

Biomechanical support, osseointegration improved with newer lumbar fusion strategies

Maintaining the spine's curvature and promoting a good rate of interbody fusion following a multilevel cervical discectomy has historically relied on plate and screw fixation.

But there are certain deficiencies inherent to that approach. Chiefly, there exists the potential for injuring the spinal cord or the nerve root with the fixation device, and from time to time it happens that screws break or lose their grip.

Consequently, leading-edge neurosurgeons looking for a better way to achieve fixation and interbody fusion are using both plates and screws as well as advanced cage technology.

Reaching the PEEK of performance

The concept behind fusion cages is nothing new. What is new, however, is how fusion cages are made.

In the past, they were cast of titanium. Now they are fashioned of high-tech bone substitutes designed to provide immediate biomechanical support, induce osseointegration of the graft and prevent complications.

The primary material used in these new cages is polyetheretherketone – better known by the acronym PEEK. Researchers at the University of Roma la Sapienza in Italy recently placed PEEK fusion cages under the proverbial microscope to gauge the material's performance in 36 patients treated surgically for degenerative disc disease. They came away reasonably confident that PEEK cages for anterior cervical fusion are safe and efficacious.

"About 97% of patients had a good to excellent outcome; the result in one myelopathic patient was fair; the cervical fusion rate was 16.7% at 3 months, 61.1% at 6 months, and 100% at one year," they write in the March 2006 issue of *Acta Neurochirurgica*.

Observing fusion in progress

Those findings are reinforced in a study of PEEK conducted by researchers at Milwaukee's own Medical College of Wisconsin and published in the journal *Biomaterials* (January 2006). Their investigation led them to recognize that PEEK "may be a useful biomaterial for interbody fusion cages....," they write.

In addition to inducing osteogenesis, PEEK offers the advantage of allowing radiographic observation of the fusion process itself – a feat not possible with titanium cages, which are inherently lacking in radiolucency.

"...[W]e evaluated a radiolucent PEEK-threaded interbody fusion device packed with autograft or rhBMP-2 on an absorbable collagen sponge in 13 sheep at 6 months," the team writes. "Radiographic fusion, increased spinal level biomechanical stiffness, and histologic fusion were demonstrated for the PEEK cages filled with autograft or rhBMP-2 on a collagen sponge."

The ability to monitor fusion progress is important because it allows surgeons to much more reliably decide when it is safe for the patient to make a return to work or play.

(As a side note, the Medical College of Wisconsin investigators found no indication that the PEEK cages in their study underwent degradation or that they sloughed any wear debris. The only complication they encountered was a single, mild case of chronic inflammation consisting of a few macrophages arising within peri-implant tissues.)

Minimally invasive lumbar fusion

Mention "lumbar fusion" and, in the minds of many, the term conjures images of a major surgical procedure involving a sizable incision and, by extension, a lengthy hospital stay.

While that might have been true in the past, it no longer is the case. Today, surgeries that involve lumbar fusion can be performed in a minimally invasive manner. The benefits? Incision size is reduced by half, as is the degree of postoperative pain associated with traditional lumbar fusion surgery. Meanwhile, the amount of time required in the hospital for recovery following surgery has been pared by 30% to 50%.

One of the more advantageous of these minimally invasive procedures is transforaminal lumbar interbody fusion (TLIF).

TLIF offers many of the same pluses as the more familiar posterior lumbar interbody fusion (PLIF) approach. These include the ability to decompress neural elements in a simultaneous fashion, correct abnormalities in alignment and sagittal balance and achieve circumferential arthrodesis through a single dorsal approach.

Earned good marks

The March 2006 issue of *Neurosurgical Focus* discusses TLIF. It states: "Both TLIF and PLIF yield high arthrodesis rates secondary to a large fusion surface area, ample blood supply to the inter-body space, and the ability to place the interbody graft in compression."

But the article goes on to report that TLIF offers a more lateral to medial approach, giving it an edge over PLIF.

"Because access is obtained via a transforaminal approach with TLIF, little if any neural retraction is required to enter the disc space," the journal offers. "In contrast, PLIF almost always requires neural manipulation and retraction, and neurological injury is one of the most commonly reported complications of that procedure. Furthermore, revision surgery with TLIF is simplified because the angle of approach avoids midline scar tissue and uses

previously undisturbed tissue planes.

"Also, TLIF procedures are performed unilaterally (obviating the need for bilateral epidural space exposure), so they are frequently associated with shorter operating room times."

Stark contrast

Importantly, the above-referenced *Neurosurgical Focus* article finds TLIF well-suited to minimally invasive application.

To perform it on that basis, the surgeon uses "a tubular retractor system and modified surgical instruments that were first developed for minimally invasive microdiscectomy procedures," the journal sets forth. "This technology provides a paramedian, muscle-dilating approach that maintains the normal midline musculoskeletal structures. The small working corridor is in stark contrast to the large midline incision and soft-tissue exposure commonly performed with open TLIF."

Neurosurgical Focus points out that conventional lumbar fusion surgery is associated with iatrogenic soft-tissue injury that can have deleterious short- and long-term effects on patient outcomes.

"Numerous studies have demonstrated that irreversible muscle injury occurs as a result of muscle stripping and retraction and can be associated with poor clinical results," the article cautions. "The goal of any minimally invasive procedure is to achieve the same surgical objectives as the corresponding open procedure through a less traumatic approach."

The journal posits that these less invasive approaches will result in decreased intraoperative blood loss, less postoperative pain and shorter hospital stays without compromising the efficacy of the procedure.

Conclusions

The most advanced cage used in lumbar fusion today is made from a special material known as polyetheretherketone. It has the look of plastic but with the feel and give of human bone. The human body responds physiologically to this type of cage better than it does to cages made of titanium. The PEEK cage is mostly invisible to X-rays, so in order to be able to visualize it during an imaging examination, a radiographic-detectable marker is built into it.

Lumbar fusion surgery can be safely and effectively performed as a minimally invasive procedure. Minimally invasive lumbar fusion, no matter the specific form it takes, allows

patients to return to normal activity faster than with conventional fixation strategies following spine surgery.

These and other advanced, sophisticated surgical approaches and services are part and parcel of my academic-like neurosurgery private practice, which serves Milwaukee, Waukesha and neighboring Wisconsin communities.

Because of my practice's use of state-of-the-art technologies and because of my high-level expertise (resulting from my training at the Mayo Clinic and years of hands-on work with these patients), physicians know they can refer to me confidently for help with patients who require lumbar fusion surgery. So can you. In addition to being responsive and accessible to you, it is customary for me to keep you informed of your patients' progress, beginning with a detailed report sent to you after the initial consult and continuing with a letter following each successive visit. You can also expect a phone call from me after surgery to apprise you of the results and discuss any pertinent details. Additionally, I take the time to inform patients and answer all their questions in terms they can understand.

By entrusting your patients to me, the stage will be set for them to return to you satisfied and delighted, more willing than ever to continue depending on you for ongoing and follow-up care.

For further information about lumbar fusion and my other neurology-specific surgical services, call me at (262) 717-9850.



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