37 T_h e spine

- Lumbar disc herniation
- METABOLIC BONE DISEASES AFFECTING THE SPINE Osteop
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- Magnetic resonance imaging
- Neuromuscular scoliosis
- Non-spinal causes of back pain
- PATIENT HISTORY
- PHYSICAL EXAMINATION
- Plain radiographs
- Primary tumours of the spine
- Provocative discography
- Red flags
- SPINAL DEFORMITY
- SPONDYLOL YSIS AND SPONDYLOLISTHESIS Spondylolysis
- Scheuermann’s kyphosis
- Spina bifida
- Spinal biopsy
- Spinal dysraphism
- Spinal stenosis
- Spondylolisthesis
- Syringomyelia
- TUMOURS OF THE SPINE Metastatic tumours
- The lack of trained spinal surgeons
- Thoracic disc herniation
- Tuberculosis
- modern imaging and equipment
- surgery

Ankylosing spondylitis

Ankylosing spondylitis

Should a patient with ankylosing spondylitis present following trauma, a high index of suspicion for occult fractures should be present. It is common for patients with ankylosing spondylitis to develop epidural haematomas with subtle neurological deficit. Patients with a significant fixed flexion deformity at the cervicothoracic junction (‘chin-on-chest’ deformity), limited forward gaze and eating and swallowing di ffi culties may be treated with a closing wedge osteotomy at the cervicothoracic junction (Figure 37.7). Extension osteotomies can also be per formed in the thoracic and lumbar spine. Ankylosing spondylitis

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Arnold–Chiari malformation

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Arnold–Chiari malformation occurs when the medulla oblongata and the cerebellar tonsils extend through the fora - men magnum into the cervical spinal canal, causing pressure on the lower medulla. Hydrocephalus and impaired neurolog - ical function are common, and there is a strong association headache, vomiting, visual disturbances, mental impairment, cerebellar ataxia, sensory disturbances or paralysis. Manage ment consists of decompressing the foramen magnum and, usually , the posterior arc h of the atlas to restore normal cerebrospinal fluid flow . Arnold–Chiari malformation

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Bone densitometry

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Bone density and osteoporosis can be measured using dual energy x-ray absorptiometry (DEXA) of the hip, wrist and spine. Bone densitometry

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Bone scintigraphy

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Isotope bone scans are highly sensitive, but non-specific, tests that are useful for screening the skeletal system for metastatic disease, discitis or vertebral body osteomyelitis, or to assess the relative activity of bone lesions such as osteoid osteoma, osteoblastoma, defects in the pars interarticularis or a pseudar - throsis (incomplete fusion). In the case of multiple myeloma or purely lytic metastases, the bone scan may not show increased activity as these tumours may not stimulate a significant osteoblastic response. Bone scintigraphy

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CLINICAL ANATOMY

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The normal cervical lordosis measures between 35° and 45°. The normal lumbar lordosis is between 40° and 80° (mean 60°) and decreases with age. Most lumbar lordosis occurs between L4 and S1. The normal thoracic kyphosis is between 20° and 50° (mean 35°) and increases with age. When standing, the normal sagittal vertical axis (sagittal plumb line) falls from the odontoid process through the C7/T1 disc space and crosses the spinal column at the T12/L1 disc space, before reaching the posterosuperior corner of the S1 vertebral body . For an energy-e ffi cient posture, cervical and lumbar lordosis will balance thoracic kyphosis. The spinal canal is formed behind the articulated vertebral body by the posterior elements of the vertebral column and can Albert Adamkiewicz , 1850–1921, Professor of Pathology , the University of Kraków (Cracow), Poland, described the arterial supply to the spinal cord in 1882. be divided into a central portion and two lateral portions. The central portion is occupied by the thecal sac containing the spinal cord, which terminates behind the body of L1. The lateral portions contain the nerve roots. The spinal nerve roots comprise 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal. Dorsal and ventral roots join to form spinal nerves. The ventral root and the dorsal root gang lion lie within the intervertebral foramen. This fora - men is bounded superiorly and inferiorly by pedicles, anteri - orly by the disc and posteriorly by the facet joint. Degenerative changes in these structures may lead to neural compromise. Laminar overlap within the lumbar spine decreases from L1 to S1 so that, at the L5/S1 level, access to the intervertebral disc requir es less bone removal than at a more proximal level. The blood supply of the spinal cord is derived from the vertebral, deep cervical, intercostal and lumbar arteries. The arteries of the spinal cord include the anterior spinal artery and two posterior spinal arteries, with the anterior spinal artery providing the majority of the vascular supply to the spinal cord. The radicular artery of Adamkiewicz makes a major contribution to the anterior spinal artery , supplying the lower spinal cord. It originates on the left in 80% of people, usually accompanying the ventral root of T9, T10 or T11, but can originate anywhere from T5 to L5. Ligation of this important artery may lead to critical ischaemia of the spinal cord. Ligat - ing segmental vessels over the midpoint of the vertebral body will minimise the risk of injury to this important artery during anterior approaches to the spine.

The treatment principles for common conditions affecting • the spine The global issues in spinal surgery •

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Cauda equina syndrome

Cauda equina syndrome

CES is a very serious and urgent condition that arises from compression of the cauda equina nerve roots, which supply the perineum and genital regions and bladder, bowel and sexual function. The most frequent cause is a massive central lumbar disc protrusion at L4/5 or L5/S1; other causes include lumbar fractures, postoperative epidural haematoma, spinal stenosis and spinal tumours. Occlusion of the lumbar arteries by dissection or aneurysm of the abdominal aorta can lead to similar dysfunction of the cauda equina without compression. CES is rare, accounting for only 2–6% of all lumbar disc herniations. However, it is important as timely treatment can y in treatment is a prevent catastrophic incontinence; dela major cause of litigation in many countries. CES presents most commonly in the 20- to 45-year age group, with some or all of the following symptoms: low back pain; unilateral or bilateral sciatica; lower limb motor weak - ness; and sensory abnormalities, including saddle anaesthesia, b ladder dysfunction (initially sensory changes, later painless retention and overflow incontinence in la ter stages) and sexual and bowel dysfunction. CES may result from acute or chronic compression of the cauda equina nerve roots.

