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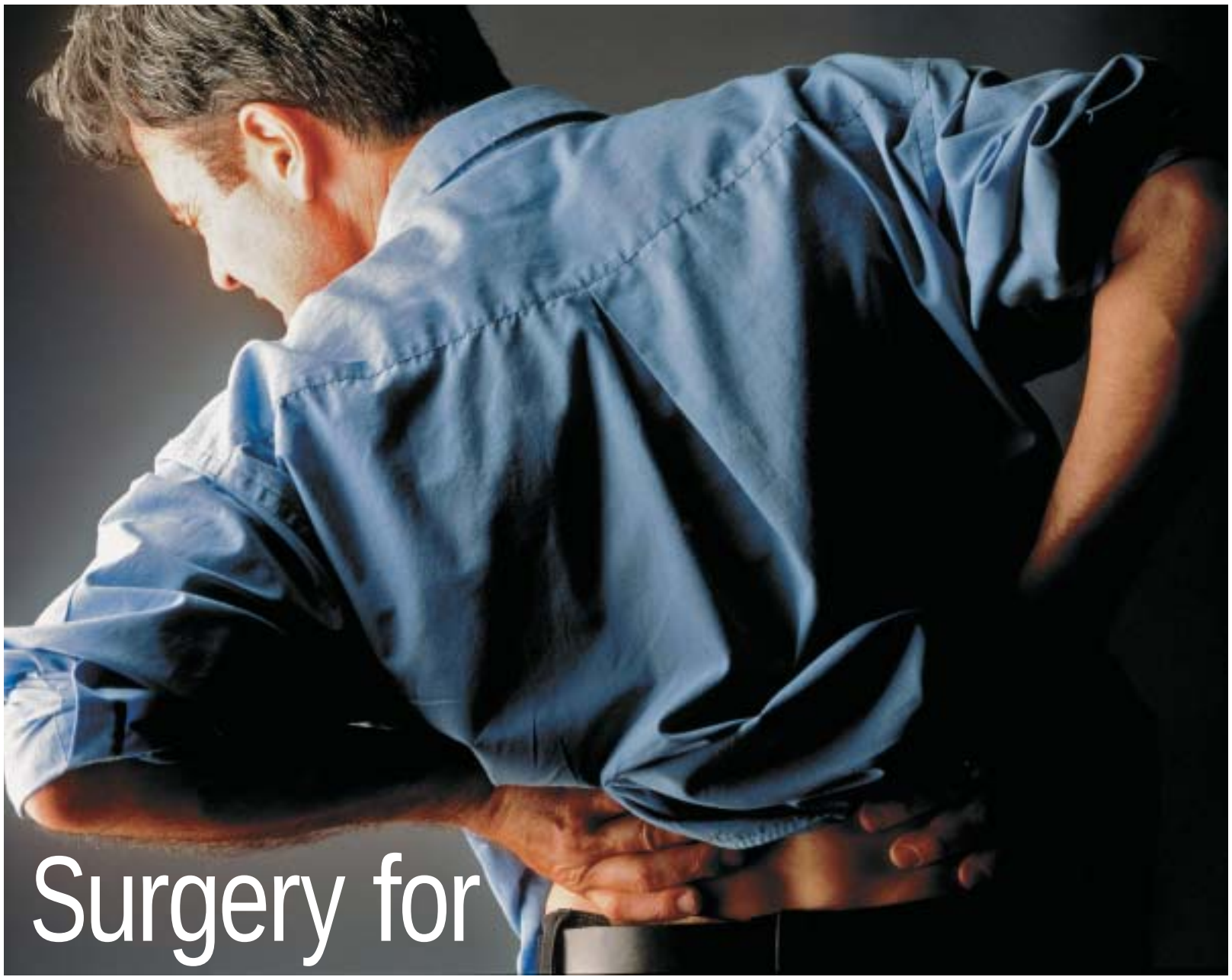

Surgery for LOW BACK PAIN

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Background

LOW back pain is an important but difficult-to-treat condition. It may cause significant disability in otherwise healthy individuals, have major social ramifications, consume a large proportion of the health dollar, and is second only to URTIs as a cause of visits to the doctor and lost time from work.

Despite advances in medicine and improvements in occupational health, disability from low back pain is increasing. Fortunately, most cases are self-limiting, resolving within weeks with simple treatment. Chronic back pain, defined as symptoms continuing beyond three months, is more problematic. Unlike conditions such as hip arthritis, surgery is not the definitive solution.

Surgery for back pain has traditionally been in the form of a spinal fusion. This operation has its origin in treatment of spinal deformity such as scoliosis, as well as conditions causing spinal instability, such as tumours, fractures or infections.

Its expansion to encompass back pain has not been without difficulty. In the past, the combination of unsophisticated imaging methods, an incomplete understanding of the causes of back pain, and inelegant surgical techniques, meant that success after back pain surgery was the exception rather than the rule.

With advances in diagnostic and surgical techniques, and greater understanding of the condition, results have improved. Consequently, surgery and other procedural interventions do have an important role to play in a small, carefully selected group of patients.

Causes of low back pain

THERE is no universal agreement about the cause of back pain, partly because the many different health care professionals involved in back pain care have fundamentally different backgrounds and philosophies.

The medical model

The traditional medical model used by doctors and based around the concept of a 'disease' diagnosed using history, clinical examination and investigations, falls short when applied to low back pain. Back pain is not a discrete diagnostic entity but a symptom, and its presentation is influenced by external non-organic factors such as compensation or litigation, coexisting depression, and social and cultural differences.

Both pain and the resultant disability vary greatly among individuals. Although investigations often identify some 'degeneration' it can be difficult to distinguish between non-specific age-related changes and discrete pathological processes. Using the medical model, it has been estimated that only 15% of patients have an accurate diagnosis made for the cause of their back pain.

Axial back pain

Although most patients with back pain have non-specific clinical and imaging findings, there are several defined 'syndromes' (see table 1). Before back pain can be attributed to benign mechanical causes (ie, pain arising from the spine and its supports), more serious causes of pain need to be excluded, such as the following.

Trauma

Vertebral crush fractures in patients with osteoporosis and the elderly are often overlooked. The degree of pain can be severe and is not related to the degree of vertebral compression. Until recently, only symptomatic treatment could be offered, but with the advent of vertebroplasty (see p29), near-complete pain relief can often be achieved.

Infection

The diagnosis of discitis and vertebral osteomyelitis, both rare but important conditions, is almost invariably delayed, often by months. The classic triad of severe non-mechanical back pain, local tenderness and fever is usually present, and a raised ESR signals the diagnosis. Risk factors include diabetes, compromised immunity, recent spinal injection or surgery, and intercurrrent infection (usually UTI or skin). Neurological deterioration can be rapid, requiring urgent identification and treatment.

