When is surgery appropriate for patients with low back pain?

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Disorders resulting from failure of skeletal or diskal self-repair

ABSTRACT: It is useful for the primary care physician to have a basic understanding of the role surgical care plays in the management of **back** disorders. **Surgery** for **low back pain** is successful only when indications are **appropriate.** Except in progressive neurologic deficit (which requires immediate operative care), **surgery** is preceded by deliberate evaluation and planning. Another nearly universal prerequisite for avoiding unnecessary **surgery** is screening with an active exercise program. In adolescent spondylolysis, posterior lateral fusion may be **appropriate** when **pain** persists. Success rates for surgical care of disk herniation are higher when **surgery** is early, after active exercise treatment has not succeeded. In diskogenic **pain** syndrome, the disk's peripheral silhouette may be unchanged, yet diskography will reveal annular tears that cause **pain.** (J Musculoskel Med. 2003;20:112-123)

Patients with **low back pain** often turn first to their primary care physician for advice on **appropriate** management. Thus, in addition to having a familiarity with other treatment modalities, it is also important that the physician have a basic understanding of the role surgical care plays in the management of **back** disorders.

In this 2-part article, I discuss the indications for which surgical care is **appropriate** in **patients** with motion disorders of the spine (Table 1). These disorders are far more common than those caused by acute spinal fractures, metabolic and inflammatory disorders, tumors, or infections. The term "motion disorders" was coined by the Quebec Task Force, which prepared a comprehensive report reviewing the treatments used in **patients** with spinal dysfunction. (1)

The report was commissioned by the government of Quebec to help plan for health care funding. One of the most important conclusions is that the decision to use surgical care should be made only after **patients** participate in an active exercise program and probably after multidisciplinary investigation and consultation. If **surgery** is warranted, it should not be delayed so long that function deteriorates but should be undertaken for the correct indications as soon as feasible.

In this first part, I review the indications and technical considerations for disorders caused by a failure of skeletal repair (adolescent spondylolysis and spondylolisthesis) and by the failure of disk repair (disk herniation and the diskogenic **pain** syndrome) to occur spontaneously or the failure of nonsurgical assistance (as with an exercise or **back** reeducation program). In the second part, to appear in a later issue of this journal, I will continue my look at the operative care of **low back pain** problems, focusing on degenerative processes (spinal stenosis, nerve entrapment, instability) and failure of a previous **surgery.**

INDICATIONS

What are the indications for **surgery** in spinal dysfunction? Ideally, **surgery** is performed only after failure of spontaneous or assisted repair of the injured spinal structure.

There is essentially one exception to this rule: increasing neurologic loss, especially of bowel and bladder function (cauda equina syndrome). This suggests a significant disk rupture. Such an event sometimes occurs after minor injury and thus at first may be overlooked. Surgical decompression is required as soon as possible. Similar neurologic deficits also sometimes occur after spine **surgery** as a result of a buildup of pressure with hematoma or infection. In these cases, immediate decompression is also necessary.

Except in these events, which are rare, there is sufficient time for careful evaluation before surgical care. Observation of the repair process and clear evidence that attempts to assist the process have failed form the conceptual framework on which the justification for **surgery** is based.

CATEGORIZATION

Failure of repair is classified into 4 categories:

* Skeletal repair failure **following** fatigue overload. This is the problem of adolescent spondylolysis.

* Failure of the disk to repair itself. The problem may emerge as a herniated disk or persistent **back pain** secondary to internal tears in the disk with subsequent **painful** derangement.

* Failure of connective tissue repair, that is, the degenerative process. Degenerative problems are usually seen in older persons. Many special demands and trade-offs are involved in the surgical care of these **patients.**

* Failure of previous **surgery** because of **inappropriate** technique or **inappropriate** selection of surgical candidates.

SURGERY: BY WHOM?

Back surgery is performed by both orthopedic surgeons and neurosurgeons. Sometimes surgeons from each specialty work together as a team. Although either specialty is competent, there is, of course, variation among individual surgeons, depending on training, extent of experience, and frequency with which **back surgery** is performed.

