Surgical Technique of Excision of Lumbar Intervertebral Disk Protrusion

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INTRODUCTION

In most neurosurgical units in India today, excision of protruded lumbar intervertebral disk is one of the most common surgical procedures undertaken.

At present, probably supratentorial craniotomy for space occupying lesions and ventriculoperitoneal shunt for hydrocephalus are performed as frequently as surgery for lumbar disk.

However, as more neurosurgeons are trained and more neurosurgical centers are opened, lumbar disk surgery is likely to become the most frequently performed neurosurgical procedure by many neurosurgeons. It is such a common operation today that sometimes it is a bit of a shock to realize that just 55 years ago the operation was unknown.

When properly performed, this operation is one of the most satisfying procedures for both the patient and the surgeon.

Having had the opportunity of performing different types of operations for disk protrusions for 30 years, I thought I may take the liberty of sharing with my young friends, the neurosurgeons in training, the little details of my personal technique in this operation.

In many procedures in life, it is the meticulous, almost obsessional; attention to little details which makes all the difference between resounding success and dismal failure whether it is cooking, driving, dancing, or operating.

ANESTHESIA

A good anesthetist who can maintain smooth anesthesia without coughing or straining throughout the procedure is a most valuable asset to the neurosurgeon. He must be able to produce good muscle relaxation so that the surgical exposure is adequate. He must be able to do a Valsalva maneuver for the patient adequately in case a small dural tear is suspected so that the neurosurgeon can locate the tear. This procedure is also useful to check the watertight nature of the repair after a dural tear is closed. The anesthetist should also keep a check on the blood loss and blood pressure (BP). If more than 200–300 mL of blood is lost, it should be replaced. The systolic BP should be near the preoperative level before starting to close the wound to avoid delayed postoperative bleeding in the depth of the surgical closure.

POSITION

The most important aspect of the positioning is that there should be no pressure on the abdomen when the patient is in the prone position. This may be achieved by special rests or frames or by the judicious use of pillows or cushions beneath the chest and the inguinal regions leaving the epigastric and umbilical regions quite free and lifted off the table by a few centimeter. By breaking the table, the spine can be flexed or extended during surgery, if necessary.

There are a few advocates of the lateral position. It is supposed to be easier for the anesthetist and cause less pressure on the abdomen. In our institution, we have not had any problem on these counts in the prone position. Some prefer to use a modified knee elbow or knee chest position. Whatever the position used, it is essential to use a foot support, straps for the thighs and support for the arms and shoulders. If there is a dural tear, it may become necessary to lower the head end of the table initially and subsequently to elevate it. The patient should be supported and secured in such a way that these tilts of the table will not displace his position.

On the contrary, on few occasions when I have operated in the lateral position, I have found myself to be a little clumsy. Probably, it is only practice that leads to the perfection. However, I do strongly feel that when one has

(Adapted from a lecture given at the Continuing Medical Education Program of the Annual Conference of the Neurological Society of India in December 1985)
to look at the disk spaces on both sides, the prone position is much more comfortable not only for the surgeon but also for the assistants who can then see the operative field much more clearly.

SKIN INCISION

The level of the disk protrusion in the myelogram in relation to the highest points of the iliac crests should be noted and its position marked on the skin by cross-hatching the proposed incision. While making this mark, allowance must be made for the thickness of the subcutaneous tissues over the iliac crest during palpation.

The incision should be generous. One should always aim to expose the lumbosacral intervertebral interval as the best method of localizing the disk is by counting upward from the lumbosacral interval.

In addition to the skin preparation before coming to the theater, it is always wise to prepare the skin again after positioning the anesthetized patient. While preparing the skin, the rubbing should be toward the natal cleft and not in the reverse direction. A large surface of the lumbar region is prepared first before preparing the site of incision.

Although adhesive sterile plastic (steri-drape) is very effective, the use of auto draped thin plastic sheets is equally effective and less expensive. During closure, they are in fact more convenient. The plastic sheets and double-folded towels are placed on either side of the incision at a distance of about 1 cm from it. They are stitched to the skin in the four corners and at one or two places on either side in the middle of the exposed skin.