Table 1: Classification of causes of back pain

Type	Age	Pathology	Symptom/pattern	Leg pain	Signs	Imaging
Discogenic	40s	Disc degeneration, with loss of nuclear water content, annular tears and end-plate reaction	Constant dull ache worse on sitting	Referred into buttock or thigh; sometimes neurogenic pain from irritation of nerve root	Painful reduction of flexion	**Plain X-ray:** narrowed disc space with end-plate sclerosis. **MRI:** loss of signal intensity in disc (T2), high-intensity zone in posterior annulus, end-plate reactive changes. **Discogram:** reproduction of pain on injecting disc in question
Facet related	50s	Typical osteoarthritic changes in facet joint	Sharp catching pain; worse on movement	Pain extends into buttock, thigh or groin	Tenderness over facet joint; pain on extension	**CT scan:** facet joint sclerosis, narrowing and hypertrophy. **Bone scan:** focal increased uptake in facet joint. **Diagnostic facet injection:** relief of pain on injection of local anaesthetic into joint
Instability related	60s	Degeneration allowing forward slip (spondylolisthesis) or lateral slip (scoliosis); often associated nerve compression (stenosis)	Combination of discogenic and facet-related symptoms	May be referred but often radicular due to associated nerve compression	Scoliosis; neurological deficit sometimes	**Plain X-ray (standing):** extensive degeneration with spondylolisthesis and/or scoliosis. **CT or MRI:** stenosis and/or degenerative disc prolapse
Non-specific	Any	Unclear — may be musculoligamentous	No constant pattern	Sometimes	Stiff tender spine	Normal or widespread mild degenerative change

Figure 1: Plain X-ray of L5-S1 isthmic spondylolisthesis demonstrating pars defect (arrow), forward slip of L5 on S1 and intervening disc space narrowing.

Figure 2: Sagittal T2 MRI showing L5-S1 disc degeneration with loss of disc height and signal intensity, and adjacent vertebral end-plate reactive changes (arrows).

Tumour

Patients often fear having a spinal tumour, and doctors often fear they will miss one. Most tumours affecting the spine are metastatic from breast, prostate, lung and kidney, or from multiple myeloma. Suspicion should be raised in patients over 50 who have severe pain without precipitants, night or rest pain, and a history of cancer.

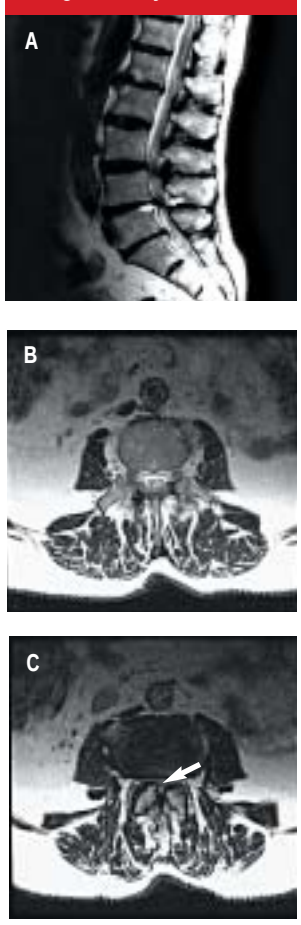
Spondylolysis and isthmic spondylolisthesis

These related conditions have variations in their genesis but are classically related to developmental weakness of the pars interarticularis (usually L5) and are aggravated by extension activities that increase the load on the pars.

Most often a stress fracture occurs in the pars (a spondylolysis) between age 6-10, often without excessive pain and usually not diagnosed at the time. Less often an acute fracture occurs in the pars, especially in a young teenager during a stressful sporting activity such as fast bowling or gymnastics.

The defect in the pars allows the L5 vertebra to slip forwards on S1 (called an isthmic spondylolisthesis [figure 1]), which can be associated with acute low back and sometimes leg pain. The increased strain on the L5-S1 disc leads to premature degeneration (figure 2), which can become symptomatic in young adults. The combination of the slip and disc degeneration can also lead to narrowing of the exit foramen for the L5 nerve root and sciatica.

Figure 3: A: Sagittal T2 MRI showing canal narrowing. B: Axial T2 MRI showing normal canal diameter. C: Axial T2 MRI showing narrowed canal (arrow) with enlarged facet joints.



However, most patients with spondylolysis, and many with spondylolisthesis, are asymptomatic. Isthmic spondylolisthesis is different to degenerative spondylolisthesis, a condition caused by facet joint degeneration in older adults, usually at L4-5.

Neurogenic pain

True low back pain is usually mechanical in nature and related to alteration in structure or function of the discs, facet joints or musculoligamentous elements of the spine. Neurogenic pain occurs when the lumbar nerve roots are affected by irritation, inflammation, tension or compression (radicular pain or sciatica).

Confusion about the cause of pain arises because axial back pain can be referred into the lower limbs, and neurogenic pain can be felt in the back as well as in a dermatomal distribution. Nonetheless, it is important to distinguish axial back pain from neurogenic leg pain, although these conditions often coexist and their clinical features overlap.

Radicular pain is usually well defined, felt in a roughly dermatomal distribution (usually below the knee), often accompanied by numbness or pins and needles, and may be associated with weakness and loss of reflexes. Referred back pain is usually less specific, not associated with a neurological deficit, and rarely extends beyond the knee.

True neurogenic pain is often accompanied by back pain. For example, disc prolapse causing sciatica is often accompanied by back pain because the disc prolapse is almost universally associated with painful disc degeneration.

During degeneration, circumferential tears of the annulus occur and coalesce into a radial tear, allowing herniation of the nucleus pulposis. Direct irritation of the dura by the prolapse can also cause back pain.

In the so-called adolescent disc prolapse the symptoms are a little different to those associated with prolapse in adults: there is a predominance of back pain, and leg symptoms are often limited to altered sensation and restriction of straight-leg raising.

Patients with spinal stenosis (figure 3) often have coexistent back pain. A combination of loss of disc height and associated disc bulging, together with facet joint degeneration and associated osteophyte formation, and ligamentum flavum hypertrophy, cause a reduction in the size of the canal, leading to compression of the nerve roots.

Clinically, spinal stenosis manifests as neurogenic claudication, with increasing leg heaviness, numbness, tingling and weakness on walking that is relieved by stooping or sitting. Back pain is an almost constant accompanying symptom because of the degeneration that leads to the stenosis.

Referred pain

Back pain can also arise from adjacent structures. For example, hip arthritis can be felt in the buttock and groin, so assessment of hip range of movement is an important part of the low back examination. The sacroiliac joint can also give rise to back pain, although pain is typically felt in the 'root of the limb' in the buttock and groin, often with radiation down the thigh.