Certainly, certification of the surgeon is requisite. To perform more complex **surgery,** younger surgeons should gain additional experience and expertise through more training in **fellowships** after completion of formal residencies.

FAILURE OF SKELETAL REPAIR

Definition of problem

Adolescent spondylolysis is considered essentially a failure of stress fracture repair, although some persons probably have a genetically determined predisposition. Chronic overload--especially in the hyperextension range--places such unusual stresses on the pars interarticularis that repeated stress eventually leads to a fracture. Because of persistent motion at the fracture site, solid bony union falls to develop and a fibrous healing with scar fills the void.

The incidence is about 5% in the general American population but is greater among athletes, such as football linemen and gymnasts. (2) The incidence of spondylolysis without any recognizably peculiar mechanical stresses is higher in certain genetically similar groups. For instance, in Eskimos, the incidence is approximately 20%. (3) For unpredictable reasons, some persons have not only failure to heal the stress fracture of the pars interarticularis but also continued forward displacement of the superior vertebra on the inferior vertebra. This spine condition is called spondylolisthesis.

If we consider failures of the anatomic lumbar spinal structures chronologically, the problems of spondylolysis and spondylolisthesis of adolescence occur early in adolescence during vigorous physical activity in the face of a growing skeletal system. Basically, they are problems of fracture healing at a site that suffers significant stress because of the severe demands of our lordotic anatomy and are seldom related to disk problems. At this particular time of life, therefore, the pars interarticularis is a unique weak link in the lumbar spine.

Before care is undertaken

Most problems in the adolescent are at L5-S1. Often, abstaining from stressful physical activity is sufficient to **allow** healing. Several months in a cast also resolves the problem. In at least 50% of adolescents with significant symptoms, the injury heals spontaneously when the activity inciting the stress fracture is removed. (4) Posttraumatic slip at L4-5 is more unstable and leads to **surgery** in about 75% of **patients.**

Exercises focused on building torso strength frequently assist in returning the patient to **pain-free** function. **Patients** with either increasing lordotic or kyphotic postures are predisposed to increased slip. In these **patients,** the strengthening of both the extensor and flexor musculature is important. Because the goal is to **allow** the pars interarticularis fracture to heal, initial treatment may be bed rest **followed** by the wearing of a lumbar brace that incorporates 1 thigh. The brace **allows** for ambulatory activity but prevents flexion and extension at the lumbosacral junction.

Surgical plan

In most adolescents whose spondylolysis is discovered before slippage begins, avoiding the mechanical stress that caused the fatigue fracture until healing has occurred resolves the problem. (5) However, for those adolescents who have participated in a conservative attempt to achieve healing and yet have persistent disabling **pain,** surgical care may be necessary (Table 2).

The bone scan is the best test to discern the presence of stress fracture. Evidence of stress fracture may appear on the bone scan even before roentgenographic appearance is noted. If the patient with **pain** created by overrigorous athletic activity has a "hot" bone scan indicating the fracture before roentgenograpbic changes are apparent, the prognosis is excellent; healing usually occurs with conservative treatment.

One predictor of the need for surgical care is a bone scan image that shows diminishing intensity in the affected area over time in spite of continued **pain.** This finding suggests that reactive osteogenic activity is diminishing and eventual union of the stress fracture site will not occur.

The choice of surgical procedures for spondylolysis and spondylolisthesis is narrow, at least compared with that available for other spinal disorders. The type of fusion that is most widely advocated is posterior lateral fusion.

In posterior lateral fusion, the lateral pedicle, the facet joints, the pars interarticularis, laminae, and transverse processes are freed of soft tissue and decorticated to **allow** the blood supply of the bone to be exteriorized. This is done either from a midline incision with exposure to the tips of the transverse processes of all tissue or from a lateral inter-muscular exposure on either side of the spinous processes. Usually, a bone graft from the pelvis is used.

During a single-level fusion procedure, blood loss is usually not excessive, and blood may not need to be replaced during **surgery.** When more significant blood loss occurs, blood aspirated during **surgery** can be passed through recycling equipment known as a cell saver and returned to the patient.