TABLE 37.7 Classi /f_i cation of cauda equina syndrome (CES). Name Abbreviation De /f_i nition CES suspected CES-S Large disc herniation or bilateral sciatica but normal S2–5 motor and sensory function CES early CES-E Some perineal sensory change but normal bladder and bowel function CES incomplete CES-I Impaired bladder function or sensation but executive/ voluntary control of bladder maintained CES retention CES-R Bladder retention and over /f_l ow incontinence CES complete CES-C Complete loss of cauda equina function MRI, magnetic resonance imaging. Investigation after initial Treatment if MRI positive for diagnosis compression of CES MRI within 24 hours Discuss risks and bene /f_i ts of surgery versus conservative treatment MRI immediate Urgent decompression MRI immediate Urgent decompression MRI immediate Urgent decompression on next daytime list if patient presents overnight MRI in working hours Decompression if improvement considered possible

rium and only have a thin endoneurium root sheath, making them more susceptible to compression forces when compared with peripheral nerves. The syndrome can result in permanent motor deficit and b ladder, bowel and sexual dysfunction. It represents a true spinal emergency and requires urgent sur gical decompression. The outcome for patients who undergo surgical decompression within 24 hours of the onset of loss of bladder or bowel control is significantly better than that of those who undergo surgery beyond this 24-hour period. Cauda equina syndrome classification The key classification of CES (Table 37.7) is into cases where there is still executive or voluntary control of the bladder (CES-I) and cases where there is bladder retention and over flow incontinence (CES-R). CES-I cases are considered to be more urgently in need of decompression to prevent deterio ration to CES-R. Most surgeons now believe that continued compression causes a continuous deterioration in function and therefore early decompression is of benefit. Summary box 37.4 Cauda equina syndrome /uni25CF /uni25CF /uni25CF

Commonest presenting symptoms: perineal numbness, alteration in bladder function and sensation leading to painless urinary retention, over /f_l ow incontinence and faecal incontinence Urgent investigation with MRI is required for all suspected cases Con /f_i rmed CES requires surgical decompression within 24 hours to achieve optimum outcomes

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Cervical myelopathy

Cervical myelopathy

Degenerative change in the cervical spine leading to spinal cord compression is the commonest cause of cervical myelop - athy in patients over 55 years of age. LMN changes occur at the level of the lesion, with atrophy of the upper extremity muscles, particularly the intrinsic muscles of the hands. UMN findings are noted below the level of the lesion and may - involve both upper and lower extremities. If surgery is consid - ered an anterior or posterior decompression may be required. Cervical myelopathy

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Computed tomography

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This investigation is the best test for assessing bone anatomy . Three-dimensional reconstructions are often useful for the assessment of congenital spinal deformity . However, one should remember that a typical CT of the lumbar spine will expose the patient to an e ff ective dose of 5–10 millisieverts (mSv), which would be equivalent to 2.5–5 years of natural background radiation; those who travel on 7-hour flights (0.05 /uni00A0 mSv per 7-hour flight) would need to make 100–200 journeys in their lifetime to be exposed to the same e ff ective dose. Computed tomography

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Congenital scoliosis

Congenital scoliosis

This is caused by vertebral anomalies that produce a frontal plane growth asymmetry . The anomalies are present at birth, but the curvature may take years to be clinically evident. Close observation of spinal growth is required until skeletal maturity is reached. Brace treatment is ine ff ective for the primary struc tural curves, which are often short and rigid, but it may have a role in the control of compensatory curves. For progressive curves, surgical options include growing rod constructs such as magnetically controlled growing rod procedures, hemivertebra excision, correction and fusion or posterior instrumented correction and fusion. Summary box 37.8 Spinal deformity /uni25CF /uni25CF /uni25CF Eduardo Luque , contemporary , professor, Shriners Hospital for Crippled Children, Mexico City , Mexico. Holger Werfel Scheuermann , 1877–1960, radiologist, Municipal Hospital, Sundby , Copenhagen, Denmark, described juvenile kyphosis in 1920.

Early-onset idiopathic scoliosis (<8 years old) has the potential to impair lung function

Neuromuscular scoliosis: timely surgery may prolong life

Congenital scoliosis: rigid curves do not respond to brace treatment

Early-onset idiopathic scoliosis.

The anteroposterior standing radio

(a) demonstrates a Cobb angle of 98° and dextrocardia. This 34-month- (b) , without fusion to correct the spinal (c, d) .

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Cost implications of modern spinal

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DEGENERATIVE CONDITIONS OF THE SPINE Cervical radi

DEGENERATIVE CONDITIONS OF THE SPINE Cervical radiculopathy

Patients present with neck and arm pain (brachialgia), paraesthesia and motor weakness in the distribution of the compromised nerve root (radiculopathy). This may be caused by disc herniation or degenerative stenosis. Symptoms often respond to conservative treatment, including physiotherapy and medication for neuropathic pain (amitriptyline, gabapen - tin or pregabalin), or CT-guided foraminal epidural steroid injections of local anaesthetic and steroid. Intractable pain). The and/or functional neurological deficit are indications for surgical intervention. Surgical options include anterior cervical discectomy and fusion (using a cage packed with bone graft and plate), cervical total disc replacement (Figure 37.2) or posterior procedures to enlarge the canal such as laminoplasty and laminoforaminotomy . Randomised controlled trials have compared anterior cervical discectomy and fusion with cervical disc replacement. Similar clinical outcomes have been observed in both groups. However, cervical disc replacements preserve motion in the operated level and may protect against adjacent segment disease in the longer term. - DEGENERATIVE CONDITIONS OF THE SPINE Cervical radiculopathy

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Figure 37.9 This 13-year-old girl sustained a cervical spinal cord injury (SCI) following a dive into a swimming pool. The International Standards for Neurological Classi /f_i cation of Spinal Cord Impairment (ISNCSCI), commonly referred to as the American Spinal Injury Association (ASIA), are based on a standardised sensory and motor assessment. The ASIA Impairment Scale splits these grades into: grade A (complete), grade B (sensory incomplete), grade C (motor incomplete, muscle grade <3), grade D (motor incomplete, muscle

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Discogenic low back pain

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Discogenic low back pain has been defined as a continuum of diagnostic categories (internal disc disruption, degenerative disc disease, segmental instability) reflecting various stages of degenerative pathology a ff ecting the intervertebral disc. Not all degenerate discs are painful. Patients typically present with chronic relapsing episodes of low back pain between the ages of 40 and 60 years. A recent study has compared rehabilitation with spinal fusion for discogenic pain. Both groups reported reductions in disability , with the authors strongly recommending a course of rehabilitation before surgical intervention. For those who fail to improve with conservative measures, provocative lum - bar discography (Figure 37.1) may help to identify the source of pain, and surgery in the form of a lumbar spinal fusion - (Figure 37.3) or lumbar disc replacement (Figure 37.4) may be considered. J E Buck , surgeon, Brook General Hospital, London, UK, described the direct repair of the defect in spondylolisthesis in 1970.

(b) (c) Figure 37.3 Anterior lumbar interbody fusion. (a) The PEEK (poly-ethyl-ethyl-ketone) cage has been packed with bone graft prior to insertion; (b, c) show the anteroposterior and lateral postoperative radiographs, respectively. (b) Figure 37.4 Lumbar total disc replacement. (a)

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graph with 30° of cranial inclination. (b) Lateral radiograph with the implant appropriately positioned.

