Degenerative and pathological disorders of the thoracolumbar spine may present with symptoms which warrant further evaluation by a neurologist. This article aims to provide an overview of the typical presentation and standard management of various thoracolumbar spinal disorders and includes information that is intended to facilitate the investigative and diagnostic process.

**LUMBAR INTERVERTEBRAL DISC PROLAPSE**

Mixter and Barr in 1934 first described the herniated disc to be a cause of segmental leg pain (sciatica or femoralgia). Acute low back pain is a relatively common condition and is accompanied by sciatica in only 1–2% of cases. Patients presenting with acute low back pain alone are therefore unlikely to have a disc prolapse. Lumbar intervertebral disc prolapse is most prevalent between the ages of 30–50 years, and the L5/S1 and L4/5 intervertebral discs account for 95% of all lumbar prolapses.

A lumbar disc prolapse typically presents with gradual or sudden onset localised back pain radiating through the buttock or hip area into the leg. The episode may have been precipitated by heavy axial loading, flexion or rotation of the spine, but may also occur at rest.

The onset of sciatica often coincides with improvement in localised back pain. The sciatica is initially severe and is often described as a dull aching pain with occasional sharp or shooting exacerbations. The pain may be aggravated by coughing, sneezing, bending or prolonged sitting. The compromised nerve root is usually identified by noting the specific dermatomal distribution of the pain or associated sensory disturbances. The myotomal distribution of any muscle weakness and hyporeflexia further refines the clinical impression. Muscle wasting is rarely seen unless the symptoms have been present for several months. Bilateral leg symptoms, peri-anal or saddle sensory disturbances, and urinary or anal sphincter dysfunction signify a cauda equina syndrome (table 1) caused by the presence of a large central disc prolapse. These patients warrant urgent investigation and treatment.

The straight leg raising test (Lasegue's sign) elicits dermatomal pain in the presence of abnormal nerve root tension caused by a disc prolapse at the L4/5 or L5/S1 level. A positive femoral stretch test (hip extension with maximal knee flexion) signifies the presence of an L2, L3 or L4 radiculopathy. This may be caused by a lumbar disc protrusion or other pathology such as a psoas abscess, haematoma, or diabetic femoral neuropathy.

It is important to distinguish between true sciatica and hip related pain. Pain on weight bearing or hip movements, particularly on external rotation and extension, suggests the presence of joint related pathology—for example, trochanteric bursitis or arthritis.

**Investigations**

A magnetic resonance image (MRI) scan is the investigation of choice for suspect intervertebral disc prolapse. A computed tomographic (CT) scan or CT myelogram is a useful alternative if MRI is either contraindicated or unavailable. Lumbar intervertebral disc prolapses are most commonly seen posterolaterally where the posterior longitudinal ligament is thinnest (fig 1). The protruded fragment compresses the nerve root just proximal to its exit foramen below the pedicle belonging to the same lumbar segment. For example, a posterolateral prolapse of the L4/5 intervertebral disc compresses the L5 nerve root proximal to its exit foramen below the L5 pedicle. However, an upwardly (craniad) migrated posterolateral L4/5 disc fragment, or a far later disc prolapse within the L4/5 exit foramen, will compress the L4 nerve root exiting at that level.

**Management**

The majority of patients with acute back pain alone may be managed conservatively provided that serious pathology such as tumour, infection, and instability has been considered and excluded. In over 85% of patients presenting with sciatica, the symptoms will resolve within 6–8 weeks of conservative management.
Conservative management:
1. Initial bed rest with gradual early mobilisation
2. Avoidance of lifting, bending, prolonged sitting
3. Analgesia—non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol, opiates
4. Muscle relaxants for paraspinal muscle pain—for example, low dose diazepam
5. Referral for epidural or nerve root block

Indications for surgical intervention in order of priority:
1. Cauda equina syndrome (may require emergency intervention)
2. Onset or progression of significant motor deficit
3. Severe intractable pain
4. Progression of pain despite conservative management
5. Failure of conservative management for 2–3 months

THORACIC INTERVERTEBRAL DISC PROLAPSE
Symptomatic thoracic disc herniations are rare and account for less than 1% of all protruded discs. They occur most commonly between the third and fifth decades of life. The most common level is T11/12, with 75% of all thoracic disc prolapses occurring below T8.

Patients usually present with a combination of symptoms including pain, sensory changes (including dysaesthesia), motor deficits, and alterations in bowel and bladder control. Pain is the most common symptom. It is either localised to the spine or radiates anteriorly in a typical girdle-like fashion along the intercostal dermatome. Nocturnal recumbent pain is also typical of thoracic spinal pain. Unlike musculoskeletal or pleuritic pain, there is little or no exacerbation with deep inspiration. Motor examination may show a paraparesis and less often a monoparesis with evidence of lower limb spasticity and sensory disturbances. A Brown Sequard syndrome is seen rarely.