Appropriate investigations

LOW back pain is often excessively and inappropriately investigated. X-rays or scans may be ordered without good clinical reason at the insistence of the patient, or to avoid 'missing something'. Although imaging can be used to reassure the patient that there is nothing seriously wrong, misinterpretation of age-related changes as serious pathology can cause unnecessary concern.

Plain X-rays

Plain X-rays have a very low yield in uncomplicated back pain and rarely change management in the general practice setting (table 2). Their main role is to assess bony anatomy and instability in the form of spondylolisthesis or scoliosis. Standing anteroposterior and lateral films are important as part of the preoperative workup.

CT scan

CT scans tend to be overused in patients with low back pain. Although they can help identify conditions such as disc prolapse or spinal stenosis and exclude tumour or infection, they have little to offer unless low back pain has a neurogenic component or 'red flag' symptom (table 2).

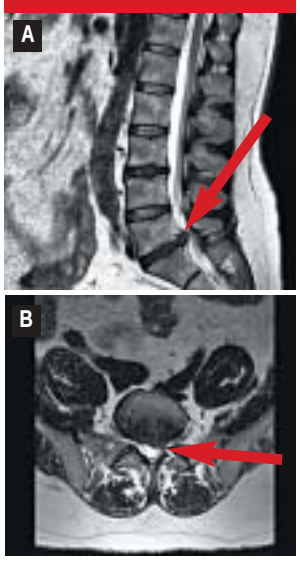
Also, older CT scanners provide poor-quality images with limited diagnostic value.

Table 2: Guidelines for the use of plain X-ray in low back pain*

- Plain X-rays are not recommended for routine evaluation of patients with acute low back problems within the first month of symptoms unless a red flag is noted on clinical examination (see next point).
- Plain X-rays of the lumbar spine are recommended to rule out fractures in patients with acute low back problems when any of the following red flags are present: recent significant trauma (any age), recent mild trauma (patient over age 50), history of prolonged steroid use, osteoporosis, any patient over age 70.
- Plain X-rays in combination with FBC and ESR may be useful for ruling out tumour or infection in patients with acute low back problems when any of the following red flags are present: previous cancer or recent infection, fever over 37.8°C, IV drug abuse, prolonged steroid use, low back pain worse with rest, unexplained weight loss.
- In the presence of red flags (especially for tumour or infection), other imaging studies such as bone scan, CT or MRI may be indicated even if plain X-rays are negative.
- The routine use of oblique views on plain lumbar X-rays is not recommended for adults in light of the increased radiation exposure.

*Adapted from: Agency for Health Care Policy and Research. *Clinical Practice Guideline 14: Acute Low back problems in adults*. Publication No. 95-0642. US Department of Health and Human Services, Rockville MD, Dec 1994.

Figure 4: A: Sagittal T2 MRI showing prolapse at L5-S1 (arrow). B: Axial T2 MRI demonstrating left S1 nerve root compression (arrow).



For preoperative investigation, a high-quality helical CT scan with the ability to provide sagittal and 3-D reconstruction is useful to delineate bony detail for planning instrumentation.

Bone scan

Bone scans have a limited role and are usually used to detect and provide information about chronicity of fractures and pars defects, or to exclude a vertebral tumour.

MRI

Restricted access to MRI (through Medicare rebate limitations) helps avoid overuse but probably increases the inappropriate use of other modalities. The advantages of MRI lie in the provision of soft tissue detail, especially of discs and nerves, and the ability to provide sagittal images of the whole lumbar spine (figure 4).

MRI gives information about the water content of the disc, implying the degree of degeneration, and can effectively identify tumour, infection and fracture. It is usually part of the preoperative workup.

Discography

Discography is controversial. It is painful, invasive and subjective, relying predominantly on the patient's pain response to the injection of dye into a disc that is a presumed pain source. It should be strictly used as a preoperative investigation to confirm the level of a planned fusion or disc replacement, and is not a screening test.

The role of injections in diagnosis

Facet joint

The role of the facet joint as a pain source is debatable. The fact that it is a synovial joint draws parallels with other synovial joints, where osteoarthritis can cause pain. When the clinical picture suggests facet-related pain, a diagnostic injection under image guidance (using CT or fluoroscopy) can help confirm the diagnosis.

Some long-term benefit may be achieved by injection of a combination of long-acting local anaesthetic and corticosteroid, and immediate benefit from the local anaesthetic suggests the facet joint is contributing to the pain. Ongoing benefit from the steroid is variable and ranges from negligible to complete relief for months. If effective, the procedure can be repeated.

There is a tendency to use facet joint injections less selectively in some particular settings, especially chronic pain. Apart from the cost, the procedure is invasive, although serious complications are rare. Research shows that facet joint injections rarely provide significant long-term improvement in chronic back pain.

Nerve root

A nerve root injection or 'block' is performed in the same way as a facet joint injection, except that the needle is directed into the nerve root foramen. It is often used to confirm that a particular nerve root is contributing to sciatica, particularly when there are multiple potential levels of compression or when the degree of compression on imaging is inconsistent with the clinical findings.

Nerve root blocks can also be used for therapeutic purposes such as treating a lateral or foraminal disc prolapse. Compared with the more common posterocentral prolapse, lateral prolapses are more difficult to access and respond less favourably to surgery. Fortunately, they also resolve spontaneously more often.

One to three nerve root blocks can accelerate recovery by shrinking the prolapsed disc and improving nerve root inflammation. Blocks are less effective for posterocentral prolapses because the site of compression is within the canal, well away from the injection.

Nerve root injections can also be used for persistent sciatica after decompression surgery, when postoperative imaging fails to explain the pain.

Percutaneous interventions

Epidural

EPIDURAL injections using local anaesthetic and cortisone are most effective for treating radicular symptoms and are often used to treat spinal stenosis. They can be administered by the lumbar interlaminar route, or caudally through the sacral hiatus; the latter tends to deliver steroid more effectively to the caudal nerve roots, although neither route is clearly more effective.

Although they can also be used for sciatica caused by acute disc prolapse, benefits are variable.

Risks of the procedure include temporary aggravation of symptoms; inadvertent lumbar puncture, with resulting headache; and, rarely, epidural haematoma or abscess.

The role of epidural injection for axial back pain is less clear. Severe back pain and diffuse leg pain occur in some cases of acute discogenic pain (the so-called internal disc disruption), presumably from an annular tear causing intense disc and adjacent nerve root irritation.