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EPIDEMIOLOGY

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The lifetime prevalence of low back pain has been reported to be 60–80%. By contrast, the lifetime prevalence of true sciatica is 2–4%. It is generally accepted that 90% of acute low back pain episodes settle, allowing return to work within 6 weeks. However, some 5–7% of the population aged between 45 and 64 years will report back problems as a ‘chronic sickness’. Up to 70% of acute episodes of sciatica resolve within 3 months. Summary box 37.1 Epidemiology /uni25CF /uni25CF /uni25CF /uni25CF

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Epidural abscess

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Facet joint injections

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Foraminal epidural steroid injections

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For patients with radiculopathy due to a prolapsed inter- vertebral disc or lateral recess stenosis, a targeted foraminal epidural injection of local anaesthetic and steroid may provide important diagnostic information and have a lasting thera peutic e ff ect. Foraminal epidural steroid injections

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GLOBAL ISSUES IN SPINE SURGERY

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It is important that the information presented in this chapter, which is widely used throughout the world for teaching and training, outlines the very best evidence-based treatment that - is available for surgical conditions. The text has covered the essentials of spine surgery and has very rightly demonstrated current techniques that involve up-to-date equipment. It is, however, an inescapable fact that the majority of the world’s population does not have access to state-of-the-art spinal surgery . There are two main reasons for this: first, the cost of spinal surgery and, second, the lack of trained surgeons. GLOBAL ISSUES IN SPINE SURGERY

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INFECTIONS OF THE SPINE Pyogenic infections

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Pyogenic vertebral osteomyelitis is primarily a lesion of the disc and its osseous margins. The most common method by which an organism spreads to the spine is via the haematogenous route. The disc is nearly always involved in pyogenic vertebral infection. In contrast, granulomatous infection, such as tuber culosis, typically does not involve the disc space. Friedrich Daniel von Recklinghausen , 1833–1910, Professor of Pathology , Strasbourg, France, described generalised neurofibromatosis in 1882. Karl Lisch , 1907–1999, ophthalmologist, Wörgl, Austria. Friedrich Theodor Schwann , 1810–1882, Professor of Anatomy successively at Louvain (1839–1848) and Liège, Belgium (1849–1880). Hans Christian Joachim Gram , 1853–1938, Professor of Pharmacology (1891–1900) and of Medicine (1900–1923), Copenhagen, Denmark, described this method of staining bacteria in 1884. Theodor Escherich , 1857–1911, Professor of Paediatrics, Vienna, Austria, discovered the advancing age, intravenous drug abuse, diabetes, renal failure, recent infections and trauma. Staphylococcus aureus accounts for 30–55% of the infections. Gram-negative organisms such as Escherichia coli, Pseudomonas species and Proteus species are asso - ciated with recent genitourinary infections and intravenous drug abuse. Anaerobic infections are uncommon, but may be seen in diabetic patients and after penetrating trauma. If there is a failure of medical management (persistent pain, elevated erythr ocyte sedimentation rate, C-reactive pro - tein), operative interventions that should be considered are shown in Table 37.11 . /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

TABLE 37.11 Operative interventions in pyogenic infections that should be used from a surgical perspective. Open biopsy (when a closed biopsy has failed) Drainage of abscesses Decompression of spinal cord compression Correction of progressive spinal deformity Stabilisation of progressive spinal instability

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rheumatoid arthritis. AAS with a PADI of 14 /uni00A0 mm or less AAS with at least 5 /uni00A0 mm of basilar invagination Subaxial subluxation with a sagittal canal diameter of 14 /uni00A0 mm or less AAS, atlantoaxial subluxation; PADI, posterior atlantodental interval.

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Idiopathic scoliosis

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Idiopathic scoliosis accounts for 70% of presentations. It can be classified into early onset (before 8 years of age) (Figure 37.8) and late onset (after 8 years of age; typical adolescent idiopathic scoliosis). The distinction is important, as the number of alveoli in the lung does not increase after the age of 8 years. Patients with severe curves in the early-onset group may develop cor pulmonale and right ventricular failure resulting in premature death. Adolescent idiopathic scoliosis is associated with a normal or near-normal life expectancy . John R Cobb , American surgeon, wrote a paper in 1948 on how to measure the angle on a radiograph in scoliosis. Guillaume Benjamin Amand Duchenne , 1806–1875, neurologist, worked successively in Boulogne and Paris, France, but never held a hospital appointment. - The prevalence of curves with a Cobb angle >10° is between 0.5% and 3%. The prevalence of curves >30° is between 1.5 and 3 per 1000. Risk factors for progression include female gender, remaining skeletal growth, curve loca - tion and curve magnitude. Not all curves stabilise when skele - tal maturity is reached. In long-term studies, 68% experienced curve progression; the most marked progression of 1° per year was observed in patients with thoracic curves between 50° and /uni00A0 75°. Idiopathic curves of less than 25° ar e monitored with clinical and radiographic examination. In growing children (premenarchal) with curves between 20° and 29°, a brace may be indicated. Bracing is used to prevent curve progression and generally does not lead to permanent curve correction. Curves beyond 45° are not amenable to brace treatment. Surgery in the form of corrective instrumentation and spinal fusion is indicated for curve progression beyond 40°, truncal imbalance and unacceptable cosmesis. During sur - ger y , continuous spinal cord monitoring is used in the form of somatosensory evoked potentials (SSEPs), motor-evoked potentials (MEPs) and free-run and stimulated electromyo - graphic (EMG) activity to minimise the risk of neurological damage. The risk of neurological injury is 0.4% (1 in 250).

C1 C1 C2 C3 C2 C4 C3 C5 C4 C6 C5 C6 C7 C7 T1 T1 T2 T2 T3 T3 T4 T4 Figure 37.7 C7 closing wedge osteotomy for correction of