Investigations
MRI provides accurate information on the location of disc protrusion, severity of spinal cord compression, and associated oedema or myelomalacia. Precise anatomical localisation of the disc protrusion relative to the spinal cord is important for accurate planning of the surgical approach.

A CT scan is useful for the identification of any calcification within the disc. If the disc is heavily calcified or is located in the midline anteriorly (fig 2), then a posterior or posterolateral approach is unlikely to provide safe access around the spinal cord for disc excision. In these cases, an anterior transthoracic approach is preferred as it provides direct access and has a significantly lower risk of spinal cord injury.

A CT myelogram may be useful in the identification of a disc which is suspected to have eroded into the intradural space (fig 3). These rare cases almost invariably require an anterior transthoracic discectomy with dural patching.

Management
Patients with non-radicular, localised back pain tend to respond poorly to thoracic discectomy and fusion. These patients should be initially managed conservatively with a combination of non-steroidal anti-inflammatory medication, muscle relaxants, and physiotherapy. If this fails then referral to a pain specialist would be appropriate. Patients presenting with mild to moderate radicular pain alone should also undergo a trial period of conservative management, including a trial of local nerve root blocks.
Indications for surgical intervention:
1. Failure of conservative measures
2. Severe intractable radicular pain
3. Significant or progressive neurological impairment—myelopathy or sphincter dysfunction is an indication for early surgical intervention

The surgical approach used depends upon several factors, including the level and laterality of the disc, presence of calcification, patient comorbidity, requirement for fusion, and the surgeon’s experience.

Anterior approaches are used for centrally located disc prolapses, intradurally eroded discs, and heavily calcified discs requiring significant manipulation. Attempts at excision of such discs from a posterior approach carry significant risks of spinal cord injury.

Posterior approaches are indicated for lateral and soft anterolateral prolapses, which require minimal manipulation of the spinal cord. The surgical access can be improved by partial excision of the facet joint or pedicle. However, this may eventually lead to spinal instability and the surgeon therefore needs to consider performing a fusion procedure at the same time.

LUMBAR SPINAL STENOSIS
Lumbar stenosis is definable as a narrowing of the lumbar spinal canal in its central part, lateral recesses or intervertebral foramina leading to symptomatic compression of one or more nerve roots. Lumbar stenosis is most commonly seen at the L4/5 level; L3/4 is the next most frequently involved level. Lumbar stenosis is usually seen in patients with a developmental shallow spinal canal related to small neural arches and short pedicles. Patients tend to present in later life when the stenosis is further exacerbated by acquired degenerative changes, including facet joint/ligamentous hypertrophy, disc protrusion, instability or spondylolisthesis.

Patients classically present with neurogenic claudication comprising progressive dull buttock and leg pain or motor deficit precipitated by walking, standing, or lying in the supine position. Because of postural widening of the spinal canal and foramina, the symptoms are typically relieved by sitting, bending forwards or crouching. Unlike patients with an acute intervertebral disc prolapse, the pain of lumbar stenosis is gradual in onset, and worsens over a period of several months. The pain may be accompanied by leg numbness, paraesthesia, and rarely, progressive sphincter disturbances or impotence.

A central spinal stenosis typically causes bilateral leg symptoms, while a focal lateral recess stenosis presents as a monoradicular neuropathy. Exercise induced motor weakness or pain affecting a single nerve root (for example, foot drop from an L5 radiculopathy) is referred to as a “root claudication”.

It is important to distinguish neurogenic from vascular claudication by detailed history taking and examination of the lower limbs for signs of vascular insufficiency (table 2). Unlike vascular claudication, which is typically relieved by simply standing for a short time, neurogenic claudication usually improves only with sitting or bending forwards for several minutes before patients are able to continue. Patients with neurogenic claudication may also note that their exercise tolerance for activities in a flexed position—for example, rowing, cycling, or pushing a trolley—is significantly better than walking upright. They may therefore even adopt a gibbous posture while walking. Neurological examination of the lower limbs in lumbar stenosis is usually unremarkable. Patchy areas of numbness, hyporeflexia or muscle wasting are seen occasionally.