Sometimes, there is suspicion of a minor skin infection at the site of lumbar puncture or at the region of the lower end of the incision near the natal cleft. While one is definite that the infection, if at all present, is not more than a millimeter or two in extent, one does not feel like incising through it. In such cases, a curved skin incision starting in the midline at the level of L1 spinous process and curving round in the paraspinal region to end in the midline at the level of S3 spinous process can be made. Alternatively, a transverse skin incision can be made in the skin with wide undermining of the skin flaps. In either case, the incision can be planned in such a way that the suspected infection is away from it and safely dissected off with the skin flap. Ideally, of course, one should wait till the infection heals, however, sometimes a sequestrated or large disk with urinary retention may force the surgeon to operate earlier.

INCISION OF THE SUBCUTANEOUS TISSUES

The skin incision is deepened down to the level of the aponeurosis covering the paraspinal muscles. Curved artery forceps are applied to the subcutaneous tissue and bunched together in two or three groups on either side. Eversion of the incised skin edges is sufficient for hemostasis of small vessels while larger vessels may need diathermization. Special care should be taken not to touch one of the artery forceps while coagulating to avoid a diathermy burn of the skin. Undermining the skin, flap is rarely necessary.

SEPARATION OF THE MUSCLES FROM BONE

If the aponeurosis is incised with a knife, a fresh knife should be used. Cutting diathermy is very useful for this incision and also for separating the muscles from the bone. The incision is made with diathermy in the midline through the supraspinous and interspinous ligaments. The dissection is performed as close to the bone as possible aiming to establish the plane of separation in the subperiosteal layer. Hemostasis by cauterization of bleeding vessels should be done several times as the dissection proceeds. Often, troublesome bleeding may be encountered between muscle and bone, especially in the upper corners of the wound. The muscle layer should be well retracted and the overhead light properly adjusted to cauterize these vessels. The diathermy dissection is carried out separating muscles from the spinous process and the medial half of the laminae on either side. At this stage, it is easier to pack the wound with roller gauze soaked in saline and carry out further stripping of muscle by using a broad osteotome to push the gauze between the muscle and bone. If the sharp edge of the osteotome is kept close to the bone and if further roller gauze is packed into the wound as dissection proceeds, bleeding can be minimized greatly. When the stripping has been done to the full breadth of the laminae on one side, the wound on that side is packed tightly with wet roller gauze. The procedure is then repeated on the other side. The two packs are left in a position for a few minutes. Removal of the gauze and immediate insertion of two large self-retaining retractors will usually result in a virtually bloodless field. If the incision is long, sometimes a third self-retaining retractor is necessary.

Vigorous muscle separation without recognizing an underlying spina bifida can injure the cauda equina.

IDENTIFICATION OF LEVEL

The interspinous ligaments are cut with heavy scissors. The lumbosacral interval is then identified. Palpation with the fingers will often show this to be the lowest wide interlaminar space whereas below this level only the sacrum will be left. When in doubt, the spinous process of L5 and S1 can be gripped with bone holding forceps or large-sized bone nibbler and very gently rocked up and
down. Whereas the L5 vertebra can be moved independently of the sacrum, rocking the spinous process of S1 will move the whole pelvis. Unilateral or bilateral sacralization of L5 should be kept in mind while interpreting the results of this maneuver.

MAGNIFICATION

Magnification is not absolutely essential for this operation. Occasionally, a magnifying loupe and a headlight are assets but not essential. Recently, there has been a spate of reports in the literature of microsurgical disk removal. Being a moderately severe myopic, I have the personal advantage of obtaining a +2 to +3 magnification when I take off my glasses, as compared to the other presbyopics of my age group with so-called normal vision.

TECHNIQUE OF FENESTRATION

I have been doing disk excisions for 30 years. For the first 4 years in Edinburgh, with Professor Dott and Professor Gillingham I did only the interlaminar approach or the fenestration technique.

This is like a McBurney operation for appendectomy. You must be sure of the anatomy at every stage and identify the structures before you go to the next stage.

After identifying the interlaminar interval, the lower border of the lamina above is removed on the side of the disk protrusion, with upcutting sphenoidal punches or Kerrison rongeurs. If the lower border of the lamina cannot be felt easily or if the end of the instrument cannot be slipped underneath it easily, some soft tissues (usually fat) may have to be removed from the interlaminar interval with pituitary punches to define the anatomy better. Rarely in a well-built person with wide interlaminar interval nibbling of bone may not be needed. An area of ligamentum flavum at least 1.5 × 1.5 cm is required to be exposed before proceeding further.

