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A brief review

Anterior Lumbar Interbody Fusion

By Michael A. Campanelli, D.O.

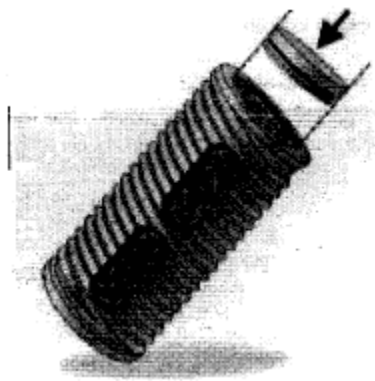
Fusion of the lumbar spine can be approached either by an anterior (front) or posterior (back) approach. There are advantages of each approach and there are indications and contraindications for each approach. In this article we will briefly review anterior lumbar interbody fusion and its indications, technique and potential complications

The first descriptions of anterior lumbar surgery were for the treatment of tuberculosis and spondylolisthesis. Today anterior lumbar interbody fusion has been advocated for tumor, infection, spinal instability such as spondylolisthesis, and the major indication for the procedure in the past has been a failure of a posterior laminectomy or other posterior spine procedure. Failed posterior decompressive laminectomy or failed spine syndrome is not a specific diagnosis, however a pathologic condition in the anterior column of the spine (i.e. an intervertebral disc), is a specific indication for anterior discectomy and inter-body fusion. The early experiences were often negative because of poor distraction of the segment, poor bone grafting material or inadequate exposure or complications related to the exposure. The techniques and instrumentation have progressed to the point where the effectiveness of anterior lumbar interbody fusion is greatly improved. Usually a one level anterior lumbar fusion can be accomplished in the modest time of one hour or less. An anterior approach to the spine makes it unnecessary to manipulate the nerve roots, which may facilitate

the approach for any future posterior surgery and avoids the complications of epidural adhesions, arachnoiditis and/or injury to the neural elements. It also permits a more complete discectomy. Furthermore, the rehabilitation time following anterior lumbar procedure is usually shorter than most posterior lumbar procedures. The disadvantages of anterior lumbar interbody fusion revolve around the fact that it requires specialized personnel familiar with the procedure, special instruments and proper bone grafting technique. Usually the procedure is done in conjunction with a vascular surgeon or a general surgeon who is familiar with vascular anatomy of the abdomen.

The painful degeneration of an intervertebral disc is a poorly understood entity. A great majority of degenerative intervertebral discs are asymptomatic.

However, in certain individuals this process can lead to severe pain requiring the use of narcotics, job loss and chronic disability. Various theories as to what generate this pain have been postulated but remain unproven. Mechanical theory



Intervertebral Fusion Cage

states that segmental instability irritates the spinal nerve roots. Biochemical theory suggests that catabolites from a disruptive disc may irritate the spinal nerves or prompt a sympathetic response. Other studies have suggested that certain vasoactive peptides promote the synthesis of proteins which cause degeneration of spinal motion segments.

The how and why of pain degeneration from diseased discs have yet to be resolved. The fact that certain disease processes can be pain producing is

undeniable. These groups of patients, those with asymptomatic degenerated disc, is the first point of controversy in the treatment of degenerative disc disease. Magnetic resonance imaging can clearly demonstrate dehydration of disc but does not provide any information as to whether degenerated discs produce pain. Many surgeons advocate the use of diskography in the treatment of degenerative disc disease. Diskography consists of injecting contrast material into the disc space and trying to reproduce the pain that the patient normally feels. There are essentially two components to a diskogram. The first component is the characteristics of the disc. The second component is pain provocation at the time of injection. It should be similar to the patient's own description of the pain. When patients have abnormal findings on magnetic resonance imaging and diskography, and fail to respond to conservative care consistent of physical therapy and pain management with epidural blocks, surgical intervention should be considered.



Radiograph of a BAK intervertebral fusion system

The relative indications for anterior lumbar interbody fusion include

- 1) primary enlarged central disc herniation,
- 2) annular tear with segmental instability of an intervertebral disc;
- 3) primary disc herniation with a long history of disabling back pain,
- 4) post laminectomy syndrome resulting from segmental instability,
- 5) severe instability with deformity in combination with a posterior fusion,
- 6) lumbar scoliosis in combination with anterior instrumentation.