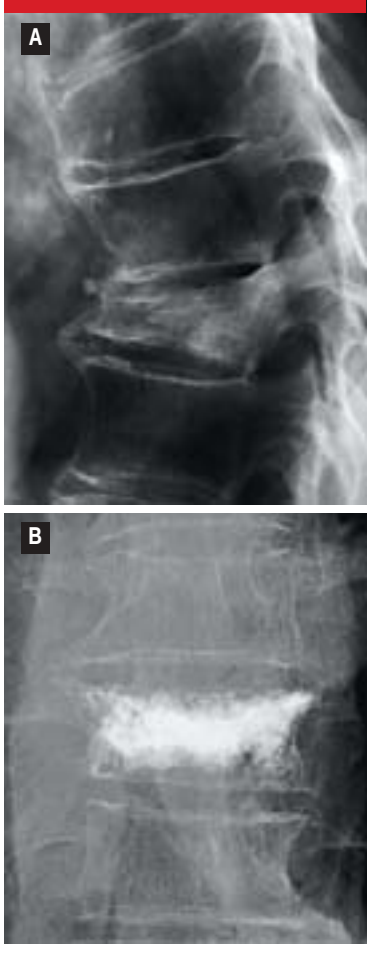
In these cases, epidural injection can temporarily relieve symptoms and perhaps hasten recovery, but there is little evidence to support routine use of epidurals for back pain.

Radiofrequency neurotomy

When facet joint injections have been effective, the sensory nerves supplying the facet joints (the medial branches of the dorsal root ramus) can be divided. Diagnostic local anaesthetic blocks of the medial branches are often performed first and, if successful, facet denervation by electrocoagulation is performed under image guidance, using a needle carrying a radiofrequency current.

Research results vary enormously. In carefully selected patients the procedure has a reasonable chance of giving some relief, although symptoms may recur after 18 months or so, presumably from nerve regeneration.

Figure 5: A: Lateral X-ray of a typical thoracic osteoporotic crush fracture. B: Anteroposterior X-ray of a thoracic vertebra treated with vertebroplasty, showing filling of the vertebral body with radiopaque bone cement.



Intradiscal electrothermal therapy

This new technique for discogenic pain proven on discogram received initial enthusiasm but recent clinical trials have questioned its value. Under image guidance a wire is passed into the annulus and directed around the whole periphery of the disc, in close proximity to the presumed painful annular disruptions.

An electric current is passed through the wire, coagulating the adjacent annulus. Proponents reported excellent relief of pain but most trials have not been able to reproduce the results, with a subsequent decline in popularity.

Chymopapain chemonucleolysis

Chymopapain injections into the disc have been used in the past to treat sciatica secondary to contained disc herniation. By enzymatically denaturing the disc, the nucleus pulposis is softened and the pressure in the disc prolapse reduced, thereby decreasing nerve root pressure.

Although moderately effective (less so than standard discectomy), its rare but serious side effects (including anaphylaxis and neurological injury) have seen its use virtually discontinued. It has no role in the treatment of axial back pain.

Percutaneous discectomy

Automated percutaneous lumbar discectomy (APLD) has similar indications to those for chymopapain and involves insertion of a large cannula into the disc, with the patient sedated, using fluoroscopic guidance and mechanically removing pieces of nucleus pulposis to decrease the pressure of the prolapse. It is safer than chymopapain injections but even less effective, with a similar decline in use over recent years.

Vertebroplasty

This technique involves injection of cement into the vertebral body (figure 5). It is primarily indicated for osteoporotic crush fractures but can also be used for tumours when resection or stabilisation is not feasible.

In cases of osteoporosis, the procedure is usually delayed for at least six weeks, as many fractures become largely asymptomatic in this time. It is not indicated for old healed fractures.

Although the age of the fracture can be assessed on bone scan, MRI is more useful. The short TI inversion recovery (STIR) sequence is very sensitive, demonstrating oedema in an acute fracture as a bright signal. Often, subtle fractures not seen on X-ray are also detected.

Vertebroplasty is carried out under image guidance, either in theatre or in the radiology department, and usually with the patient sedated. A hollow needle is inserted into the vertebral body (or bodies) and liquid bone cement is injected. Injection technique is crucial, as the cement can extravasate into the spinal canal, with disastrous consequences such as nerve injury or paralysis.

The risk can be minimised with careful injection and constant monitoring of the spread of opaque cement on imaging. The procedure is effective in about 80% of cases and sometimes pain relief is instant and complete.

A modification of this technique, called kyphoplasty, uses a balloon to first expand the vertebral body, correcting some of the deformity and making room for the cement. It is a more complex procedure and results to date have not shown a clear advantage.

Surgical interventions

Neurogenic symptoms

Nerve compression needs decompression

NEUROGENIC pain responds well to surgical decompression in the form of discectomy or laminectomy. However, the effect of these techniques on back pain is variable and decompression is *not* indicated for treatment of axial back pain.

Mini-discectomy for disc prolapse Open mini-discectomy (with or without use of a microscope) has become the accepted procedure for the treatment of sciatica due to disc prolapse. Using a small skin incision, the interlaminar space is opened, the nerve root retracted and the herniated portion of the nucleus pulposis is removed, with most of the disc left intact. The procedure takes about an hour and can be performed as a day case.

Relief of leg pain occurs in >90% of suitable cases (see table 3). There is a 5-15% incidence of recurrent disc prolapse needing further surgery, and an incidence of nerve injury or serious complication of <1%.

Mini-discectomy provides variable relief for the back pain associated with nerve compression. However, discogenic back pain is usually unchanged and occasionally worsened by this procedure. Many disc prolapses do not cause sciatica, and removal of the disc in the hope that back pain will be alleviated is not indicated.

Disc bulge is overestimated by CT scans, over-reported by radiologists and over-rated as a significant entity. As the normal disc ages, the central nucleus pulposis acts less as a 'sponge'. Water content and turgor decreases and there is loss of disc height, accentuated by associated degenerative tears of the annulus.

The result is concentric disc bulging, similar to a partially deflated car tyre. However, the presence of disc bulge does not signify pathology causing back pain, nor does it cause nerve compression and does not warrant discectomy.

Laminectomy for spinal stenosis Decompression of the spinal canal by removal of the posterior elements with laminectomy is a reliable way of treating symptomatic spinal stenosis: 80% of patients achieve good relief of sciatica and neurogenic claudication.

Although minimally invasive procedures have been tried, the accepted procedure for multilevel stenosis is to completely remove several laminae over the length of the compression. Infrequent but serious complications include nerve root injury; removal of excessive bone, leading to instability; and postoperative haematoma with cauda equina injury.

Like discectomy, laminectomy may improve the neurogenic component of back pain and sometimes decrease pain associated with facet joint degeneration through osteophyte removal and partial denervation. However it is not a reliable treatment for axial back pain and should not be undertaken in the absence of a significant radicular component to pain.

The role of fusion in neurogenic pain With few exceptions, there is no place for fusion either as an adjunct to discectomy for treatment of sciatica, or as an adjunct to laminectomy for spinal stenosis, unless coexistent instability contributes to canal narrowing and requires additional intervention.