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Intradural tumours

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These are rare. They may be intramedullary (within the substance of the spinal cord) or extramedullary (outside the cord). Most are extramedullary and benign; the commonest are meningiomas and neurofibromas. Meningiomas are usually benign and arise from the meninges. They are generally slow growing and often warrant radiological surv eillance. If the lesion is large and impinges on the spinal cord or nerve roots, steroids and early surgery may be indicated. Neurofibromas are benign tumours that arise from the nerve sheath. There are three major types of neurofibroma: cutaneous, spinal and plexiform. In 90% of cases they present as solitar y lesions, with the remainder presenting in patients with neurofibromatosis type 1 (NF-1), an autosomal dominant genetically inherited disease. NF-1 occurs in 1 in 3000 births and has been referred to as peripheral neurofibromatosis or von Recklinghausen disease. Diagnosis of NF-1 is confirmed when an individual has two or more of the following: at least six café-au-lait macules >5 /uni00A0 mm diameter before puberty or six café-au-lait macules >15 /uni00A0 mm after puberty , two or more neurofibromas of any type or one plexiform neurofibroma, multiple freckles in the axillary or inguinal regions, a distinctive bone abnormality involving the eye socket or arm/leg bones, optic glioma in the brain, two or more Lisch nodules in the eye, and a parent, sibling or child with NF-1. Neurofibromatosis type 2 (NF-2) is a genetically determined disorder that a ff ects 1 /uni00A0 in 40 /uni00A0 000 individuals worldwide. A diagnosis of NF-2 is made when an individual has the following findings: schwannomas on both eighth cranial (vestibular) nerves or a parent, sibling or child with NF-2 plus one vestibular schwannoma in a person less than 30 years of age, or any two of the following: menin gioma, glioma, schwannoma, juvenile cataracts. Intradural tumours

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Introduction

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Learning objectives

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To learn: The salient features relating to the history and examination • of the spine The investigations commonly used in the /f_i eld of spinal • disorders Learning objectives

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Lumbar disc herniation

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Symptomatic lumbar disc herniation occurs during the lifetime in approximately 2–4% of the population. Risk factors include family history , male gender, age (30–50 years), heavy lifting or twisting, stressful occupation, lower income and cigarette smoking. Over 90% of lumbar disc herniations occur at the L4/5 or L5/S1 levels. A posterolateral disc protrusion will a ff ect the traversing root, e.g. an L4/5 disc protrusion will a ff ect the L5 nerve root. A far-lateral disc protrusion (extraforaminal) will a ff ect the exiting nerve root, e.g. a far-lateral L5/S1 disc protrusion will a ff ect the L5 nerve root. Symptoms typically commence with a period of back pain followed by sciatica. There may be paraesthesia, motor weakness, loss of reflexes and a reduction in SLR. For simple sciatica, a period of 6–12 weeks of conservative treatment is advised. Up to 70% of patients will settle within this period. A trial of pregabalin (GABA analogue) and/or a transforaminal epidural steroid injection may be helpful. Microdiscectomy is the standard surgical intervention f or those in whom conservative treatment has failed. The procedure is carried out in the prone position with radiographic confir mation of the correct level. Loupes with a headlight or use of the operating microscope greatly facilitate the procedure. the multifidus. The spinal canal is entered via r emoval of the ligamentum flavum under the lamina. The thecal sac and tra - versing nerve root are identified. T he dura and nerve root are retracted medially and the o ff ending disc prolapse incised via - a transverse annulotomy . The disc fragment is removed and the disc space cleared of any remaining nuclear material with r ongeurs and multiple washouts of the disc space. The wound is closed. Patients are generally discharged the next morning. Lumbar disc herniation

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Patients with osteoporosis may present with pain following minimal trauma, loss of height and exaggerated thoracic kyphosis. Medications used to prevent and treat osteoporosis include calcium, vitamin D, bisphosphonates (alendronate, rise dronate, once-yearly intravenous zoledronic acid), denosumab, strontium ranelate, selective oestrogen receptor modulators (SERMs) such as raloxifene, hormone replacement therapy and teriparatide . Patients with painful thoracic fractures may be treated with short-term bed rest, analgesics and a spinal orthosis. If the back is still painful 6 weeks after the injury , patients may be considered for vertebroplasty or kyphoplasty . V ertebroplasty inv olves the injection of polymethylmethacrylate (PMMA) bone cement under pressure into the vertebral body with fluoroscopic guidance. The goals of the procedure are to stabilise the spine and decrease the pain associated with compression fractures. Kyphoplasty , on the other hand, involves inserting bilateral bone tamps with balloons into the vertebral body . These are inflated under fluoroscopic control with the bone tamp re-expanding the body , and elevating are then deflated and removed, and PMMA is placed in the - cavity created by the balloons. The goals of kyphoplasty are spinal stabilisation, pain relief and restoration of vertebral body height . Significant complications have been reported, including nerve root injury and spinal cord injury resulting from cement extravasation, along with cement embolism, infection and hypotension. METABOLIC BONE DISEASES AFFECTING THE SPINE Osteoporosis

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Magnetic resonance imaging

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Neuromuscular scoliosis

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This may be due to neuropathic disorders, such as cerebral palsy , spinocerebellar degeneration, syringomyelia, tetraplegia (Figure 37.9), spinal muscular atrophy and poliomyelitis, or myopathic disorders, such as Duchenne muscular dystrophy and myotonic dystrophy . There is good evidence that stabi - lisation of the spine in children with Duchenne muscular dystrophy who are able to walk (before respirator y compromise is too severe to preclude a general anaesthetic) may increase their lifespan by several years.

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Non-spinal causes of back pain

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PATIENT HISTORY

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The commonest reasons for referral to a spinal clinic include pain and spinal deformity . A detailed history of the pain, including site, type, severity , duration, frequency and aggravat - ing factors, should be sought. Has there been any history of the upper limbs (brachialgia) or lower limbs (sciatica)? Is there associated numbness, tingling, weakness or di ffi culty with gait? Is there a family history of ankylosing spondylitis or rheuma toid arthritis? Are there concurrent medical conditions such as diabetes, peripheral vascular diseases, osteoarthritis of the hip or previous malignancies? Are there systemic symptoms such as unexplained weight loss, chills or fever? Patients should al ways be asked about the presence of per ineal numbness (saddle area) and di ffi culties or changes in sen sation when passing urine or faeces, as these symptoms may indicate a cauda equina syndrome (CES) (Table 37.1). Patients should be asked whether the pain is interfering with their ability to work. What treatment has the patient alread tried and how e ff ective were these treatments (e.g. analgesics, e xercise, physiotherapy or spinal injections)? Pending litigation or worker’s compensation claims may have a negative prognos tic e ff ect on future treatments. Spinal deformities, e.g. scoliosis and excessive kyphosis (>50°), are generally painless in children but may be symp tomatic in adult life. How quickly has the spinal deformity pro gressed? It is important to assess skeletal maturity and whether the child has gone through a recent growth spurt. Has men struation commenced in the female or has the voice dropped in the male, indicating the onset of puberty? /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

TABLE 37.1 Cauda equina syndrome Low back pain Uni- or bilateral sciatica Saddle anaesthesia Motor weakness in the lower extremities Variable rectal and urinary symptoms