Because of the great healing potential inherent in youth, expectation of fusion across the facet joints and the transverse processes is high in young **patients.** Even though it is not possible to achieve total immobilization--the motion segment at L5-Sl cannot be totally immobilized with bracing or recumbency--union across the motion segment is expected. (This potential for healing is similar to that seen in fractures even without internal fixation, if relative immobilization can be achieved.)

Internal fixation is seldom necessary in adolescent spondylolisthesis fusion **surgery.** Usually, postoperative braces are used. Fusion generally takes 3 to 6 months to achieve solid union. It may take 1 year before function returns to normal.

With innovations in internal fixation, direct repair of the pseudarthrosis with bone grafting and internal fixation of just the pars interarticularis repair is now being done. The advantage is not causing loss of motion at any segment. It is thus the preferred treatment for athletes.

Using recently developed internal fixation techniques, it is possible to achieve reduction to normal alignment in **patients** with severe slip (more than 50%). The technique usually involves placing screws in the sacrum and in the pedicle of L4 and L5. For reduction of the L5 vertebral body, fusion to L4 is necessary. However, because **patients** treated by fusion without reduction (that is, in situ) have resolution of **pain** and note no significant cosmetic complaints, the need for this technically demanding and potentially risky procedure is still in question. Why attempt the reduction when the cosmetic problem of flat **back** and the associated hamstring spasm typically seen in **patients** with **painful,** severe spondylolisthesis resolve with solid fusion across the unreduced slip?

FAILURE OF DISK REPAIR WITH HERNIATION

Definition of problem

The pars interarticularis is often the weakest link in the lumbar spine during the rapid growth and vigorous physical activity of childhood and early adolescence. From a chronologic standpoint, the disk is the next anatomic lumbar spinal structure to fall as the spine ages. The lumbar disk appears to be the weakest link in the 20- to 30-year-old age group.

The disk, because of its avascular status, has the smallest number of cells per unit area of any tissue. The potential for repair is thus greatly diminished compared with that in other connective tissue. Our lordotic posture places unusual stresses on the disks at the L4 and L5 levels: about 90% of all lumbar disk hermations occur at these 2 levels.

Disk deterioration results when the continuity of the anulus fibrosus is disrupted. This **allows** for migration of nuclear material to the periphery. Tears of the peripheral anulus attachment to the vertebral body also create greater stress on the fibers of the inner anulus, **allowing** tears to develop internally. The connection of the internal radial tear with the peripheral (circumferential) rim tear **allows** a herniation to occur.

Once herniation of the nuclear material has occurred, disk tissue invades the spinal canal and impingement on the nerve roots may develop. This impingement causes an inflammatory reaction. It is not just disk pressure on the nerve that is a source of **pain.** That is why epidural corticosteroids may help in the acute stages of herniation. Degrees of herniation vary, ranging from a small protrusion to complete extrusion of disk material into the spinal canal (sequestered disk).

So far, we have no predictor to explain the variations in degree of protrusion that occur in the population. We do know, however, that there is a genetic predisposition for premature disk deterioration in some families.

The more significant the protrusion appears radiologically and the more precisely this finding correlates with the clinical picture of nerve root dysfunction, the greater the success of surgical care (Table 3). (6) On the other hand, significant disk protrusions are noted incidentally in at least 20% of the adult population with no symptoms. Thus, it is apparently a combination of mechanical impingement and associated inflammatory reaction that creates the **pain** secondary to a herniated disk.

This **pain** should reflect the neuroanatomic abnormality. If the nerve root is being irritated, the symptoms and signs should correlate with the anatomic distribution of that specific nerve root, and its impaired function relates to the signs. We should expect diminished sensation, changes in reflex, and even motor weakness.

The reactive inflammation leads to **pain** during nerve root motion. This is demonstrated by specific signs suggesting nerve root tethering in the spinal canal.

The most reliable test is the straight leg raising test. In **patients** with diminished straight leg raising and with aggravation of **pain** by dorsiflexion of the foot (creating slightly greater tension on the nerve root), imaging studies will most likely demonstrate a disk protrusion. The test is most clearly positive when the leg **pain** is worse than the **back pain,** although in central disk protrusions **back pain** with referred **pain** to either leg may be the clinical finding.