A sharp hook is inserted into the exposed ligamentum flavum which is then pulled up. An Allis tissue forceps can be used instead of a sharp hook. With a sharp 11 blade knife, the ligamentum flavum is incised gently 1 or 2 mm at a time. As soon as the anterior limit is reached, the epidural fat or dura will be exposed and if the traction on the ligamentum is good and the anesthesia is smooth, the fat will even fall away from the ligament. A moist patti is now introduced beneath the ligament to protect the underlying structures. These can be very close to the ligament, especially in the case of large or sequestrated disks.

A cube of ligament is now excised incising a square on the surface and deepening it down to the epidural space.

A little dissection with long blunt-ended bayonet forceps will now reveal nerve root and the underlying disk protrusion.

Epidural fat should be saved during this dissection and kept in saline. After excision of the disk, it can be put back as a free graft around the nerve root.

The rest of the procedure is very similar to what one does after a hemilaminectomy or laminectomy.

HEMILAMINECTOMY AND LAMINECTOMY

After returning to India and working with Professor Ramamurthi, I realized over the next few years that the interlaminar approach was not an adequate operation for all cases of disk protrusion. There have been failures to give complete relief of pain in Edinburgh, however, the percentage of such cases appeared to be more in Madras. This is because the incidence of relative lumbar canal stenosis with disk protrusion is much greater in our subjects than in the West. I suspect this is true to a varying extent in other parts of India as well.

Just like Dr Ramamurthi and I, many of the senior neurosurgeons present here would have had the experience of doing a laminectomy in the early 1960s for a suspected disk protrusion, of finding hardly any disk protrusion on the operating table, of being very disappointed at having to close the wound as a negative exploration and of having the unexpected joy later of seeing the patient have a surprisingly good recovery and relief from symptoms. We failed to document and publish this, being shy of publicizing our negative explorations till the true significance of this chain of events dawned on us with the publication of papers on lumbar canal stenosis.

I gave up doing the fenestration operation about 25 years ago except very occasionally to demonstrate the technique to residents in training. I gave up hemilaminectomy about 20 years ago when I became the head of an independent neurosurgical unit. Nowadays, I always do a full laminectomy for all disk protrusions and very often remove two and sometimes even three laminae. I have never regretted it.

Personally, I find the angled double action bone nibblers to be one of the most useful instruments in neurosurgery. With a little care, the structures underneath the bone to be nibbled are well protected and dural tears are avoided. I have read of surgeons nibbling the bone with other types of instruments and on withdrawing the instrument quickly to meet the horrifying spectacle of a long nerve root dangling from the instrument like spaghetti with cerebrospinal fluid gushing at the depth of the wound.

PREVENTION OF DURAL TEAR

When a lumbar canal stenosis is present the danger of dural tear during laminectomy is quite high. In such cases, it is always wise to start removing the lamina one space above the level of the disk protrusion. Once the dura is identified, the laminectomy can be gently extended
downward to the level of the disk protrusion. One should never try to remove too large a bit with each bite. Small repeated nibblings are easier and safer. As the nibbling proceeds medially, the dura may bulge and special care has to be taken to avoid injuring it. All the laminectomy is carried out laterally, the nerve root is often found to be pushed backward by an underlying disk protrusion and is therefore in danger of being harmed. It is sometimes possible to remove the bone only leaving the anterior part of the ligamentum flavum as a protective covering over the dura. The ligament can then be excised pushing the dura away with flat instruments or lintine. A particularly dangerous area is near the upper border of the sacrum. Here, the spinal canal becomes narrow and the dural tube bends at a slight angle backward (‘upward’ from the point of view of the operating surgeon). It is easily harmed especially if there is a large central disk protrusion at that level. A good precaution is to keep the dura away from the nibbler or punch with a broad curved Adson’s periosteal elevator. Another golden rule is to gently rock and loosen each bone bit with the nibbler after biting into it and if this movement produces distortion or traction on the dura, it almost always means that either the dura is caught in the nibbler or is adherent to the bone bit. The nibbler should be taken off, the dura carefully dissected off and then the bone piece removed. As the fibers in the dura run vertically, a violent pull after pinching the dura will often produce a linear tear much bigger than the bit caught in the nibbler.