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PHYSICAL EXAMINATION

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The patient should be undressed and posture should be eval uated in both frontal and sagittal planes. Shoulder or waist asymmetry suggests the presence of scoliosis. The Adams forward bend test will accentuate trunk asymmetry and allow appr eciation of rib or loin prominence on the convex side of each curve. The skin should be examined for cutaneous neuro fibromata, café-au-lait patches or axillary freckling commonly present in neurofibromatosis. Neurological examination should include abdominal reflexes. Leg lengths should be measured. In the case of kyphosis , the sagittal alignment and forward gaze should be assessed. Palpation is useful to locate specific areas of tenderness. The normal range of motion in the cervical spine is 45° of flex ion, 55° of extension, 70° of rotation and 40° of lateral bend. The normal range of motion in the lumbar spine is 40–60° of fle xion, 20–35° of extension, 15–20° of lateral bending and 3–18° of rotation. Schober’s test is a simple clinical test William Adams , 1820–1900, described the forward bending test for scoliosis in 1865. His understanding of the nature of the rotational element of scoliosis was given by a postmortem examination he performed on an eminent surgeon and geologist, Gideon Mantell. Paul Schober , 1865–1943, German physician. Johann Ho ff mann , 1857 – 1919, Professor of Neurology , Heidelberg, Germany . Joseph Francis Felix Babinski , 1857–1932, neurologist, Hôpital de la Pitié, Paris, France. skin midway between the posterior superior iliac spines and at points 10 /uni00A0 cm proximal and 5 /uni00A0 cm distal to this mark while the pa tient is standing. The patient is then asked to bend forwards - as far as possible and the distance between the two points is measured with the patient in the flexed position. Normally one would expect to see an increase of at least 5 /uni00A0 cm between the two points in the erect and flexed positions. A distance of less than 5 /uni00A0 cm between these points may indicate ankylosing - spondylitis. - Neurological examination of the upper and lower limbs will focus on tone, power, coordination, reflexes, sensation and gait (Tables 37.2 and 37.3) . A rectal examination and y assessment of perineal sensation should be performed if there is any concern about cauda equina integrity . The superficial abdominal reflex is an upper motor neurone (UMN) reflex. - It is performed by stroking one of four abdominal quadrants in succession. The umbilicus should move towards the quad - rant that was stroked. The reflex should be symmetrical from - side to side. Absent or asymmetrical abdominal reflexes may - indicate intraspinal pathology such as syringomyelia or spinal cord injury . - Myelopathy or UMN lesions are reported by spasticity , motor weakness, hyper-reflexia, positive Ho ff mann’s sign (forced flexion of the distal phalanx of the middle finger results in flexion of the thumb and index finger), upgoing Babinski response and patellar and ankle clonus. Summary box 37.2 UMN lesions are characterised by: /uni25CF /uni25CF /uni25CF /uni25CF - /uni25CF /uni25CF /uni25CF /uni25CF - Typical signs of radiculopathy (lower motor neurone [LMN] lesion) include sensory loss, motor weakness, flaccid paralysis, muscle atrophy , loss of reflexes and muscle fascicu - lation. The straight leg raise (SLR) test is performed with the patient in the supine position. The leg is elevated with the knee - straight to increase tension along the L5 and S1 nerve roots. The test is positive if the leg elevation prov okes radicular pain. The crossed SLR test is carried out by elevating the asymp - tomatic leg; if positive, this produces sciatic symptoms in the opposite

leg. A positive test is associated with a herniated disc

Increased tone – spastic Hyper-re /f_l exia Muscle spasms Motor weakness Disuse atrophy Positive Hoffmann’s sign Ankle and patellar clonus Upgoing plantar response

in /uni00A0 97% /uni00A0 of patients. Lasègue’s sign denotes radicular pain aggravated by ankle dorsiflexion. The femoral nerve stretch test is performed with the patient in the prone position by extending the hip and flexing the knee. This creates tension on the L2, L3 and L4 nerve roots. The femoral nerve stretch test is considered positive if radicular pain occurs in the anterior thigh region during the test. The examination should include, where appropriate, exam ination of the shoulder, hip, knee, sacroiliac joint and vascular system, as dual pathology is common in the ageing community . In 1979, Waddell and colleagues (see Further reading developed and validated a series of signs and tests that have proved helpful in identifying individuals who are magnify ing or exaggerating symptoms, possib ly for secondary gain (Table 37.4) /uni25CF /uni25CF : /uni25CF : /uni25CF : /uni25CF : Summary box 37.3 LMN lesions are characterised by: /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF Charles Ernest Lasègue , 1816–1863, Professor of Medicine, University of Paris, and physician, La Salpêtrière, Paris, France

Neurological level Motor C5 Deltoid C6 Wrist extensors C7 Triceps C8 Long /f_i nger /f_l exors T1 Interosseus muscles TABLE 37.3 Neurological evaluation of the lower limb. Neurological level Motor L2 Hip /f_l exion L3 Knee extension L4 Ankle dorsi /f_l exion L5 Extensor hallucis longus S1 Ankle plantar /f_l exion TABLE 37.4 Non-organic physical signs in low back pain. Tenderness : super /f_i cial or non-anatomical Simulation tests axial loading or rotation Distraction tests variable straight leg raises Regional disturbances non-anatomical sensory or motor loss Over-reaction grimacing, muscle tremor, etc. Decreased tone – /f_l accid Hypore /f_l exia Denervation fasciculations Motor weakness Sensory loss Severe atrophy Downgoing plantar response Sensation Re /f_l exes Lateral arm Biceps (C5/6) Lateral forearm Brachioradialis (C5/6) Middle /f_i nger Triceps (C7/8) Medial forearm No re /f_l ex Medial arm No re /f_l ex Sensation Re /f_l exes Anterior thigh, groin No re /f_l ex Anterior and lateral thigh Patellar (L3/4) Medial leg and foot Patellar (L3/4) Lateral leg and foot No re /f_l ex Lateral foot and little toe Achilles (S1/2)