**Investigations**
MRI scanning is the investigation of choice in lumbar stenosis. It provides accurate sagittal and axial images showing areas of facet and ligamentous hypertrophy, disc protrusion, and nerve

**Table 2 Comparison of vascular and neurogenic claudication**

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![Image of Table 2](image-url)
root compromise. CT or CT myelography is useful where MRI scanning is either unavailable or contraindicated. The combination of bilateral facet hypertrophy and lateral recess stenosis results in a typical “trefoil” or “clover leaf” appearance of the spinal canal on axial imaging (fig 4).

Patients presenting with a combination of mechanical back pain and neurogenic claudication may have pre-existing degenerative lumbar instability or spondylolisthesis. A lateral flexion–extension spine x-ray is indicated in these patients to exclude lumbar instability as the surgeon may wish to perform a fusion procedure at the time of surgical decompression.

Management

Mild symptoms may be managed conservatively with rest, analgesia, physiotherapy, and a lumbar corset to alleviate lumbar lordosis. Up to a third of patients in selected series have been reported to obtain long term symptomatic relief from a course of epidural steroid and local anaesthetic injections. Physiotherapy for postural advice and trunk muscle strengthening exercises may also be beneficial. Unfortunately, in contrast to conservative treatment for herniated disc, many patients with lumbar stenosis experience recurrent symptoms as soon as they resume normal activities following a period of conservative management.

Indications for surgical intervention:
1. Failure of conservative treatment
2. Incapacitating or permanent pain
3. Significant motor deficit
4. Sphincter disturbances

Decompressive surgery for lumbar stenosis involves resection of the hypertrophic medial surface of the facet joint, excision of the thickened ligamentum flavum, and release of the nerve roots within the lateral recesses and exit foraminae. In the presence of spondylolisthesis (fig 5) or lumbar instability, a fusion procedure may be appropriate at the same time. A monoradiculopathy related to a unilateral recess stenosis usually responds to a focal microsurgical decompression.

Lumbar decompression for stenosis has an 80–90% chance of a good outcome (return to premorbid activity levels). Recurrent symptoms have been reported in up to 15% of patients after five years of follow up. However, in over 50% of these patients, recurrent symptoms are caused by new stenoses at previously non-operated levels.

OSTEOMYELITIS OF THE SPINE

Vertebral osteomyelitis is uncommon, usually presents insidiously, and is associated with potentially serious complications. A high level of clinical suspicion coupled with detailed history taking is therefore vital for early diagnosis and prompt treatment.

Risk factors for spinal infection include intravenous drug abuse, diabetes, endocarditis, immunosuppression, human immunodeficiency virus infection, and alcohol dependence. Patients who have a recent history of undergoing spinal surgery or urological procedures including urinary catheterisation are also considered at risk.

The route of bacterial spread in spinal infection is usually haematogenous. Gram positive cocci are the most common organisms cultured. *Staphylococcus aureus* is found in up to 60% of all cases of vertebral osteomyelitis, while streptococcal infections are more prevalent in children and young adults. Spinal infections caused by Gram negative organisms, including *Escherichia coli*, *Proteus*, *Klebsiella*, and *Enterobacter* species, are usually related to haematogenous spread following genitourinary tract procedures. *Pseudomonas* species osteomyelitis is rare and most commonly associated with intravenous drug abuse.

In most cases, symptoms have been present for less than six months. Over 30% of patients present with a duration of symptoms of less than three months. Localised and gradual onset chronic spinal pain is the chief complaint in 70–80% of patients. The pain is typically constant, worse at night, and associated with localised tenderness. It may be worsened by activity and can therefore mimic degenerative mechanical back pain. Radicular or referred pain to the abdomen or thorax suggests compression of the segmental nerve roots or the presence of an epidural or psoas abscess.

Neurological signs and symptoms are found in 10–15% of patients and are usually related to vertebral instability, collapse or epidural abscess formation. Neurological dysfunction is a relatively late feature of spinal infections and signifies a delay in presentation or diagnosis.

**Figure 4** Lumbar canal stenosis: “Trefoil” shaped spinal canal caused by posterolateral facet and ligament hypertrophy.

**Figure 5** Spondylolisthesis at L4/5 causing lumbar stenosis. Postoperative x ray showing decompressive laminectomy (anteroposterior view) with pedicle screw stabilisation.
Investigations
A low grade fever is present in only 40–50% of patients. Haematological tests, although not specific for infection, may aid in the diagnosis. Elevation of the white blood cell count is found in less than 30% of patients. Inflammatory markers (C reactive protein, plasma viscosity, erythrocyte sedimentation rate (ESR)) are raised in over 70–80% of cases. Although not specific for infection, these tests are diagnostically of greater value than a white blood cell count.