There are special circumstances which anterior lumbar interbody fusion has distinct advantages over other methods which include patients with a greater degree of back pain than leg pain, patients who have undergone previous posterior surgery including laminectomy and/or

fusion which may produce dense scar around the nerve and posterior elements causing another procedure from the back to be much more

difficult and potentially producing more complications.

As stated above, anterior lumbar interbody fusion avoids violation of the spinal canal and its nerve roots, thereby reducing the formation of scar tissue and the subsequent risk of arachnoiditis and chronic pain. Replacement of the disc which occurs with anterior lumbar inter body fusion with either a cage or a bone restores the ventral height of a disc which allows proper maintenance of neural foramen.

Although there are many indications for anterior lumbar interbody fusion, there are a few contraindications. These include posterior pathology only because anterior lumbar interbody fusion anteriorly does not relieve posterior pathology. Patients may have dense adhesions form as a result of an earlier operation which make it difficult to get a clear view of the front of the spine. Obesity during a surgical procedure may become dangerous in a grossly obese patient and difficult for the surgeon, as working with instruments close to major vessels. Severe arteriosclerosis of the aorta or iliac arteries especially in older patients because manipulation of these arteries must occur in order to obtain access to the spine and perform interbody fusion.

In general, the surgical technique for anterior lumbar interbody fusion takes one hour or less for a one level fusion.. Patients are brought to the operating room and placed in the supine position laying on their back. Usually a transverse incision is made for cosmetic reasons by the general or vascular surgeon through the abdomen and between the umbilicus and the pubic bone. The exposure is taken down through the abdominal muscles and the peritoneal structures are moved aside exposing the vascular structures. Depending on the level, these would include the aorta, iliac vessels and also the ureters. The vascular surgeon then mobilizes these structures and provides the spine surgeon with access to the anterior portion of the spine. A spinal needle is placed in the disc space and x-rays are taken to confirm the appropriate level. A small scalpel is then used to incise the disc and it is removed with pituitary rongeurs. The procedure is done using fluoroscopy. Once the disc is removed the end plates are prepared. It is important to perform a good arthrodesis for the success of the procedure. Implanted devices include titanium cages which are circular cages typically filled with the patients own bone which is harvested from the iliac crest at the time of the procedure and then placed in the disc space. There are several types of titanium cages. Other implants consist of femoral ring allografts and cortical bone dowels. Although the titanium cages are structurally much stronger; some feel that radiographic evidence of a fusion is much more difficult to ascertain at a later date. Using fluoroscopy and instrumentation, the interbody device chosen is placed to a predetermined depth in the disc space prepared. The general vascular surgeon then closes the incision.

The complications associated with anterior lumbar interbody fusion can range from a benign abscess stitch to vascular injuries. The range of complications include neural injury, graft displacement, hardware failure, fracture of the vertebral body, abdominal adhesions. laceration of the ureter, a hernia, and potentially embolization from manipulation of the arteries.

The popularity of anterior lumbar interbody fusion has grown dramatically in the past two decades. The advantages of the weight bearing fusion which the anterior lumbar interbody affords along with complete disc ablation and minimal morbidity have aided in the success of this approach toward fusion of the lumbar spine.

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Smoking is a Risk Factor for Back Pain

• By Victoria Wilcox PA-C

Smoking contributes heavily to serious diseases. Roughly one-quarter of the North American population smoke.⁹ Back pain has become one of today's most common complaints, afflicting 52 million individuals² or 60-90% of all people⁷ which are temporarily or -permanently 'disabled in the United States.² From 1976 through mid- 1999⁴, there has been evidence regarding the association between smoking and back pain⁹. In fact, the link between nicotine consumption and disc disease has become so apparent that smoking has been listed as a risk factor-for back pain, lumbar disc herniation, and cervical disc herniation.⁸ Thus, prevention occurs only if recognized risk factors can be eliminated.