When there is associated degenerative spondylolisthesis or scoliosis, laminectomy alone may cause worsening of deformity and lead to renewed nerve compression, so a fusion is added to the decompression.

Table 3: Indications for discectomy

Leg pain present for more than six weeks	Nerve root irritation is due to a combination of nerve root pressure and inflammation. In the early phases, inflammation predominates, explaining why many patients improve in the first few weeks, as inflammation subsides. Surgery in this phase can actually initially aggravate symptoms. After the inflammatory phase settles (six weeks or so), compression is the main cause of pain. This can be successfully alleviated with surgery, although spontaneous resorption of the disc can also occur, but at an unpredictable rate.
Leg pain greater than back pain	Discectomy can predictably relieve leg but not back pain, meaning that leg pain needs to be the major symptom for surgery to yield good results.
Leg pain in a radicular distribution	Back pain is often associated with referred leg pain. This differs from true radicular pain in that it is widespread and poorly defined. Only true radicular pain is likely to be relieved with discectomy.
Nerve root compression signs	It is helpful to confirm the diagnosis of radiculopathy if there are accompanying signs of nerve dysfunction such as sensory loss, weakness and reflex loss.
Nerve root tension signs	A reduced straight-leg raise strongly suggests the presence of a disc prolapse causing nerve root impingement. Even more reliable is a positive crossover test, when raising the opposite leg reproduces sciatica.
Presence of confirmatory imaging	CT or MRI showing the clinically suspected disc prolapse and associated nerve root compression.

Table 4: Ideal profiles of suitable and unsuitable candidates for back surgery*

SUITABLE CANDIDATE	UNSUITABLE CANDIDATE
■ Self-employed	■ Employee undertaking manual work
■ Successful business	■ Dissatisfied with employment
■ No specific injury	■ Unremitting pain after lifting at work
■ **No compensation or litigation**	■ **Unresolved compensation claim with civil action pending**
■ **Works with some difficulty**	■ **Failed attempts at return to work**
■ Has given up some of the more active sports	■ Has given up all social activities
■ **Uses intermittent over-the-counter analgesics**	■ **Uses regular narcotic analgesia**
■ Non-smoker	■ Smoker
■ Normal body weight	■ Unfit and overweight
■ **No abnormal illness behaviour**	■ Abnormal illness behaviour on examination
■ **Goal is to be able to return to active lifestyle**	■ Goal is for someone to get rid of their pain

*Highlighted factors are most significant

Figure 6: Minimally invasive posterior lumbar interbody fusion technique.

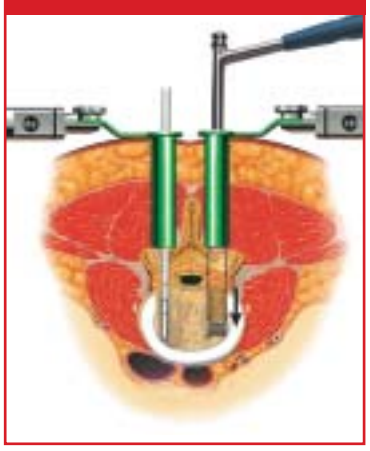


Figure 7: Surgery in the form of anterior interbody fusion with supplemental posterior pedicle screws, with partial correction of slip and disc height.

Axial symptoms

Does axial back pain warrant surgery?

Surgery is not a panacea for back pain. Indeed some have gone as far as accusing spinal surgery of "leaving more tragic human wreckage in its wake than any other operation in history".[1]

This attitude reflects the time when imaging and surgical techniques were less advanced, and long fusions were performed with unclear indications, leading to substandard outcomes and the associated morbidity of extensive muscle damage and large bone graft harvests.

It has become clear that surgery helps a small group of carefully selected patients who have a surgically treatable condition. Fusion is the mainstay of treatment in this group, but other procedures, including disc replacement, are emerging.

Patient selection

It is tempting for a surgeon, after seeing a series of very grateful patients whose incapacitating back pain has been remedied with surgery, to broaden their indications. Pleas of, "You've got to do something, doc!" or "Anything is better than this!", must be resisted, and strict selection criteria maintained.

Table 4 depicts the ideal surgical candidate compared with someone in whom surgery is likely to fail. Note that the nature of the spinal problem has not been included, reinforcing the point that selection criteria revolve more about the patient than the pathology.

Discogenic pain

Discogenic low back pain due to a single, significantly degenerate level may respond well to surgery (see below). The ideal situation is when the disc (usually L5-S1) is markedly narrowed on plain X-ray, and MRI confirms its degenerative nature and demonstrates that other discs appear normal.

However, the more intensively one has to look for the pain source, the less likely it is that surgery will help, ie, if a plain X-ray looks nearly normal and MRI shows only subtle degeneration (requiring a discogram to confirm the disc in question as painful), the chances of success through surgery diminish.

When there are multiple levels of degeneration, surgery also has less likelihood of success. With widespread degeneration, the odds are that there is a generalised intrinsic predisposition to disc degeneration rather than a defect in one particular disc, increasing the chance that degeneration will continue after surgery, at adjacent levels.

The more extensive the surgical procedure, the greater the biomechanical effect on the lumbar spine, including possible detrimental effects on other levels. Sometimes two-level degeneration is considered for surgery, but success in a three-level procedure is unusual.

Isthmic spondylolisthesis

When isthmic spondylolisthesis in teenagers causes uncontrollable pain that does not respond to usual conservative measures, surgery can give excellent results.

In adults, discogenic pain due to disc degeneration at the level of a slip warrants consideration for surgery. However, in the typical case of L5-S1 involvement, there are often early changes of degeneration at L4-5 on MRI, making it difficult to decide whether L4-5 should also be included in the surgery, as surgery for L5-S1 degeneration may accelerate changes at L4-5.

Facet-related pain

True facet-related pain is less common than discogenic pain, and surgery directed at facet degeneration is performed infrequently. Occasionally, when the clinical picture is typical and supported by imaging, surgery can be helpful.

Instability-related pain

Surgery for degenerative spondylolisthesis or scoliosis in association with canal stenosis has been discussed previously, but surgery for these conditions solely to alleviate back pain is less common. Back pain from degenerative spondylolisthesis can sometimes be improved by surgery, but often adjacent degeneration limits success.

Correction of degenerative scoliosis is a complex and extensive procedure, and the resultant pain relief may not be sufficient to warrant the procedure if done for back pain alone.

Techniques for axial back pain surgery

Fusion Varying methods of fusion surgery often give equivalent results, and surgeons will often choose a particular technique because of training and experience.