**CLOSING THE DURAL TEAR**

The assistant must avoid the temptation at all cost to suck CSF close to the dural opening to clear the field. If one or two nerve roots have not already come out through the tear, sucking near it will encourage them to do so and get sucked into the sucker as well. When a nerve root prolapses, the head of the table should be gently lowered, the field cleared of CSF by sucking on a cotton hold placed away from the tear and the prolapsed root and the root gently coaxed back into the subarachnoid space. This is easier if the dura on either side of the tear is gently lifted up with dural hooks.

A protective piece of gelfoam should be introduced beneath the tear and then the dura closed with closely spaced interrupted silk stitches using 3–0 or 2–0 suture material. After closure, the head end of the table should be elevated and the closure checked if it is watertight. Sometimes, a fat graft is useful to close a minute leak which is present despite stitches.

**EXCISION OF ARTICULAR FACETS**

A lot of good sense and sometimes not so good sense has been written about preserving the articular facets and their joints.

My personal policy is this. If it is necessary to sacrifice the facets and the joints to get a good surgical exposure of the root and the disk or if it is necessary to do so to achieve a good decompression, I never hesitate to do it. I do not believe that postoperative arthritis of the inter-articular joints will cause pain in such cases. One cannot get an arthritis when there is no joint. When one of the articular surfaces is removed, the question of arthritis does not arise.

However, excision of multiple articular facets carries a real danger of delayed post-laminectomy spondylolisthesis.

**IDENTIFICATION AND RETRACTION OF NERVE ROOT**

The nerve root is usually identified easily. However, when there is difficulty, it is a good policy to identify the lateral border of the dural tube in the space above and then gently follow it inferiorly. When it starts deviating laterally, it is the beginning of the nerve root.

Rarely, a nerve root flattened out by a bulging disk is difficult to identify. There is a danger of incising into it mistaking it for the thinned out annulus. Such a surgical tragedy must be avoided by always identifying the nerve root. Adequate exposure and anatomic dissection are the corner stones of surgery here as indeed of surgery anywhere in the nervous system.

Except in rare circumstances, one should try to separate the nerve root and retract it medially. Lateral retraction of the nerve root is more difficult because it is anchored by the rest of the dura, and it is prone to tear the dura at the axilla of the root sleeve. Such a tear at the depth of the wound is very difficult to repair watertight. Even for a medially placed disk protrusion, it is better to retract the nerve root and adjacent dura inferomedially than to attempt to excise the disk through the interval between the nerve root and the dura.

In exceptional cases of very large and medially placed disks, it may be wise to remove part of the disk through the axilla of the root and then retract the root medially without too much tension and remove the rest of the disk working lateral to the nerve. When a nerve root is flattened out and adherent, teasing and dissecting by the side of the root with a blunt nerve hook is quite helpful.

Sometimes, beginners may mistake the lateral fibers of the ligamentum flavum for the nerve root, especially if the exposure is inadequate and the field is full of oozing blood. A bloodless field and wide bone nibbling will easily show that the lateral fibers of the ligamentum flavum are on the same anatomical plane and continuous with the medial part of the ligament. The nerve root is more anterior, continuous with the dura and close to bone. Its direction also is oblique in contrast to the vertical direction of the ligamentous fibers.
It is better to avoid demonstration of the bulging disk to all and sundry in the theater by retracting the nerve root forcibly. Each onlooker breathes near the wound and increases the chance of infection despite his mask.

If the surgeon wants to impress his colleagues or the patient’s relatives, it is much more effective to preserve all the excised disk material and put it in formalin and present it to the patient the day after surgery.

While separating and retracting the nerve root, the epidural veins can cause a lot of trouble. Rarely, they form a network almost all round the nerve root. More commonly, the bulk of them is situated anterior to the root. Retracting the nerve root well, the veins can be coagulated taking special care not to touch the nerve root or dura with the diathermizing forceps. Incidentally, it is always preferable for the surgeon to retract the nerve root himself, at this stage and later on during the disk excision, rather than ask his assistant to retract. The nerve root already compressed by the disk protrusion and often swollen and oedematous requires the gentlest handling by the surgeon. When the surgeon retracts the nerve root, he can exert pressure for a few seconds at a time only when room is required for bringing other instruments into the operative area. He can relax the pressure of retraction for long periods in between. Continuous strong retraction of the nerve root by the assistant probably contributes to postoperative morbidity.