The best predictor of success in disk **surgery** to relieve leg **pain** is the amount of disk material protruded into the spinal canal. This correlation was demonstrated clearly by the most extensive study done to review this question. (6) **Surgery** to remove minor bulges was less successful than **surgery** for large protrusions.

Before care is undertaken

None of the approaches to surgical excision of the herniated disk is **appropriate** unless an attempt has been made to resolve the problem by means of an active exercise program. Some evidence indicates that disk nutrition is enhanced by cyclic activity of the spine, such as with repeated flexion or extension exercises. (7,8) Flexion exercises alone often cause further protrusion of disk material posteriorly. Extension exercises coupled with continued avoidance of flexed postures (McKenzie program) can often centralize the leg **pain** to the **back** and then resolve symptoms.

On the other hand, in **patients** who do not improve after a vigorous attempt at exercise programs and have persistent or increasing **pain,** further delay would appear to offer no advantage. Studies indicate that early surgical care has a greater chance of success than delayed care. (9) With the advantage of modern imaging studies, a clear understanding of the disk-nerve relationship is possible. MRI is especially useful for the study of soft tissue problems, such as disk degeneration, protrusion, and rupture. CAT scans can give better bone detail, but in the midlife age group skeletal problems are usually not significant.

Surgical plan

There are 3 general categories of surgical correction. Laminotomy is the traditional approach. The disk material is removed under direct vision through a small posterior incision, and the nerve root is visualized directly. The offending material is removed mechanically with specialized grasping instruments. Surgical exposure is minimized.

Microdiskectomy is the same procedure, but special magnification, an operating microscope, and special retractors and tools are used. (10) In microdiskectomy, surgical exposure is further minimized. Advocates of microdiskectomy note that with this technique there is less soft tissue injury caused by intervention and, thus, less postoperative morbidity; **patients** undergoing microdiskectomy usually spend only 1 or 2 days in the hospital.

A limitation with microdiskectomy is the narrower view of the bone-disk-nerve relationships. Diminished nerve function in older persons is sometimes secondary to impingement by an arthritic facet joint or narrowness of the nerve canal or both, and additional removal of surrounding degenerative tissue is necessary to fully decompress the nerve root.

The technique of nerve root exposure--even when performed without a microscope--has become progressively more discrete. A small amount of bone is removed from the inferior and superior aspects of the lamina to broaden the area of exposure; the offending disk material is easily removed, and minimal injury to the neurostructures is expected. After removal of disk material, the spinal canal and nerve root canal are probed to ensure that no additional fragments or compression is present.

Controversy still exists about the amount of disk material to be removed from the disk space. More traditionally trained surgeons remove as much disk material as can be scraped from the disk space to avoid recurrent herniation. More recently, procedures in which only the protruding material is removed have been advocated. Studies show that **surgery** is no less successful or the recurrence rate any greater when only the protrusion is removed. The smaller exposure is thus becoming the typical method. (11)

An even more minimally invasive technique for correction of disk protrusion is now emerging with the use of an arthroscope. With the use of local anesthetic, the instrument can be placed in the disk or neuroforamen and, with special equipment, disk material can be removed. As the equipment continues to improve, this approach will become more common. It is performed without general anesthesia in same-day **surgery** centers.

Whether fusion is needed after disk removal depends to some extent on how much support tissue has to be removed during the diskectomy. For example, a wide exposure with a massive amount of disk removed tends to destabilize the spine at the site of **surgery,** increasing the need for fusion. With the expectation of more discrete **surgery** and demand for less time in the hospital and earlier return to work, fusion is now rarely done at the time of diskectomy.

Fusion might be advocated if the patient undergoes repeated disk **surgery.** Recurrences of disk protrusion occur in about 8% to 10% of **patients** who had standard laminotomy but in only about 4% of those who had the discrete **surgery.** Usually the most mobile segment is at the L4-5 level, and fusion of the L4-5 segment sometimes becomes necessary during repeated **surgery** purely for a prolapsed disk. Some surgeons prefer to accomplish this with an interbody fusion, either front or **back.** Metal spacers known as fusion cages are also used to avoid loss of disk space. This creates more room at the neuroforamina.

