Neurosurgical Techniques

Eben Alexander, Jr., Editor
Removal of Protruded Lumbar Intervertebral Discs

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Removal of a protruded lumbar disc has become so common it is surprising to the newcomer in the neurosurgical field that 35 years ago the procedure was rare. The classic paper of Mixter and Barr entitled "Rupture of the Intervertebral Disk Without Involvement of the Spinal Canal" read in Boston at the annual meeting of the New England Surgical Society, September 30, 1933, changed the whole concept of ruptured intervertebral discs and opened a large new field in neurological surgery. Neurosurgeons whose practices span the last 35 years have seen an evolution in the operative procedure with many digressions from what seems to the author to be the simplest and most effective method of surgical treatment. In the infancy of protruded lumbar disc surgery, a wide bilateral laminectomy was done, the posterior dural sac opened, nerve roots separated, the anterior dura incised, and, finally, the protruded portion of the disc exposed and removed. This extensive procedure is not desirable in the usual case of protruded lumbar disc; equally cumbersome and dangerous is the transabdominal anterior approach.

A certain number of patients with protruded lumbar discs should have spinal fusions in conjunction with the removal of the protruded portion of the disc. Indications for the fusion depend on age, occupation, symptoms, and roentgenographic findings. In brief, young and middle-aged patients who hope to return to heavy physical labor, who have had much back pain over a long period, and whose roentgenograms may indicate some instability of the lower lumbar spine are considered for fusion. In my own series, 25% of the patients with protruded lumbar discs had spinal fusions at the same time the protrusion was removed. When a fusion is to be done, a modified Hibbs fusion utilizing bone from an iliac crest is the operation of choice.

Myelography

Unless there is some definite contraindication, such as a history of sensitivity to iodine, Pantopaque myelography is considered desirable prior to all operations for protruded lumbar disc. A myelogram more definitely establishes the exact level of the protrusion and rules out cauda equina tumor; clinical symptoms and signs cannot always be relied on to do this. Myelography may reveal protruded discs at two levels or the presence of some other lesion causing the symptoms. In the author's series, clinical diagnosis was found to be 80% accurate. Myelography as a supplement to clinical examination reduces errors in diagnosis to 7%.

Reactions to Pantopaque are rare. There has been only one severe reaction in over 2000 Pantopaque studies in our hospital. If there is a history of allergy to iodides, some other contrast medium such as air may be used. A "needle defect" occasionally is erroneously thought to represent the presence of a protruded intervertebral disc. Since 96% of protruded lumbar discs are found at the L4-5 or L5-S1 level, the needle used to perform the myelogram should be introduced at the L3-4 or L2-3 level. It is true that the higher the needle is placed, the more tedious the removal of the contrast medium. If it becomes necessary to introduce a second needle at a more caudal level to remove the oil, the first needle should never be removed until the procedure has been completed because cerebrospinal fluid and oil may leak from the dural puncture site of the removed needle.

Anesthetic

In most cases, the author prefers the use of spinal anesthesia, employing a hypobaric solution. If the myelogram is done just prior to the scheduled operation and if the diagnosis is confirmed, the needle used for the Pantopaque study is left in place; the patient is
transferred to the operating room and placed prone on the table, and the spinal anesthetic is then administered in this position. Even then the needle is not withdrawn unless its presence proves to be a handicap to the surgeon. Removal of the needle may allow leakage of cerebrospinal fluid from the dural sac and collapse of the sac; the author feels that this increases bleeding from epidural veins because of loss of the tamponade effect. A second reason for leaving the needle in place is that it may be used as a landmark, thus reducing the size of exposure. This is particularly helpful in a case where the protruded disc lies higher than the last two disc spaces.

**Operative Position and Preparation**

Various positions have been used for operating on patients with lumbar protruded discs. The lateral and sitting positions have been tried but abandoned as having no real advantages and some disadvantages over the prone position with the table flexed to spread the interlaminal spaces (Fig. 1). Rolls are placed under the shoulders and along the lateral anterior chest wall. A strap "cradles" the buttocks to prevent the patient from slipping. The back is scrubbed 10 min with Povidone-Iodine,* and meticulous antiseptic technique is employed. If for any reason a lateral roentgenogram is to be taken on the table, draping is done without towel clips, the drapes being secured to the patient with an adherent spray. When a spinal fusion is also planned, the iliac crest on one or both sides is draped into the operative field.

![Fig. 1. Position of patient on table. Table is flexed to spread interlaminal spaces; rolls are placed under the shoulders and along the anterior chest wall.](image)

* The Purdue-Fredrick Co.