Posterolateral non-instrumented fusion This is the original fusion technique: it relies on laying down bone graft between the transverse processes and facet joints of adjacent decorticated vertebrae, with subsequent fusion of the graft. Deformity cannot be corrected, and successful bony fusion does not always occur.

This technique has largely been supplanted by newer ones (below) but it remains a useful procedure when correction of deformity is not required and use of screws and rods may not be desirable. An example would be a low-grade isthmic spondylolisthesis in a teenager.

Pedicle screw fusion Posterolateral fusion can be enhanced by adding fixation in the form of pedicle screws and rods, increasing the chance of fusion and allowing correction of deformity. However, there are potential drawbacks, including cost and an increased risk of complications.

Pedicle screw fusion is indicated in instability-related back pain, and together with laminectomy is the procedure of choice in degenerative spondylolisthesis with stenosis.

Interbody fusion An interbody fusion involves removing the whole disc, placing spacers and bone graft within the disc space, and restoring intervertebral height. Removing the disc is an advantage in treating discogenic back pain, as the presumed pain source is abolished.

Restoring intervertebral height allows correction of foraminal stenosis, decompressing the exiting nerve roots. It also helps in correcting deformity such as spondylolisthesis.

Posterior interbody fusion (figure 6). A posterior interbody fusion is performed from the back of the spine, accessing the disc space between the nerve roots, and is supplemented with pedicle screws.

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It is more complex and time consuming than a pedicle screw fusion alone and requires nerve retraction to insert the cages, with the potential risk of nerve damage. Damage to the paraspinal muscles that occurs secondary to muscle retraction can, in itself, cause back pain.

In particular, this procedure is indicated for foraminal stenosis when there is radicular pain from exiting nerve root compression. It can be used to treat discogenic back pain and is especially useful when it is not feasible to perform an anterior approach to remove the disc (see below).

Anterior interbody fusion (figure 7). When compared with posterior fusion, approaching the spine through the abdomen (an interbody fusion):

- Avoids the paraspinal muscle damage associated with posterior procedures.
- Significantly lessens the risk of nerve injury.
- May also lessen subsequent adjacent degeneration.

However, the approach is difficult and increases the risk of injury to abdominal contents and retroperitoneal structures, especially the aorta, vena cava and the iliac vessels that run over the vertebral bodies. It is also difficult in overweight patients or when there has been previous abdominal surgery with adhesions.

There is also a small but real risk of retrograde ejaculation (due to injury of the hypogastric plexus, which runs over the vertebrae), making it a less attractive choice in young males. It is primarily used for discogenic back pain.

Table 5: Advantages and disadvantages of disc replacement

Advantages	But …
Theoretically protects adjacent level from premature wear	No good evidence in the literature yet
Allows normal movement of spine	Loss of movement from single-level fusion minimal and not detectable by the patient
Minimal tissue damage with anterior insertion approach and no need for bone graft	Fusion can also be performed anteriorly using artificial bone graft
Disadvantages	**But …**
Disc is a moving part, so it can wear out	Theoretical wear rate low
Revision difficult because of abdominal vessel scarring	Revision not often required
Difficult to insert More expensive than fusion	Learnable skill Earlier discharge and return to work compared with fusion

Alternatives to bone graft in fusion surgery Despite advances in instrumentation, success is still largely dependent on solid bony fusion. Traditionally, the bone required has been 'harvested' from the iliac crest of the patient, the most common complication being long-term pain at the harvest site.

Bone morphogenic protein and hydroxyapatatite/calcium phosphate granules can be combined to mimic bone graft, but the cost is a drawback. Its use is increasing, with early studies showing results comparable to those of traditional bone graft.

Disc replacement The idea of replacing a worn disc rather than fusing it is attractive. Philosophically the concept of fusion is contrary to modern orthopaedics, as arthritic joints elsewhere in the body are now replaced to relieve pain and increase movement, rather than being fused. An alternative to fusion is also appealing to the patient, as spinal fusion does not generally have a good reputation.

There are several advantages and disadvantages of disc replacement compared with fusion (table 5). Although some proponents are reporting good early results, long-term advantages over fusion are unknown. It is important to remember that patient selection is just as important — someone who is not a fusion candidate is equally not a candidate for a disc replacement.

Emerging technologies

Interspinous spacer

THIS is a relatively new device, with very few published results. It is easily inserted between the spinous processes and limits rather than eliminates movement.

Biomechanically it partially unloads the disc and facet joints (potentially reducing discogenic and facet-related pain) and places the segment in kyphosis (increasing the canal diameter and improving stenosis). Its exact indications remain to be determined.

Nucleus replacement

Inserting something within the disc to reconstitute the worn nucleus holds great promise but the ideal design and composition has yet to be perfected, and clinical testing of different prototypes has not yielded good results.

Computer-aided surgery

An innovative technique has been developed to give the surgeon live intraoperative 3-D information about the spine, primarily to increase the safety of pedicle screw insertion. It guides the surgeon to the desired anatomical point and indicates structures along the way.

An infrared camera tracks a specialised surgical probe and superimposes a live image of the instrument on a computer screen over an X-ray of the patient's spine taken before surgery. Although expensive and somewhat time-consuming, ongoing refinements are likely to see this technology increasingly used.

Minimally invasive surgery

Minimising the wound size is appealing to the patient, but minimising associated muscle damage is more important. Two approaches allow this:

- Minimal access, or 'keyhole', surgery. Small incisions are made using a combination of X-ray guidance, computer assistance, video endoscopes and specialised instruments and implants. The drawback is that the skills required are quite different to those of traditional techniques. They rely on two-dimensional information from X-ray screens and video monitors, which necessitates training and experience, an initial steep learning curve and associated costs.
- 'Less invasive surgery'. Specialised retractors allow small incisions to be combined with traditional open techniques under direct vision. The wounds are not as small as those in minimal techniques, but the requirement for retraining and equipment is less and the results are similar.

Author's case study

Back in the saddle again

A 39-YEAR-old cyclist presented with a 12-month history of severe left sciatica that was unresponsive to rest, NSAIDs and physiotherapy. The pain had worsened recently to the point where he could not cycle or work. He described pain in the low back that radiated down the left buttock, posterior thigh and calf, and numbness in the lateral part of the foot.

On examination he had signs of an S1 radiculopathy, with left-sided calf wasting and weakness together with an absent ankle jerk and decreased sensation on the lateral aspect of the foot. His straight leg raise was reduced to 30°.

An MRI (figure 8) showed degeneration in the L5-S1 disc plus a disc prolapse compressing the left S1 nerve root. He was advised that discectomy surgery was likely to improve his buttock and leg pain but not his back pain.

An uncomplicated mini-discectomy was performed as day surgery and the patient made an excellent recovery, returning to work and cycling. A year later he re-presented with continuing relief of leg pain but gradually increasing back pain that interfered with prolonged sitting and especially sleeping.