With the currently available imaging technology, there is no justification for surgical exploration. A specific surgical plan should be identified before surgical care is undertaken. Correlation among the imaging studies, including MRI, CT, and myelography (now used only occasionally), is a necessity before **surgery** is undertaken.

FAILURE OF INTERNAL DISK REPAIR

Defining the problem

One of the most controversial classifications of potentially correctable **back** problems is the diagnosis of **painful** disk disruption (the diskogenic **pain** syndrome), a syndrome first described by Crock. (12) **Patients** have an abnormality within the disk that does not alter the peripheral profile of the disk. These **patients** have no clinical signs of nerve root irritation, and no abnormalities can be identified on roentgenogram, CT scan, or myelogram.

Usually, the MRI scan shows a disk with some dessication. Often, there may be a small area of intense hydration at the periphery, known as a high intensity zone. Most dessicated disks (degenerated disks) are not **painful.** The only way a specific disk can be demonstrated as a **pain** generator is by diskography, which itself is not always reliable. Persons with chronic **pain** syndromes may receive false-positives on diskography.

The structural abnormality in this syndrome can be visualized only by using MRI (both axial and sagittal views) or with diskography. Ideally, the diskogram is accomplished with a CT scan, thus **allowing** an axial as well as a sagittal view. As noted above, these tests are not very specific. We still do not understand the reasons why some degenerating disks become **painful** but most do not (see "The patho physiology of disk deterioration" on page 121).

Before care is undertaken

Most **patients** with disk disruption syndrome **(painful,** nonherniated disk and exact reproduction of **pain** on diskography) have relief of **pain** if they **follow** an active exercise program. A program focused on enhanced disk and connective tissue nutrition has the greatest potential for **allowing** healing and reversal of the abnormal internal chemical activity, which apparently is the source of **pain.** The use of passive physical therapy modalities--such as ultrasonography, massage, manipulation, and heat--offer no potential to change the deranged structure of the disk.

We now know that at least the outer one third of the disk is innervated. In **painful** disks removed at **surgery,** it has been demonstrated that there is innervation even in the center of the disk. **Painful** disks have higher concentrations of various chemicals, such as nitric oxide, phospholipase A, and some metalloproteinases. The goal of physical treatment is to enhance fluid exchange in the disk so that the noxious chemicals are diluted to a level not involving the nerves.

Surgical plan

None of the surgical solutions is ideal. Three are now advocated: posterior lateral fusion, anterior interbody approach with fusion, and disk excision without fusion.

The most rational approach would be to remove the disk totally and replace it with a substitute. Although several designs of total disk replacements have been proposed and some clinical trials have been accomplished, considerable time will pass before disk replacement is a reliable clinical remedy. (13)

Here too different strategies are emerging. One is to replace the disk completely with a 3-piece metal and plastic interface--a technique conceptually similar to total hip or knee replacement. Another is to merely replace the center, nuclear portion of the disk with a polymer that swells when hydrated and thus elevates the disk space. The hydrated polymer is pliant and thus functions mechanically as the nucleus in a normal disk. Both systems have been used in Europe for several years, and the FDA has given permission for trials in the United States.

One solution, reminiscent of the early days of surgical reconstruction of other joints, is the ablation of motion at that segment, that is, a fusion. A fusion of the spine may be accomplished either by anterior or posterior interbody approach or more traditional posterior lateral fusion. Under ideal circumstances, this problem of **painful** internal disk disruption occurs at only 1 motion segment (level).

An anterior lumbar interbody fusion is performed through an abdominal retroperitoneal approach. With this type of approach no nerve root damage is expected. However, in the mobilization of the vessels, tears may be created in the vena cava or iliac vessels unless the procedure is done with considerable skill. The anterior anulus fibrosus is incised, and disk material is removed. Once all of the disk material is removed and the intervertebral disk space is widened, plugs or squares are cut out of the superior and inferior end plates. Matching dowels or rectangles of bone are then impacted into this space. The bone grafts, which may be autogenous or cadaveric grafts, are mechanically matched to fit the recipient site.