![Fig. 2. Subcutaneous fat has been wiped away from the lumbar fascia. The incision over the spinous processes is midline.](image)

**Disc Exposure and Removal**

A midline longitudinal incision is preferred to a transverse one or to an incision lateral to the midline. After the incision is made through the skin and subcutaneous fat down to the lumbar fascia, the fat is "wiped away" from the fascia for a short distance so that the edges of the fascia are clean and easily visible when closure is performed (Fig. 2). Thumb forceps compress the soft tissue on both sides of the spinous processes to keep the incision in the midline. Minimal
bleeding is insured by subperiosteal elevation of the muscles from the spinous processes and laminae (Fig. 3). The muscle is retracted laterally to expose the articulation between the inferior and superior articular processes, and retraction of the muscle is maintained by hooking the tip of a Taylor retractor lateral to the superior articular process (Fig. 4). The laminae vary greatly in width; in some patients the interlaminal space, particularly between L-5 and S-1, is sufficiently wide to permit removal of the protruding intervertebral disc tissue without removal of any bone. The laminae also vary greatly in position like slats in a venetian blind. The ligamentum flavum between the laminae is resected and a cotton ball inserted into the epidural space to protect the dural sac and nerve root while the opening is being enlarged (Fig. 5). Enough bone and ligamentum flavum are then removed from the adjacent laminae for adequate exposure of the nerve root and protruding disc. Bone should be removed well laterally, but it is inadvisable to destroy the joint between the inferior and superior articular processes (Fig. 6). Sometimes a protruded disc will be located far laterally, compressing the root in the intervertebral canal, a protrusion that the Pantopaque study possibly has not shown.

A nerve hook is slipped lateral to the nerve root or the dural sac or both, and these structures are gently retracted medially (Fig. 7). Occasionally the protrusion is in the “axilla” between the dural sac and the nerve root, in which case a large portion of the protruding disc may be removed before retracting the nerve root medially. This
Protruded Lumbar Discs

Fig. 4. Tip of a Taylor retractor is hooked lateral to the articular process. Ligamentum flavum between the laminae is excised.

Fig. 5. After ligamentum flavum has been resected, a cotton ball is inserted into the epidural space to protect the dura and nerve root.

Fig. 6. A. Removal of bone from the laminae with Adson rongeurs. The facet is protected as much as possible. B. Angled Spurling-Kerrison laminectomy punch may be used for bone removal.
avoids unduly traumatizing the nerve root by pulling it medially over a large protrusion. In patients who have had long-standing symptoms, adhesions between the nerve root and the posterior longitudinal ligament may be dense. Careful sharp dissection will be required to free the nerve root so that it can be retracted and the protruded disc exposed. When the nerve root is free, the nerve hook is replaced by a nerve-root retractor (Fig. 8). An incision through the posterior longitudinal ligament may be necessary to allow extrusion of the nucleus pulposus; in some cases it may already have ruptured through the ligament (Figs. 9 and 10). The nucleus pulposus is grasped and withdrawn with an intervertebral disc rongeur (Fig. 11 A). After withdrawal of the free nucleus pulposus, curettement of the space from which it has herniated is carefully performed and all loose fragments removed (Fig. 11 B). The surgeon should always keep both hands on the curette, one hand acting as a control over the other so there is no chance of penetration through the anterior rim of the annulus fibrosus. No attempt is made to remove all of the annulus.

In those patients in whom there is no herniating nucleus pulposus but rather a high annulus, the surgeon must use judgment in deciding whether to remove the high annulus and curette the disc space or to be content with posterior decompression of the nerve root. Fortunately, these cases are few, and too many “high annuli cases” in a series indicates that the surgeon is operating on many patients who would have fared just as well without surgery. The same statement applies to “hypertrophied ligamentum flavum” as a cause of the patient’s discomfort. In dictating his operative note, a surgeon should describe the findings in detail. Too often the operative note briefly states that a protruded disc was found and removed. Those subsequently reviewing the case are left to wonder whether there was an extrusion of the nucleus pulposus, a ruptured protruding annulus, a combination of both, or simply a “high annulus.”

Bleeding from epidural veins should be carefully controlled before closure of the wound. Taking the patient out of the flexed position, thus relieving pressure on large intra-abdominal veins, often controls epidural venous bleeding. Cautious electrocoagulation or small bits of gelfoam are justifiable when
Protruded Lumbar Discs

necessary. Electrocoagulation controls bleeding from the retracted muscle mass. Closure of the lumbar fascia may be with silk or 0 chromic catgut. The author prefers 00 plain catgut to close the subcutaneous tissue and interrupted mattress sutures to close the skin.