REMOVAL OF SEQUESTRATED DISK

If a fragment of a disk is already sequestrated, it can be usually palpated easily. Sometimes, if it has travelled down to the intervertebral foramen after sequestration, careful search may be required to find it. The sequestrated disk should not be pulled out with a straight force in one direction. Such a maneuver may well tear the dura and harm the nerve root. Gripping one cod of the sequestrated piece with a pituitary punch and gently rocking it from side to side and up and down while exerting a constant gentle traction will usually deliver it. If the piece is large, after a part of it is extracted, the pituitary punch must be reapplied to grip the fragment lower down near its middle portion and if necessary reapplied again after some more delivery of the extruded fragment. The direction of pull can be altered during the delivery depending on the force exerted by the fragment on the dura or nerve root. Once the largest ‘diameter’ of the fragment is delivered, the rest of it comes out in a flash. The delivery is not dissimilar to the obstetrical exercise for a baby and produces equally gratifying results for the patient and the surgeon.

After removing the sequestrated disk, careful palpation and inspection must be made again for another sequestrated fragment. Only once I operated on a young woman who had four separate sequestrated fragments, a very unusual occurrence indeed. Once detected, the second fragment can usually be removed much more easily.

It is almost never necessary to remove a disk transdurally. Very rarely, a large sequestrated piece of disk situated centrally and adherent to the dura may require transdural excision. Such a procedure always carries the disadvantages: (i) Increased epidural oozing because of collapse of dural tube on letting out CSF; (ii) Spillage of blood into subarachnoid spaces; and (iii) technical difficulty in closing the anterior dural incision.

CONTROL OF EPIDURAL BLEEDING

If there is persistent oozing from the epidural space, it is better to pack the area above and below the disk with small lintines. These pieces must have long strong black threads attached to them. It is better to clip the other ends of these threads to the towels with hemostats. Otherwise, there is a danger of the thread snapping and the Lintine being left behind while closing the wound.

Sometimes, there is persistent oozing from the upper or lower ends of the wound at the plane of separation between the muscle and bone. It is wise to pack this area with a long moist swab and clip the other end of the swab to the towel. Four such swabs at the four corners can control venous oozing which can sometimes be quite troublesome. Oozing from the nibbled bone edges can be stopped by the judicious use of bone wax. After waxing the raw surface of the bone, special care should be taken to remove all small pieces of wax in the epidural space.

EXCISION OF THE DISK

Having thus exposed the bulging annulus in a bloodless field and retracting the nerve root gently, a circular incision is made into the disk space through the protruding annulus with a 11 blade knife. The degenerated disk material is usually under tension and extrudes under pressure.

As much of the degenerated disk material as possible is removed with pituitary punches. Different sized punches are useful. Angled punches are especially helpful to remove disk material just beneath the ligament adjacent to the opening made by the surgeon. I find it quite useful to pass the knife into the disk space and deliberately incise degenerated disk material and then remove it with punches. The overhead light should be powerful and properly positioned so that the surgeon can see well into the disk space. A curette is also quite useful to detach degenerated disk material. Unless one is careful, it is not that difficult to penetrate the anterior boundary of the disk space and get into the retroperitoneal space especially when the annulus is degenerated anteriorly also. There are several reports in the literature of injury
to the eat vessels by this route and a few of injury even to the intestine and ureter.

It is a very good habit for the surgeon to control the pituitary rongeur or the bone nibbler with the left hand while using the instrument actively with the right. This doublehanded maneuver should become automatic for the neurosurgeon working at the depth and on delicate structures. It prevents sudden movement of the instrument at depth and eliminates minimal tremor of the hand. This is of course more obvious while using the microscope.

**EXPLORING THE OPPOSITE SIDE**

I always make a point of exposing the opposite nerve root in the same disk space and even if there is a mild bulge, repeat the operative procedure on that side after retracting the nerve root. Occurrence of symptoms of nerve root compression on the other side after unilateral nerve root decompression is not infrequent. For some unknown reasons, the little degenerated disk material which has been left behind prefers to come out and compress the opposite nerve root rather than occupy the space cleared by the surgeon. It is also surprising how much more degenerated disk material one can take out from the opposite side after an apparently thorough clearing of the disk space from one side.

**FULL DECOMPRESSION OF THE NERVE ROOTS**

Both the nerve roots are then followed up to the intervertebral foramina and the bone posterior to the roots is nibbled away. Special care should be taken not to compress the root by the surgeon's instrument during this nibbling. Special care should also be taken to disturb the epidural fat round the nerve root as little as possible.