More recently, metal spacers in the form of perforated tubes or porous reticulated squares have been used. The inner part of these fusion cages is filled with autogenous bone graft, which incorporates with the vertebral body above and **below** the excised disk space.

Bracing is generally used postoperatively. Diminished activity in extension is **appropriate.** The best results are seen in **patients** who are mobilized **slowly.** Recuperation takes 6 months before good roentgenographic evidence of living bone traversing from the superior vertebral body to the inferior vertebral body is visible.

Success with the anterior inter-body fusion for single-level disk disruption syndrome has been described to be as high as in the 90% range. (14) More recently, the surgical morbidity has been greatly reduced with the use of the endoscopic technique. Postoperative recovery time is greatly shortened and return to normal function occurs sooner because of the minimal dissection associated with this technique.

Demonstration of **pain** by diskography is by itself insufficient to suggest **surgery.** All other explanations for the patient's **pain** must have been ruled out and a sincere effort made at an active exercise program monitored by functional capacity measurement. Psychosocial factors must be considered.

When all of the above have been tried and failed, fusion may be a reasonable approach. However, **patients** must expect to take several months off from work **following** spinal fusion. When fusion is successful at 1 or 2 disk levels of the spine, they can return to their previous level of physical activity.

Another strategy has emerged for treatment of the **painful** nonprotruding disk (internal disk disruption). Based on the observation that heat will shrink collagen, a radiant heat source has been developed that can be passed into the disk. The approach is the same as for diskography in that the heating element (labeled a catheter by the manufacturer, Oratek) is passed into the disk posterior laterally and then circled around to the area of **painful** fissures in the posterior part of the disk. That area is heated for several minutes. This is known as an IDET (intradiskal electrical thermal) coagulation procedure. Some results are very good, some are not. The best candidates for this procedure are still being clarified. This procedure does not preclude more **surgery.**

Because we do not understand what really happens with the heat, the results remain unpredictable, even as we gain more experience in using it. In spite of prolonged bracing after the procedure, a significant percentage can worsen.

Nucleoplasty, another needle procedure, is now emerging. Very little tissue damage occurs at sites not being treated.

Table 1

Operable motion disorders of the **lower** spine

Failure of skeletal repair

Adolescent spondylolisthesis
Adolescent spondylolysis

Failure of disk repair

Herniation
Internal disk disruption **(painful** disk syndrome)

Failure of connective tissue repair

Central stenosis

Degenerative instability (degenerative spondylolisthesis, scoliosis)
Foraminal stenosis

Failure of surgical repair

Incomplete decompression
Pseudarthrosis
Recurrent disk herniation
Spinal scarring

Table 2

Care for **painful low back** disorders in adolescents **following** failure of nonsurgical skeletal repair

Problem	Predictors
Failure of stress fracture repair (spondyloysis)	Persistent **pain** despite treatment with rest for several months
	"Cooling" bone scan (diminishing

	osteogenic activity indicates fracture union unlikely)
Progressive forward slipping of cephalad vertebral body	> 50% slip with increasing sagittal posterior rotation of sacrum Anterior rounding of superior surface of caudal vertebral body

Problem	Procedure and considerations
Failure of stress fracture repair (spondyloysis)	Fusion (posterior lateral)
Progressive forward slipping of cephalad vertebral body	Fusion (usually in situ posteriorly; reduction is complex) Fixation seldom necessary

Table 3

Care for **painful low back** disorders **following** failure of nonsurgical disk repair

Problem	Predictors
Invasion of spinal canal by nuclear material and anulus fibrosis with nerve root irritation (herniation)	Active exercise program fails to relieve Persistent neural deficits that correlate positively with imaging findings
Pain from disk anulus secondary to chemical irritation (internal disk disruption)	Dramatic **pain** reproduction on diskography (usually at 1 level) Active exercise program fails to relieve Significant lifestyle changes have occurred

Problem	Procedure and considerations
Invasion of spinal canal by nuclear	Removal of offending material

material and anulus fibrosis with nerve root irritation (herniation)	Approach may be posterior, micro-surgical, intradiskal
Pain from disk anulus secondary to chemical irritation (internal disk disruption)	Interbody fusion Front and **back** approach necessary (with internal fixation of 2 or more levels)