**Reoperation for Radicular Pain**

All patients operated on for lumbar protruded disc will not be permanently relieved of pain. Some continue to have original symptoms; some are relieved for a time, only to have recurrence of back and leg pain months or years after operation. The persistence or recurrence of pain may be caused by: 1) protrusion of more disc material from the space already explored or by another disc; 2) intradural or extradural adhesions about the nerve roots; 3) persistent inflammatory or traumatic reaction in the nerve root (radiculitis); 4) pain originating from the facet joint (facet syndrome); 5) osteoarthritic spurs; 6) myofascitis; 7) deep postoperative infection in the disc or vertebra;

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**Fig. 9.** Nucleus pulposus protruding through a rent in the annulus fibrosus and posterior longitudinal ligament; the nerve root is being compressed.

**Fig. 10.** Cross section of the nucleus pulposus herniating through the annulus fibrosus and posterior longitudinal ligament. In this instance, the herniation is so far lateral that the myelogram might not show defect.

**Fig. 11.** A. The herniated nucleus pulposus is grasped and withdrawn with an intervertebral disc rongeur. B. Loose fragments are curetted out of the interbody space.
8) pelvic inflammatory or neoplastic disease; 9) spinal cord tumor. In such cases, another complete general and neurological examination, repeat x-rays of the lumbar spine, and a second myelogram are indicated. If myelography reveals another disc protrusion, reoperation should follow.

Reoperation on a disc space that has been explored previously is technically more challenging than a primary operation. The scarred muscle is removed from the spinous processes and laminae in the same manner as in the primary operation except that the surgeon now must be more careful to avoid injury to the dural sac and nerve roots by a periosteal elevator that may slip between the laminae at the site of the previous operation. Scar will be tightly adherent to the dura, and to prevent opening the dura and arachnoid with escape of cerebrospinal fluid one should obtain a fresh “toe hold.” A sharp curved periosteal elevator (Fig. 12) is slipped between the scar and the undersurface of the remaining lamina above and below the previously explored disc space. Enough lamina, adjacent to the previously explored space, is then removed to expose the ligamentum flavum, which can be dissected easily from the dura. Using sharp dissection and a periosteal elevator (Fig. 12), the surgeon can develop a line of cleavage between the scar tissue and the dura so that scar tissue can be dissected carefully from the dura and nerve root. It is rarely necessary to interrupt a lamina completely, although in some instances this is easier and less time-consuming. If one intends to interrupt a lamina completely, the “toe-hold” is obtained by starting the removal of the lamina at the interspace above or below the space explored previously.

Persistent or recurrent pain from some other cause than another disc herniation presents a difficult problem. After one or more previous operations for protruded lumbar disc, the surgeon may resort to one of the following procedures in an attempt to obtain relief: 1) wide laminectomy, opening the dura, and thoroughly inspecting the lower lumbar and sacral nerve roots; 2) another interlaminar exploration, again removing a limited amount of bone, careful removal of scar tissue from the dural sac and nerve root, followed by fusion of the lower lumbar vertebrae to the sacrum; 3) rhizotomy.

**Extensive Laminectomy.** The author has seldom resorted to extensive lower lumbar laminectomy and intradural exploration of the nerve roots in protruded disc cases with persistent or recurrent radicular pain. Lysis of nerve roots in patients with adhesive arachnoiditis is seldom, if ever, beneficial and may result in further damage to the roots. Likewise, wide exposure of nerve roots by extensive laminectomy has seldom resulted in benefit in the author’s experience. On the other hand, if the myelogram now shows a complete or near complete block to the flow of contrast material, the laminectomy must be extensive enough to prove the block is due to adhesive arachnoiditis and not to a tumor.

**Interlaminar Reexplanation.** A more rewarding operation in patients with continuing back and leg pain has been interlaminar extradural reexploration of the nerve roots in the distribution of the leg pain, decompression of the roots well laterally, and fusion of the vertebrae adjacent to the roots explored. Pain may be originating in

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**Fig. 12.** Reexploration for recurrent protruded disc. *A.* Periosteal elevator is slipped underneath lamina above and below original opening. *B.* Adson curved sharp elevator.
stretched articular capsules and subluxation of the facets. Resection of the capsules and fusion of the facet joints results in relief in a high percentage of patients.

**Rhizotomy.** Cordotomy seldom brings permanent relief from pain in the low back and legs due to non-malignant causes. In persistent radicular pain, rhizotomy is more likely to be effective. Echols\(^1\) reported that 60% of his 62 patients unrelieved of pain after one or more operations for ruptured intervertebral disc were dramatically and probably permanently relieved of pain by section of one or two sensory roots. The indications and technique for interruption of posterior spinal roots have been thoroughly discussed by White and Sweet.\(^5\)

### References