A repeat MRI showed progressive degeneration of the L5-S1 disc and mild degeneration of the L4-5 disc (figure 9). He was advised to continue intensive rehabilitation. He re-presented six months later with increasing pain wishing to discuss surgical options. A discogram (figure 10) caused reproduction of his pain at L5-S1, and only mild pain at L4-5.

He was advised that the L5-S1 disc was the most degenerate and fusion of this level was a reasonable option. However he was warned that the L4-5 disc showed mild degeneration, and fusion of this level as well could be considered. Because a two-level fusion was a more involved procedure (involving anterior and posterior surgery), he opted to have a single level anterior only fusion. An L5-S1 anterior lumbar interbody fusion was performed using a titanium cage (figure 11) filled with bone morphogenic protein-soaked collagen sponge, fixed with a titanium plate.

The procedure was uncomplicated and he was discharged <24 hours later. He resumed work at three weeks and at six-week review was pain free and able to resume gentle cycling. The long-term outcome remains to be seen but usually, early resolution of pain is associated with a good outcome.

Figure 8: The patient's preoperative MRI. A: T2-weighted axial section of L5-S1. B: T2-weighted sagital section.

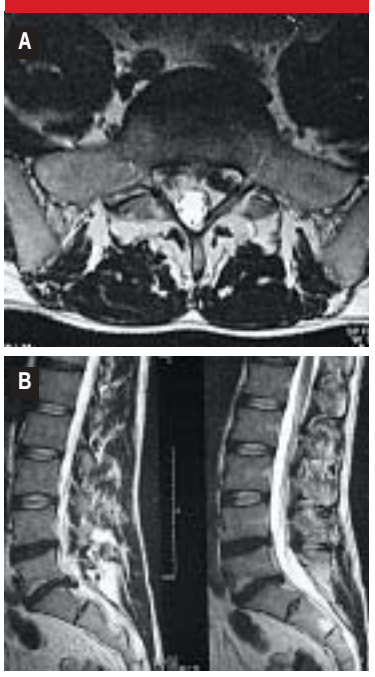


Figure 9: Progressive degeneration of the L5-S1 disc and mild degeneration of the L4-5 disc.

Figure 10: The patient's discogram.

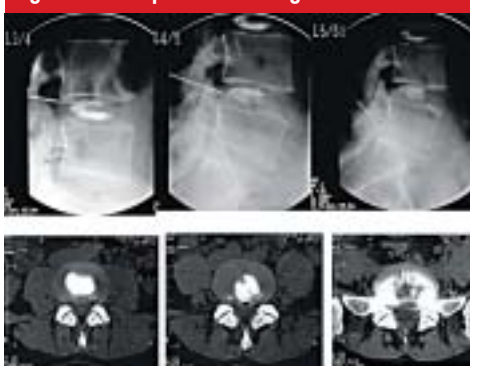
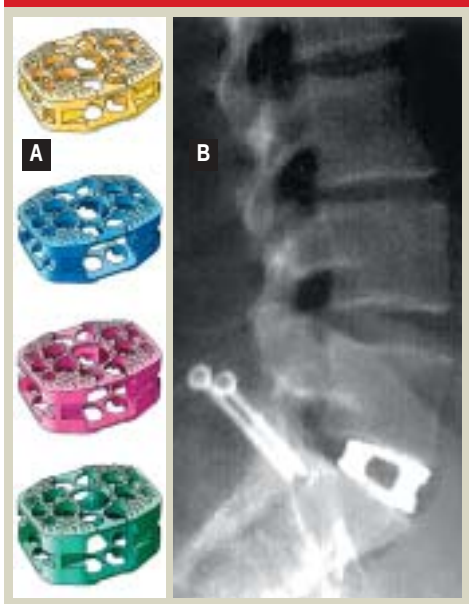


Figure 11: A: SynCage titanium alloy anterior lumbar interbody fusion implants (different colour for each size). The denticulated surface increases initial stability while the bone grows into the open structure. B: A Syncage in situ at L5-S1, with translaminar screw fixation. (Images courtesy of *SYNTHES* GmbH & Co. KG.)



Reference

1. DePalma AF, Rothman RH. *The Intervertebral Disc.* WB Saunders, Philadelphia, 1970.

Online resources

- Spine-health.com: www.spine-health.com
- SpineUniverse: www.spineuniverse.com
- National Library of Medicine, Medline Plus: Back pain: www.nlm.nih.gov/medlineplus/backpain.html

GP's contribution

DR MARTINE WALKER
Mosman, NSW

Case study

MANI, a fit and muscular 38-year-old carpenter, specialises in the laying of designer parquetry. He arrived in Australia 12 months ago from Austria and spends most of his working day kneeling on the floor and hammering, with his back flexed.

Eight months ago, he fell three metres onto his back and sustained an L1 wedge fracture with a 26% reduction in the anterior height of the vertebra in comparison to the posterior height. He was treated with rest and analgesia and a graded return to work. He continues to have physiotherapy once a week and goes to the gym three times a week.

He continues to experience significant pain in his back after only 30 minutes of kneeling work and is unable to drive more than 30 minutes without pain. The pain is localised to his back at the site of the fracture, and he denies any leg pain.

There is a visible hump and bony protrusion at the L1 level, but no tenderness. Mani has full flexion of his back and is able to touch his toes. Neurological examination of his lower legs is normal.

Mani's previous GP declared him fit for full duties three weeks ago but he is very unhappy about this. He is very bitter that he has, through no fault of his own, been left with significant limitation to his ability to work. He says he enjoys his job and is not yet ready to be relegated to paperwork. He wants me to advocate on his behalf.

Questions for the author

Should Mani have received alternative treatment at the time of his injury? If so, what?

Probably not. It is most likely that Mani suffered a simple crush fracture, with loss of anterior vertebral height but no disruption to the spinal canal. It is possible that he had a more serious burst fracture,

which can potentially cause neurological injury or spinal instability; however, it does not seem to be the case in Mani's injury.

Almost all crush fractures and most uncomplicated burst fractures are treated non-operatively, with return to activities as pain subsides. The role of a brace is mainly for pain relief in the initial weeks.

Apart from manual therapy (eg, physiotherapy, chiropractic, osteopathy) are there any injection or other non-surgical treatments I could suggest?

It is possible to consider vertebroplasty but at eight months from injury it is likely that the fracture has healed and therefore the procedure would be unhelpful. An MRI would help to determine his suitability.

Are there any surgical options for Mani?

It is unlikely. The only time surgery would be used at this stage is if Mani had spinal instability with an increasing kyphotic deformity. If this were the case, major reconstructive surgery would be required. Surgery for back pain in an uncomplicated fracture rarely yields good results.