References

(1.) Spitzer WO. Scientific approach to the assessment and management of activity-related spinal disorders. A monograph for clinicians. Report of the Quebec Task Force on Spinal Disorders. Spine. 1987-12(suppl);8-52.
(2.) Jackson DW, Wiltse LL, Cirincoine RJ. Spondylolysis in the female gymnast. Clin Orthop. 1976;117:68-73.
(3.) Kettelkamp DB, Wright DG. Spondylolysis in the Alaskan Eskimo. J Bone Joint Surg. 1971 53A:563-566.
(4.) Hensinger RN. Spondylolysis and Spondylolisthesis in Children. American Academy of Orthopaedic Surgeons Instructional Course Lectures. St Louis: CV Mosby; 1983; 32:132.
(5.) Saraste H. Long term clinical and radiological **follow-up** of spondylolisthesis. J Pediatr Orthop. 1987;7:631-638.
(6.) Spangfort EV. The lumbar disc herniation: a computer aided analysis of 2504 operations. Acta Orthop Scand. 1972;142;1.
(7.) Adams MA, Hutton WC. Gradual disc prolapse. Spine. 1985;10:524.
(8.) Krag M, Seroussi R, Wilder D, et al. Internal displacements from an in-vitro loading of human spinal motion segments: experimental results in finite element model predictions. Spine. 1987;12:1001-1007.
(9.) Hurme M, Waranta H. Factors predicting the result of **surgery** for lumbar intervertebral disc herniation. Spine. 1987;12:933-938.
(10.) Williams RW. Microlumbar discectomy: a 12 year statistical review. Spine. 1986; 11:851-852.
(11.) Spenglar DM. Lumbar discectomy: results with limited disc excision and selective foraminotomy Spine. 1982;7:604-607.
(12.) Crock HV. A reappraisal of intervertebral disc lesions. Med J Aust. 1970;1:983-990.
(13.) Mooney V. A perspective on the future of **low back** research. Spine. State of the Art Reviews. 1984;3:173-183.
(14.) Inoue S, Watanabe T, Hirose A, et al. Anterior discectomy and interbody fusion for lumbar disc herniation: a review of 350 cases. Clin Orthop. 1984;183:22.
(15.) Walsh TR, Weinstein JN, Spratt K, et al. Lumbar discography: a controlled perspective of normal volunteers to determine the false positive rates. Presented at: the AAOS Annual Meeting; February 1989; Las Vegas.

RELATED ARTICLE: The pathophysiology of disk deterioration

In the lumbar spine, the disk deteriorates with the passage of time, most commonly at L4-5 or L5-S1. MRI--especially with T2-weighted images--has revealed that the water content of the disk diminishes in deterioration (Figure). However; deterioration by no means correlates with symptoms.

More advanced disk deterioration creates reactive changes in the adjacent bone and facet joints; eventually, the degenerative process of the disk can be seen roentgenographically. No study has correlated the incidence of roentgenographic degenerative changes in the spine with **back pain** symptoms.

Researchers found that in healthy disks no **pain** is created by the procedure. (15) There is, however, a group of **patients** who have severe and persistent **back pain,** normal results on physical examination, and no evidence of herniated disk on other imaging studies but who have abnormal MRI scans. These **patients** have diskogenic **pain** syndrome, or **painful** disk disruption. On diskography, the exact source of the **pain** complaint is demonstrated, and internal tears of the anulus fibrosus can be seen within the disk.

Practice Points

* **Surgery** for **patients** with spinal dysfunction is performed only after failure of spontaneous or assisted repair of the injured spinal structure, except when there is increasing neurologic loss, suggesting a disk rupture.
* Most spinal problems in adolescents occur at L5-S1. In at least half of **patients,** healing occurs with abstinence from stressful physical activity and wearing of a cast for several months.
* Diagnosis of **painful** disk disruption is controversial because **patients** have no clinical signs of nerve root irritation. Most **patients** have relief of **pain** if they **follow** an active exercise program.

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