Plain radiography may not be diagnostic during the first month of spinal infection. The initial radiographic signs of osteomyelitis usually become evident after 4–6 weeks and include end plate erosions and reduction of disc height. This is followed by the formation of osteolytic areas, paravertebral soft tissue shadows (indicative of paraspinal abscess), and eventual vertebral collapse.

CT scanning is useful in identifying diffuse bony destruction and soft tissue collections in patients with non-diagnostic radiographs. Radionuclide imaging modalities may also be useful in the early stages of infection as the sensitivity of a technetium 99m-diphosphonate bone scan is nearly 100% in spinal infection. Unfortunately its specificity is considerably less. Nevertheless, a negative scan virtually eliminates the diagnosis of infection except in neonates and the elderly, where there have been occasional reports of false negative bone scans.

MRI is the imaging modality of choice in the diagnosis and monitoring of spinal infections. It provides accurate anatomical and pathological information on the intervertebral disc, vertebral marrow, neuronal structures, and epidural or paraspinal soft tissue collections. The typical MRI findings in vertebral osteomyelitis and discitis include loss of end plate definition and decreased signal in the disc and adjacent vertebral bodies on T1 weighted images. Increased signal intensity is found in these areas on T2 weighted images. MRI may also distinguish infection from tumour, as the latter is seldom associated with disc involvement. One caveat is that in tuberculous osteomyelitis, disc space involvement is usually spared.

Management
The optimal management of spinal infection depends upon rapid and accurate identification of the causal bacteria. Repeated blood and urinary cultures are important as they may eliminate the need for more invasive diagnostic procedures. In the absence of bacteraemia or urinary infection, the standard recommendation is to proceed to a CT guided sampling of the infected area. The diagnostic rate of CT guided needle biopsy is only 40%. Repeat needle biopsies are therefore advised before considering an open surgical biopsy. Provided that the patient is systemically stable, antimicrobial treatment should be withheld until the organism is identified.

Prolonged intravenous antibiotic treatment remains the standard management for spinal infections and is successful in up to 75% of patients. Provided that there is no evidence of gross spinal instability, patients may mobilise after an initial 1–2 week period of bed rest with the aid of a rigid external orthoses for support and pain control. Pyogenic osteomyelitis is treated with a 4–6 week course of intravenous antibiotics followed by a similar period of oral therapy. The response to treatment is monitored with regular haematological tests (C reactive protein, ESR, plasma viscosity, white blood cell count), plain radiography, and MR imaging. Tuberculous osteomyelitis usually requires between 6–12 months of antituberculous treatment. Paraspinal and psoas abscesses are ideally treated by CT guided tube insertion and drainage before consideration is given to surgical drainage.

Indications for surgical intervention:

1. Confirmation of suspect infection
2. Identification of the organism
3. Neurological impairment
4. Progression of spinal deformity
5. Mechanical instability
6. Failure of non-operative management

The principles of surgical intervention include decompresion, debridement of necrotic and infected tissue, and restoration of spinal stability by instrumented fusion. Spinal osteomyelitis usually affects the vertebral body and spares the posterior elements. Although a posterior laminectomy is an effective method of neurological decompression, it may lead to progressive kyphosis or subluxation in the presence of anterior column disease. Consideration must therefore be given to a posterior fusion procedure at the time of decompression. In the presence of significant anterior destruction or vertebral collapse, posterior fusion alone is unlikely to prevent progressive kyphosis. In these cases, anterior decompression, debride-ment, and instrumentation is usually advised.

THORACOLUMBAR SPINAL TUMOURS
Spinal tumours are anatomically classified into three groups: intramedullary, intradural extramedullary, and extradural (table 3). The identification of the precise anatomical site of a spinal tumour by CT scan or MRI allows the clinician to deduce a useful differential diagnosis.

Metastases are the most frequently occurring tumours of the spine. Metastatic disease occurs in up to 60% of patients with cancer and the majority of lesions are found in the lung, liver, and skeletal system. The spine is the common site of skeletal metastases.

Risk factors for malignant spinal disease include unexplained weight loss, advanced age, and a history of smoking or cancer. Pain is the most common presenting symptom in

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<td>Chondrosarcoma</td>
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<td>Ewing’s sarcoma</td>
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patients with a spinal tumour and is the chief complaint in over 90% of patients. Cancer patients presenting with back pain should therefore be investigated without delay. The pain is usually localised to the area of disease, but may radiate in a dermatomal pattern. It is usually dull in nature but may have a dysaesthetic or burning quality. Thoracic spinal intradural extramedullary tumours (for example, meningioma, schwannoma) may present with nocturnal recumbent pain which radiates anteriorly in a girdle-like distribution. Pain that is worsened by movement may indicate underlying instability related to progressive bony destruction and deformity. In extradural metastatic spinal tumours, palpation of the posterior spine usually elicits local tenderness at the site of disease.