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Schober , 1865–1943, German physician. Johann Ho ff mann , 1857 – 1919, Professor of Neurology , Heidelberg, Germany . Joseph Francis Felix Babinski , 1857–1932, neurologist, Hôpital de la Pitié, Paris, France. skin midway between the posterior superior iliac spines and at points 10 /uni00A0 cm proximal and 5 /uni00A0 cm distal to this mark while the pa tient is standing. The patient is then asked to bend forwards - as far as possible and the distance between the two points is measured with the patient in the flexed position. Normally one would expect to see an increase of at least 5 /uni00A0 cm between the two points in the erect and flexed positions. A distance of less than 5 /uni00A0 cm between these points may indicate ankylosing - spondylitis. - Neurological examination of the upper and lower limbs will focus on tone, power, coordination, reflexes, sensation and gait (Tables 37.2 and 37.3) . A rectal examination and y assessment of perineal sensation should be performed if there is any concern about cauda equina integrity . The superficial abdominal reflex is an upper motor neurone (UMN) reflex. - It is performed by stroking one of four abdominal quadrants in succession. The umbilicus should move towards the quad - rant that was stroked. The reflex should be symmetrical from - side to side. Absent or asymmetrical abdominal reflexes may - indicate intraspinal pathology such as syringomyelia or spinal cord injury . - Myelopathy or UMN lesions are reported by spasticity , motor weakness, hyper-reflexia, positive Ho ff mann’s sign (forced flexion of the distal phalanx of the middle finger results in flexion of the thumb and index finger), upgoing Babinski response and patellar and ankle clonus. Summary box 37.2 UMN lesions are characterised by: /uni25CF /uni25CF /uni25CF /uni25CF - /uni25CF /uni25CF /uni25CF /uni25CF - Typical signs of radiculopathy (lower motor neurone [LMN] lesion) include sensory loss, motor weakness, flaccid paralysis, muscle atrophy , loss of reflexes and muscle fascicu - lation. The straight leg raise (SLR) test is performed with the patient in the supine position. The leg is elevated with the knee - straight to increase tension along the L5 and S1 nerve roots. The test is positive if the leg elevation prov okes radicular pain. The crossed SLR test is carried out by elevating the asymp - tomatic leg; if positive, this produces sciatic symptoms in the opposite leg. A positive test is associated with a herniated disc

Increased tone – spastic Hyper-re /f_l exia Muscle spasms Motor weakness Disuse atrophy Positive Hoffmann’s sign Ankle and patellar clonus Upgoing plantar response

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Plain radiographs

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It is not appropriate to order spine radiographs for every patient presenting with neck or low back pain. Patients with red flag signs or symptoms and those who have not responded to conservative treatment require imaging, with most units in resource-rich countries utilising MRI (no radiation penalty) in this situation. Standing radiographs of the whole spine are important for the assessment of scoliosis. Radiographs cannot diagnose early-stage tumour or infection, because significant bone destruction (between 40% and 60% of bone mass) must occur before a radiographic abnormality is detected. /uni25CF

Condition Signs and symptoms Cauda equina syndrome Severe or progressive bilateral neurological de /f_i cit of the legs, such as major motor weakness with knee extension, ankle eversion or foot dorsi /f_l exion Recent-onset urinary retention (caused by bladder distension because the sensation of fullness is lost) and/or urinary incontinence or alteration of function (caused by loss of sensation when passing urine) Recent-onset faecal incontinence (due to loss of sensation of rectal fullness) Perianal or perineal sensory loss (saddle anaesthesia or paraesthesia) Unexpected laxity of the anal sphincter Spinal fracture Sudden onset of severe central spinal pain that is relieved by lying down A history of major trauma (e.g. road traf /f_i c collision or fall from a height), minor trauma or just strenuous lifting in people with osteoporosis who take corticosteroids Structural deformity of the spine such as a step from one vertebra to an adjacent vertebra There may be point tenderness over a vertebral body Cancer The person being 50 years of age or more Gradual onset of symptoms Severe unremitting pain that remains when the person is supine, aching night pain that prevents or disturbs sleep, pain aggravated by straining (for example, at stool or when coughing or sneezing) and thoracic pain Localised spinal tenderness No symptomatic improvement after 4–6 weeks of conservative low back pain therapy Unexplained weight loss Past history of cancer; breast, lung, gastrointestinal, prostate, renal and thyroid cancers are more likely to metastasise to the spine Infection (such as discitis, vertebral Fever osteomyelitis or spinal epidural Tuberculosis or recent urinary tract infection abscess) Diabetes History of intravenous drug use HIV infection, use of immunosuppressants or where the person is otherwise immunocompromised HIV, human immunode /f_i ciency virus. TABLE 37.6 Non-spinal causes of low back pain: referred pain. Respiratory, e.g. mesothelioma Vascular, e.g. abdominal aortic aneurysm Renal, e.g. pyelonephritis Gastrointestinal, e.g. peptic ulcer, pancreatitis Urogenital, e.g. testicular, ovarian or prostatic carcinoma

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Primary tumours of the spine

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Primary bone tumours of the spine account for only 2% of all spinal tumours. They arise de novo in the bone, cartilage, neural or ligamentous structures of the spine. They may be benign, intermediate or malignant. Benign primary spine tumours include osteoid osteoma, osteoblastoma (Figure 37.6), chondroma, chondroblastoma, chondromyxoid fibroma, giant cell tumours, haemangioma, lymphangioma and lipoma. Intermediate primary spine tumours include aggressive osteoblastoma, haemangiopericytoma, haemangioendothe - lioma and chordoma. Malignant primary spinal tumours include osteosarcoma, chondrosarcoma, Ewing’s sarcoma, neuroectodermal tumours, malignant lymphoma, myeloma, eader is angiosarcoma, fibrosarcoma and liposarcoma. The r

(b) (d) Figure 37.6 Osteoblastoma arising from the posterior elements of C5. This 21-year-old man presented with severe unremitting neck pain. Isotope bone scan (a) demonstrated increased uptake in C5. An axial computed tomography scan (b) further delineated the expansive lesion. The tumour was successfully removed with the aid of an intraoperative gamma probe to con /f_i rm complete excision; (c, d) postoperative anteroposterior and lateral radiographs, /uni00A0 respectively, following reconstruction with a tricortical bone graft, lateral mass screws and rods.

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Provocative discography

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This investigation involves the placement of a 24-gauge needle into the centre of the intervertebral disc in a conscious patient. Radio-opaque contrast agent (1–3.5 /uni00A0 mL) is then injected into the disc. The contrast pattern will allow the discrimination of di ff erent degrees of disc degeneration; cotton ball or lobular would be considered normal whereas irregular, fissured or ruptured would be considered degenerate (Figure 37.1 patient is asked if they are experiencing their ‘usual type of back pain’. To diagnose discogenic low back pain one must document evidence of disc degeneration and concordant pain during the injection. Treatment options may include spinal fusion or disc replacement. Provocative discography

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After taking a history and examining the patient it is important to consider ‘red flags’ (Table 37.5), which allow diagnostic triage into those with serious pathology of the spine, such as CES, fractures, tumours and infection, and those without. - Red flags

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Spinal deformity may be categorised into a coronal plane deformity (scoliosis) or a sagittal plane deformity (kyphosis and lordosis). Further classification may be made on the basis of aetiology into congenital, neuromuscular, idiopathic or syndromic. Appropriate radiographs for the assessment of scoliosis include a full posteroanterior and lateral standing spine. When surgery is contemplated, supine lateral bending radiographs are obtained to assess the flexibility of the curve(s). Curve magnitude is measured in degrees and is known as the Cobb angle. The criterion for diagnosis of scoliosis is a Cobb angle of 10° or more. The causes of scoliosis are given in Table 37.13 . /uni25CF /uni25CF /uni25CF /uni25CF