Keeping in mind that Mani has many 'yellow flags', how likely is it at this stage that we will achieve significant improvement?

It is estimated that, after such a fracture, one-third of patients recover completely, one-third have limitations with more active recreational pursuits but can resume employment, and one-third do not return to work or sport. It is usually clear at six months which category someone will fit into, and at eight months from injury it is unlikely that Mani will improve significantly.

General questions for the author

In older patients it is often difficult to differentiate neurological claudication from vascular claudication. How is it best to make this distinction?

Neurogenic claudication is:

- Usually associated with pain from the low back into the buttocks and posterior thighs extending into the calves, rather than just in the calves.
- Usually associated with pins and needles and tingling.
- Eased only by sitting or leaning forward rather than just stopping and standing.

There is usually a history of back pain, and pedal pulses are usually present. CT or MRI demonstrates significant spinal canal narrowing. However, spinal and arterial stenosis can coexist, making the distinction less clear.

In a young patient with severe radicular leg pain, what is the usual time frame for the pain to settle?

Symptoms generally begin to ease within four weeks and are tolerable within six weeks. They have usually resolved within three months. If they have not settled within this time frame, they are likely to persist for some months.

What is the role of manual therapy in axial and radicular back and leg pain? Can these treatments aggravate radicular pain?

Manual therapy has been shown to be beneficial for *acute axial* low back pain. There is little evidence that chronic back pain benefits in the long term from manual therapy. There is no indication for manual therapy in radicular pain.

Any improvements seen were likely to have occurred anyway with the passage of time, and manipulation can worsen a disc prolapse and increase radicular symptoms.

At what point or with what features should we refer a patient for consideration of nerve root injection or surgery?

Acute cauda equina syndrome should be referred immediately. Severe sciatica with true radiculopathy can be referred after four weeks, when it appears clear that symptoms are not settling of their own accord.

How to Treat Quiz

Surgery for low back pain — 12 May 2006

INSTRUCTIONS

Complete this quiz to earn 2 CPD points and/or 1 PDP point by marking the correct answer(s) with an X on this form. Fill in your contact details and return to us by fax or free post.

FAX BACK	FREE POST	ONLINE
Photocopy form and fax to (02) 9422 2844	Australian Doctor Education Reply Paid 60416 Chatswood DC NSW 2067	www.australiandoctor.com.au/cpd/ for immediate feedback

1. Which THREE non-mechanical causes should be considered in the differential diagnosis of back pain?
- ❑ a) Vertebral crush fractures
- ❑ b) Infection
- ❑ c) Isthmic spondyolisthesis
- ❑ d) Tumours

2. Which TWO statements about back pain are correct in general?
- ❑ a) Pain that is facet related is usually sharp and worse with movement
- ❑ b) Instability associated with conditions such as scoliosis and spondylolisthesis rarely causes radicular pain
- ❑ c) Nearly all patients with a spondylolysis complain of low back pain
- ❑ d) Discogenic pain is usually dull and worse on sitting

3. Sven, 48 and an import/export businessman, develops pain that extends down his left leg to the ankle. Which THREE symptoms or signs would be consistent with a radicular cause?
- ❑ a) Bladder dysfunction
- ❑ b) A positive crossover test
- ❑ c) Left ankle hyporeflexia
- ❑ d) Numbness in the distribution of the pain

4. Sven requests back X-rays, which you discuss with him. In which TWO circumstances would they always be indicated?
- ❑ a) Recent significant trauma
- ❑ b) Sven's age group (>45)
- ❑ c) History of prolonged steroid use
- ❑ d) Diabetes

5. Sven's symptoms do not improve with NSAIDs and physiotherapy. A CT scan shows L4-5 and L5-S1 disc degeneration and prolapse, with nerve root compression. Sven wants to avoid open surgery. Which other options are you most likely to discuss with him (choose TWO)?
- ❑ a) Nerve root block(s)
- ❑ b) Radiofrequency neurotomy
- ❑ c) Chymopapain injection
- ❑ d) Epidural injection

6. Sven has some improvement with percutaneous therapy but returns six months later with an acute recurrence. He wants to discuss mini-discectomy. What information can you give him (choose TWO)?
- ❑ a) Leg pain is relieved in about 90% of ideal candidates
- ❑ b) The procedure takes about four hours and requires hospital admission
- ❑ c) The risk of recurrent disc prolapse is about 30%
- ❑ d) His associated back pain may or may not improve with mini-discectomy

7. Stephanie, 41 and with a BMI of 32, complains of chronic diffuse low back pain, aggravated by most activities. A CT scan show bulging at two lumbar levels. What advice are you most likely to give her (choose TWO)?
- ❑ a) Mini-discectomy would be the treatment of choice
- ❑ b) Weight loss may help
- ❑ c) An MRI is indicated
- ❑ d) Stephanie should see a physiotherapist for an assessment and back exercises

8. Trevor, 67, develops leg symptoms with walking that improve with rest, and you suspect canal stenosis. If your provisional diagnosis is correct, which other symptoms or signs would he be likely to have (choose THREE)?
- ❑ a) Numbness
- ❑ b) Paraesthesia
- ❑ c) Absent dorsalis pedis pulses
- ❑ d) Back pain

9. Trevor improves with surgical treatment but five years later develops a painful compression fracture of T8 with minimal trauma. Investigations show osteoporosis. What information can you give Trevor about vertebroplasty (choose TWO)?
- ❑ a) Cement is injected into the vertebral body under image guidance in the theatre or radiology department
- ❑ b) Trevor should wait at least six weeks because he may become asymptomatic with no treatment
- ❑ c) Pain relief is achieved in about 50% of cases
- ❑ d) The degree of pain relief varies but is never instant and complete

10. Which ONE statement about imaging in patients with low back pain is correct?
- ❑ a) Plain X-rays rarely show changes that affect general practice management
- ❑ b) The routine use of oblique views on plain lumbar X-rays is recommended for all adults
- ❑ c) Age-related changes on X-ray can always be distinguished from serious pathology
- ❑ d) Disc bulge on CT proves nerve compression

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HOW TO TREAT Editor: **Dr Lynn Buglar**
Co-ordinator: **Julian McAllan**
Quiz: **Dr Lynn Buglar**

The mark required to obtain points is 80%. Please note that some questions have more than one correct answer. Your CPD activity will be updated on your RACGP records every January, April, July and October.

NEXT WEEK Elevated cholesterol level is a major, if not *the* major, cause of coronary atherosclerosis. But which patients need treatment? And which need drug treatment? And how far should LDL-c level be lowered after treatment has begun? Next week's How to Treat on hyperlipidaemia has all the answers. The author is **Associate Professor David Colquhoun,** a consultant cardiologist in private practice in Brisbane and medical director of Core Research Group and honorary professor of medicine, University of Queensland.