Myelopathy, radiculopathy, sensory disturbances or impairment of sphincter control may eventually develop as a consequence of direct neurological compression or spinal cord ischaemia/infarction caused by vascular compromise.

Investigations
Plain radiography represents a useful screening tool for the general assessment of the integrity and alignment of the vertebral elements. They also provide qualitative bone information such as the identification of lytic lesions or sclerotic areas.

CT provides excellent definition of the bony architecture and is useful for defining areas of tumour invasion and its anatomical relation to adjacent soft tissue structures. CT images are viewable as both bone and soft tissue windows, and may also be reconstructed to provide sagittal and coronal images.

MRI has become the imaging modality of choice for spinal tumours. It provides multiplanar high definition views of soft tissue structures and bone marrow. It accurately delineates anatomical and pathological structures and, to a certain extent, assists in the characterisation of different groups of tumours. It is also very useful for the planning of surgical decompressive and reconstructive procedures. Sagittal MR imaging allows rapid screening of large sections of the spine. MRI has been shown to be more accurate than scintigraphy in the detection of bony lesions.

CT myelography is a useful imaging modality in patients in whom MRI scanning is contraindicated. Tumours in the extradural, intradural extramedullary, and intramedullary compartments can be distinguished through their distinct myelographic patterns.

Skeletal scintigraphy with radiopharmaceuticals such as technetium 99m-labelled diphosphonates is a useful mode for screening the whole skeleton. Scintigraphy is highly sensitive at detecting early disease; its main disadvantage is the lack of specificity as infection and degenerative and tumour pathology can all show a positive uptake.

Management
The effective treatment of spinal tumour disease depends upon early detection and subsequent management by a multidisciplinary team of physicians, surgeons, and oncologists.

Timely evaluation and treatment is important because tumour growth can rapidly lead to neurological dysfunction which may not resolve with decompression. Pain and neurological deficits may improve significantly with high dose steroid treatment (for example, 4 mg dexamethasone four times daily) while surgical or oncological treatment is being planned.

Benign spinal tumours such as meningioma or haemangioblastoma are usually treated by radical surgical excision. In malignant disease, surgical intervention in patients without neurological compression, deformity or instability has not been shown to have any survival benefit over oncological treatment. Therefore, the majority of patients presenting with malignant spinal disease are managed with palliative radiotherapy and/or chemotherapy. A high proportion of patients...
presenting with spinal pain, without neurological compromise or instability, respond to radiotherapy or chemotherapy.

Patients presenting with early signs of neurological compression often respond favourably to urgent radiotherapy. However, surgical decompression may provide a more immediate response if the neurological dysfunction is severe or rapidly progressive.

**Indications for surgical intervention:**
1. Diagnostic biopsy in patients without a history of malignancy
2. Radioresistant tumours
3. Static or progressive neurological dysfunction
4. Solitary lesions not responding to adjuvant treatment
5. Instability or neurogenic pain
6. Progressive spinal deformity

Major decompressive or reconstructive spinal surgery for malignant spinal disease is not appropriate in patients with significant risks from concurrent medical problems. Extensive surgery is also seldom undertaken in patients in whom the prognosis is considered to be less than three months.

The principles of surgical management include decompression, correction of the deformity, and instrumented stabilisation/fusion. The technique and approach used depends on the extent of the pathology, the location of the tumour in relation to the spinal cord, the degree of instability, and the access required to allow safe decompression and adequate instrumentation.

A posterior laminectomy approach is the most common method for decompressing the spinal canal. Patients with significant anterior vertebral disease or with pedicle or facet joint involvement are susceptible to subsequent progressive kyphotic deformity and instability following a posterior decompressive procedure. These patients are therefore best managed with posterior instrumented stabilisation at the time of decompressive surgery.

Anterior decompressive surgery is indicated in the presence of anterior vertebral collapse or spinal cord compression (fig 6). The transthoracic and retroperitoneal approaches provide excellent access to the anterior thoracolumbar spine and permit safe and thorough decompression of the spinal cord with vertebral reconstruction and instrumentation.

A combined anteroposterior decompression with instrumentation fusion is rarely indicated but is useful in selected patients with circumferential compressive disease or vertebral destruction. Circumferential radical surgery is particularly indicated in patients with low grade destructive tumours such as chordoma or chondrosarcoma, which are relatively resistant to adjuvant treatment (fig 7). Long term survival, and even cure, has been reported in these cases following radical circumferential tumour resection.

**KEY REFERENCES**