TABLE 37.13 Aetiology of scoliosis. Idiopathic Neuromuscular Congenital Syndrome-related

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This is a unilateral or bilateral defect in the pars interarticu - laris without vertebral slippage. The incidence is reported in approximately 6% by the age of 14 years, but is much higher in the young athletic population. The diagnosis is di ffi cult to confir m with plain radiographs. Reverse gantry CT , MRI and single photon emission computed tomography (SPECT) are useful investigations for this condition. Treatment involves rest, non-steroidal anti-inflammatory medication, activity modifi - cation and a lumbosacral orthosis. For patients who remain symptomatic despite an adequate trial of non-operative care, surgery in the form of a direct repair of the pseudarthrosis b y a Buck’s fusion may be indicated. Spondylolysis /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

Incidence in general population 6% by 14 years Incidence in athletic population 15–47% May be completely asymptomatic/incidental /f_i nding on radiograph Dif /f_i cult to image, but MRI proving more useful Conservative treatment: activity modi /f_i cation, anti-lordotic brace Surgical treatment: direct repair preserving motion or spinal fusion if associated disc degeneration

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Incidence in general population 6% by 14 years Incidence in athletic population 15–47% May be completely asymptomatic/incidental /f_i nding on radiograph Dif /f_i cult to image, but MRI proving more useful Conservative treatment: activity modi /f_i cation, anti-lordotic brace Surgical treatment: direct repair preserving motion or spinal fusion if associated disc degeneration

Scheuermann’s kyphosis

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Typically , in this condition, there is wedging of the seventh to 10th thoracic vertebrae. The patient presents with both apical pain and low back pain (due to attempts by the lumbar musculature to compensate for the thoracic hyperkyphosis). - The incidence has been estimated at 1–8% of the population, and it is more common in males. Physiotherapy may be useful. Bracing for skeletally immature patients with kyphosis up to 65° may be e ff ective in arresting progression. Indications for surgery include pain (apical or low back pain produced by compensatory hyperlordosis), progressive deformity greater than 70°, unacceptable cosmesis and neurological and/or cardiopulmonary compromise. If surgery is contemplated, it may require anterior release followed by posterior correction and fusion. Increasingly , posterior chevron osteotomies carried out at the time of posterior instrumentation may prevent the need for the initial anterior release.
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Spina bifida

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Spina bifida is caused by a failure of fusion of the vertebral arches and possibly the underlying neural tube. Spina bifida cystica has an incidence of 1 in 300 live births and is associated with hydrocephalus. It is now decreasing as a consequence of folic acid supplementation, antenatal ultrasound and the measurement of α -fetoprotein (AFP) levels. There are two basic types: /uni25CF Meningocele : the meninges herniate through the bony defect and are covered by skin. /uni25CF Myelomeningocele : the roof of the defect is formed by exposed neural tissue, with 75% of patients developing hydrocephalus. A meningocele with good-quality skin over the defect may be treated conservatively . A meningocele with a more Julius Arnold , 1835–1915, Professor of Pathological Anatomy , University of Heidelberg, Heidelberg, Germany , described this condition in 1894. Hans Chiari , 1851–1916, Professor of Pathological Anatomy , Strasbourg, Germany (Strasbourg was returned to France in 1918 after the end of the First World War), gave his account of this condition in 1891. - prominent sac can be excised at 3–6 months. The manage - ment of myelomeningocele is more controversial. Enthusiasm for closing all defects has been replaced by a more selective approach with the recognition that it was inappropriate to en with severe hydrocephalus, a large open operate on childr defect and no distal neurological function. The majority of these children die in their first year if closure is not attempted. With antibiotics, early surgical closure and shunts to prevent hydrocephalus, half the children who survive the first 24 hours will reach school age, but long-term problems remain, includ - ing skin problems, neuromuscular scoliosis, bone and joint deformity and the complications associated with a neuropathic bladder.

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Spinal biopsy

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Either CT-guided or open biopsy is often performed to obtain tissue for diagnostic study in cases of suspected tumour and/ or infection.

Figure 37.1 Lumbar discography. Antero

posterior (a) and lateral (b) radiographs following injection of contrast medium into the lower three lumbar discs. Morphology: L3/4 cotton ball, L4/5 /f_i ssured, L5/S1 ruptured. Concordant low back pain was reproduced when injecting the L4/5 and L5/S1 discs. No pain was experienced when the

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Spinal dysraphism

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This is a group of disorders arising from abnormal embryo- logical formation of tissues; all are associated with a progressive neurological deficit as the result of spinal cord tethering and traction or cord compression. There is a strong association with spina bifida. In diastematomyelia, there is an abnormal bony or cartilag inous spur projecting across the middle of the vertebral canal, dividing the dural tube and spinal cord in two. Between 50% and 70% of patients are seen to have a skin naevus, dimple or hairy patch when the spine is examined. Surgical r elease of the tethering has variable results. Spinal dysraphism

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Spinal stenosis

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Spinal stenosis may be defined as any type of narrowing of the spinal canal, nerve root canal or intervertebral foramen. The resultant nerve root compression leads to nerve root - ischaemia, presenting with back, buttock or leg pain provoked by exercise. Spinal stenosis may be congenital, as is the case - in achondroplasia, or acquired, as is the case for degenerative types (commonly presenting between 50 and 70 years of age). The narrowing is caused by facet joint hypertrophy , disc bulg - ing and ligamentum flavum thickening. Symptoms of spinal claudication can be distinguished from vascular claudication because they are frequently associated with neurological symptoms, are often worse in e xtension and pedal pulses are present on clinical examination. Symptoms progress in approximately 20–33% of patients who receive no treatment. The condition may be treated successfully by surgi - cal decompression alone with preservation of the facet joints. Summary box 37.5 Spinal stenosis /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

Extremely common condition in the 50- to 70-year age group Classic symptoms: back, buttock, thigh and calf pain Provoked by walking and extended posture Relieved by /f_l exed posture Symptoms progress in up to one-third of untreated patients

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Spondylolisthesis is a forward slippage of the vertebral body engendered by a break in the continuity or elongation of the pars interarticularis and presents in 4% of the adult population. Spondylolisthesis can be classified into six types by causation (Table 37.8) or by the degree of slip (Table 37.9) . For skeletally immature patients (<18 years old) who have progressive slips in the spine, and in individuals with intract able low back or radicular pain or neurological symptoms, sur gery may be indicated. For low-grade slips (Meyerding grades I and II) fusion- in-situ is the procedure of choice. If there is objective evidence of neural compression (e.g. weakness of extensor hallucis longus), a spinal decompression should be performed at the same time. For high-grade slips (Meyerding grades III or IV) (Figure 37.5), opinion is divided on whether to reduce the slip first and then fuse, or simply to fuse in situ Spondylolisthesis

