excellent results that can be obtained with this technology. My point in this discussion is to

remind our readers that as time passes, we will accrue additional long-term results which should allow us to better describe the wear patterns, longevity and success rates of these devices.

In conclusion, I believe that disc replacement surgery is in its infancy. The modern treatment of single level discogenic (originating from a disc) pain with lumbar spinal fusion has been extremely successful. To abandon success in favor of an unproven, motion-sparing technique with a limited lifespan and associated life-threatening risks, is foolish. For a very select few patients, this technology is clearly promising. On the other hand, for the majority of the patients presenting to my practice with intractable low back pain, arthroplasty is not a reasonable option. In patients with degeneration of the cervical spine, cervical disc replacement carries with it a lower risk of complications and likely a better pattern of wear. In that sense, arthroplasty may be an alternative to fusion. Unfortunately, there is no one single answer. Just as each patient presents with unique symptoms, each patient will require a unique solution to his problem. A panacea does not exist in any of the options available. I believe that with careful consideration and informed decision-making, the patient and surgeon will identify the most appropriate treatment options.



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