Cigarette smoking over the years contributes to increased severity of back pain both in frequency and intensity. In moderate back pain, the population smoked one pack of cigarettes a day for 10 years while those that smoked for 19 years were afflicted with a greater severity of pain^{7,2}. However, if three packs of cigarettes were smoked per day, this resulted after a year in drastically increased back pain.² One study compared smokers with their non-smoking twins. This demonstrated 18% more degenerative disc disease in the lumbar spines of the twin smokers compared to their non-smoker twins. The effect was present throughout the entire lumbar spine.¹

There are plausible pathomechanisms that have been suggested to explain the association between smoking and back pain. These include coughing, lifestyle, osteoporosis, fibrinolysis and blood flow.

Coughing

Coughing increases the intradiscal pressure and intra-abdominal pressure. These pressures put a mechanical strain on the spine and discs.⁶ They therefore can be causative factors in disc bulging and/or ruptures alone with back pain.^{1,2,3,10}

Lifestyle

Secondly, there is an association between the lifestyle of a smoker and back pain. Physical inactivity, overeating, and alcohol consumption often contribute to a smoker's lifestyle.² Activities of daily living in smokers such as reaching and stooping for misplaced cigarettes may also lead to back pain.³

Osteoporosis

Next, smoking decreases bone mineral content.⁴ The micro- or macrofractures of the trabeculae in the lumbar vertebral bodies leads to osteoporosis.^{2,6,10} Postmenopausal women who smoke lose significantly more cortical bone which increases spinal osteoporosis.. Smoking interferes with osteoblastic function thus less mineral content is available for bone.^{6,10} This leads to a possible cause of back pain.

Fibrinolysis

Impaired fibrinolysis, thirdly, is a result of smoking. This impairment occurs when a fibrin cuff binds around vessels. Oxygen and other nutrients are unable to diffuse across the vessels and be exchanged. Although an insufficient fibrinolytic system occurs after damage to a spine, it has been hypothesized that the defect is responsible for the development of back pain and chronicity^{2,4}.

Blood flow

Finally, the periphery of discs are avascular .from early childhood. Smoking decreases blood flow to the spine, which changes the metabolic processes to the discs, therefore hastening the degenerative process which results in mechanical deformities and finally injuries.³ Five factors in which smoking contributes to reduced blood flow are: carboxyhemoglobin, vasoconstriction, atheroma, hemorrhheologic defect, and fibrinolytic defect. In carboxyhemoglobin, the carbon monoxide from the smoke displaces the oxygen from the hemoglobin which: then reduces the oxygen-carrying capacity of hemoglobin 2.6- Nicotine acts to con strict the vessels by decreasing the vessel lumen, thus limiting blood flow. This in turn causes ischemia of the. dependent tissues. The third factor of chronic smoking leads to atheroma. Nicotine enhances vasospasrns or arteriosclerotic changes by thickening arterial walls causing obstruction of blood flow. This leads to ischemia. The fourth factorof smoking decreases fibrinolytic activity which poses a barrier for oxygen diffusion. Lastly, chronic smoking produces changes in blood flow. As plasma becomes more viscous, blood cells stiffen and increase in number. The increase in viscosity limits blood flow and in turn less oxygen is exchanged.²

The inner disc is anaerobic and depends on a diffusion mechanism for its metabolic balance.^{4,5} At the center of the disc, there is low oxygen tension and thus the disc relies on glycolysis to meet the metabolic needs of cells within itself.² This is seen laboratory studies in which showed reduced vertebral body blood flow after a small amount of. nicotine was injected. As the oxygen became depleted, the lactic acid built up and it was unable to be evacuated. by the exchange of fluid. Therefore an acidic pH of 6.99 developed.⁴ The role of pH in the disc plays an integral part in back pain. An asymptomatic human disc is approximately 7.1-7.2. Measurement of pH in discs known to be painful at the time of surgery was below 7.0^{1,4}

Conclusion

Smoking is associated with nonspecific back pain. This is seen in the increased coughing as well as an unhealthy lifestyle. Smoking contributes to spinal osteoporosis as well as a fibrinolytic defect causing back pain. The factors which contribute to diminished blood flow causing poor diffusion as well undernourishment are carboxyhemoglobin, vasoconstriction, atheroma, hemorrhheologic defect. These in turn make the tissues more vulnerable to mechanical stress, a cause for back pain. Back pain advances as cigarette smoking continues.

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