On occasion, one will find that even after excising the disk, the nerve root is riding over a hard bar which forms the inferior or medial border of the circular opening made into the disk space by the surgeon. This ridge must be excised and smoothened out. Very rarely, I have had to use a narrow osteotome and chisel to do this but such an occasion is indeed very rare. The important point is that right from the dural tube to the intervertebral foramen, the nerve roots should be completely free of pressure from disk, bone, or distended veins.

At this stage or even a little earlier during the operation, it is a good practice corelax the self-retaining retractors applied to the muscle and to the skin incision. This prevents ischemia due to prolonged pressure.

**THE CALCIFIED DISK**

This is one of the most difficult lesions to deal with. The root is often inflamed and adherent to the disk and requires careful separation. It may not be possible to incise into it with an ordinary knife. Narrow osteotomes and chisels may be needed to excise the protrusion and to open into the disk space. Of course, very great care has to be exercised to avoid injury to the dura and the nerve root.

**EXPLORING THE ADJACENT DISK SPACES**

If the myelogram shows only a small filling defect in the lateral view in the adjacent disk space, I do not expose that space unless there are clinical signs and symptoms referable to the nerve roots of that space. If the myelogram shows a large defect in the center (in the lateral view) or laterally (in the anterior view), I expose that space also and excise the degenerated disk in an identical manner.

If there is extensive lumbar canal stenosis, I remove at least three laminae and give a full decompression.

**PRECAUTIONS BEFORE CLOSURE**

I avoid using gel foam for hemostasis in the epidural space. Even if I am forced to use it for troublesome oozing, I try if I can take the bits off before closure. If there is rebleeding, I put back as few and as small bits as is compatible with good hemostasis. The free fat grafts taken earlier are placed round the nerve root, especially if it is close to a roughened bone edge or a large plexus of diathermized veins.

The anesthetist is asked to raise the intraspinal pressure to check for any inadvertent puncture of the dura. He is also requested to check the BP. If the systolic BP is well below the normal pressure, wound closure should be started only after BP rises. Then all small bleeding points can be cauterized in the muscle layer.

**SPEED OF SURGERY**

I remember, 25 years ago when I was still a novice in some ways, I took a bet with our theater sister that I will finish a disk operation skin to skin in 45 minutes. She had wanted the case cancelled as she had bought tickets for the evening show in a nearby theater and we were starting the case at 3 pm. I finished the case in 40 minutes. The patient continues to be alright not because of my surgical skill but because of the grace of God. This is the one case of disk operated by me which I am ashamed of. One should never hurry in disk surgery. Nowadays, I am proud that I take usually 2 hours and frequently even longer to do a lumbar disk excision. Unless the surgeon is very experienced, the anesthetist is perfect, the patient is very lean, and the theater sister and the assistants are brilliant, any time less than 1.5 hours is to take a risk of doing an inadequate job.
OPENING THE DURA

If there is any suspicion of the possibility of intradural lesion, the dura should be opened. I had the unique experience of a large disk and neurofibroma occurring at the same level in a patient. Both were excised at the same sitting and the case was reported in our Society’s journal. I had another case where a very large disk was excised by an orthopedic surgeon who did not give enough importance to a CSF protein of more than 150 mg%. Three weeks later, I removed an intradural neurofibroma situated 0.5 inch above the level of the excised disk.

CLOSURE OF THE WOUND

Before closing the wound, the disk space is filled with garamycin solution and all the layers sprayed with the same solution. The muscles are dosed in three layers with interrupted silk stitches and the skin incision in two layers.

If there is a lot of oozing, it is wise to place all the stitches of one muscle layer in position, check for hemostasis and then tie them.

DRESSING

The dressing should be bulky with several layers of pads with cotton so that the patient can lie on his back without too much discomfort and if there is any soiling of the dressing while passing urine or motion, it will be confined to the superficial layers till the dressing is changed.

CONCLUSION

Long ago, Rodney Maingot wrote about abdominal operations that the surgeon should be radical in exploration but conservative in excision meaning that exploratory laparotomy should be done even for mild indications, however, resection should be done only for very definite indications. For disk surgery, I would say the opposite: “Be conservative in exploration but radical in excision.” Do not open up the spine in a case of disk protrusion unless there is a very definite indication to do so: But having opened up, please ensure that the nerve roots are adequately decompressed.”

SUGGESTED READINGS