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Syringomyelia

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TUMOURS OF THE SPINE Metastatic tumours

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The commonest malignancies that metastasise to the spine are shown in Table 37.10 . Red flags picked up on history or examination will alert the clinician to this possible diagnosis. Over 80% of patients with spinal metastases present with progressive pain, and only 20% present with spinal cord com pression. Relevant investigations include full blood count (FBC), urea and electrolytes , liver function tests, calcium, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), prostate-specific antigen (PSA), serum protein electro phoresis , thyroid function tests (where a thyroid mass has been palpated) and nutritional indices. Plain radiographs may show an absent pedicle (‘winking owl’ sign), vertebral cortical erosion and/or vertebral collapse. MRI of the whole spine will detect most metastases. Most metastases are osteoblastic and will show up on bone scintigraphy; however, osteolytic lesions such as multiple myeloma and renal cell carcinoma may not show up on an isotope bone scan. Metastases from the prostate may be sclerotic. Biopsies may be obtained via a percutaneous CT-guided method or open biopsy . Henry W Meyerding , 1884–1969, Professor of Orthopaedic Surgery , Mayo Clinic, Rochester, MN, USA. James Ewing , 1866–1943, Professor of Pathology , Cornell University Medical College, New Y ork, NY , USA, described this type of sarcoma in 1921. /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF - - . - Treatment options include orthotics, steroids (dexametha - sone), radiotherapy , chemotherapy , hormonal therapy , surgery or a combination of any of the above. Radiotherapy promotes - reossification of the vertebral body and reduces tumour load. It can be very e ff ective f or reducing ‘bone pain’. Lymphoma, breast, lung and prostate metastases are highly radiosensi - tive . Gastrointestinal adenocarcinoma, metastatic melanoma, thyroid and renal carcinoma are radioresistant . Small cell carcinoma of the lung, Ewing’s sarcoma, thyroid carcinoma, breast carcinoma and neuroblastoma are usually sensitive to chemotherapy and should have chemotherapeutic agents as the first-line management. Adenocarcinoma of the lung is resistant to chemotherapy . Prostate metastases may respond well to antiandrogenic hormone medication.

(see Further reading). Type 1 Dysplastic Associated with congenital de /f_i ciency of the L5/S1 articulation Type 2 Isthmic Associated with a lesion of the pars interarticularis Three subtypes: 2A: lytic defect of the pars 2B: elongated or attenuated pars 2C: acute pars fracture Type 3 Degenerative Segmental instability due to disc spondylolisthesis degeneration/facet arthrosis Type 4 Traumatic Acute fracture in the region of the posterior elements, other than the pars interarticularis Type 5 Pathological Generalised bone disease resulting in attenuation of the pars (e.g. metabolic, neoplastic) Type 6 Post surgical After decompression of the lumbar spine TABLE 37.9 The Meyerding classi /f_i cation for the degree of slip of spondylolisthesis. Grade I 1–25% Grade II 26–50% Grade III 51–75% Grade IV 76–100% TABLE 37.10 Commonest malignancies that

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(d) (e) (g) Figure 37.5 High-grade spondylolisthesis. Lateral standing radiograph grade IV slip associated with high pelvic incidence. Anteroposterior (AP) radiograph the inverted Napoleon hat sign. T2-weighted mid-sagittal magnetic resonance imaging scan the ‘domed sacrum’. The patient underwent a modi /f_i ed Gaines procedure under one anaesthetic anterior vertebral resection of L5 along with the L4/5 and L5/S1 intervertebral discs, followed by resection of the posterior elements, articular process and L5 pedicles. AP /f_i nal reduction of L4 onto the sacrum with pedicle /f_i xation from L4 to S2. standing radiograph at 12 months. (f) (a) demonstrates Meyerding (b) demonstrates (c) shows (d) with (e) and lateral (f) radiographs demonstrate (g) Postoperative full-length lateral

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(see Further reading). Type 1 Dysplastic Associated with congenital de /f_i ciency of the L5/S1 articulation Type 2 Isthmic Associated with a lesion of the pars interarticularis Three subtypes: 2A: lytic defect of the pars 2B: elongated or attenuated pars 2C: acute pars fracture Type 3 Degenerative Segmental instability due to disc spondylolisthesis degeneration/facet arthrosis Type 4 Traumatic Acute fracture in the region of the posterior elements, other than the pars interarticularis Type 5 Pathological Generalised bone disease resulting in attenuation of the pars (e.g. metabolic, neoplastic) Type 6 Post surgical After decompression of the lumbar spine TABLE 37.9 The Meyerding classi /f_i cation for the degree of slip of spondylolisthesis. Grade I 1–25% Grade II 26–50% Grade III 51–75% Grade IV 76–100% TABLE 37.10 Commonest malignancies that metastasise to the spine and their frequency. Breast 21% Lung 14% Prostate 7.5% Renal 5% Gastrointestinal 5% Thyroid 2.5%

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(d) (e) (g) Figure 37.5 High-grade spondylolisthesis. Lateral standing radiograph grade IV slip associated with high pelvic incidence. Anteroposterior (AP) radiograph the inverted Napoleon hat sign. T2-weighted mid-sagittal magnetic resonance imaging scan the ‘domed sacrum’. The patient underwent a modi /f_i ed Gaines procedure under one anaesthetic anterior vertebral resection of L5 along with the L4/5 and L5/S1 intervertebral discs, followed by resection of the posterior elements, articular process and L5 pedicles. AP /f_i nal reduction of L4 onto the sacrum with pedicle /f_i xation from L4 to S2. standing radiograph at 12 months. (f) (a) demonstrates Meyerding (b) demonstrates (c) shows (d) with (e) and lateral (f) radiographs demonstrate (g) Postoperative full-length lateral

reserved for those patients whose life expectancy exceeds 3–6 months. For patients with malignant spinal cord compression, the combination of decompressive surgery with stabilisation and postoperative radiotherapy has been shown to be superior in outcome when compared with radiotherapy alone. In one randomised trial, surgery and radiotherapy permitted most patients to remain ambulatory for the remainder of their lives, Summary box 37.7 Metastatic tumours of the spine /uni25CF /uni25CF /uni25CF portion of their remaining time as paraplegics.

Commonest presentation is progressive spinal pain Whole-spine MRI will detect most metastases Surgery is indicated for instability, pain, progressive deformity or neurological de /f_i cit (a) (c)

The lack of trained spinal surgeons

The lack of trained spinal surgeons

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Population per provider <18,059 18,059 – 56,261 56,261 – 139,732 139,732 – 306,301 306,301 – 664,333

> 664,333 Figure 37.10 Global distribution of surgeons, anaesthetists and obstetricians. Each country in the world is represented with an area proportional to the number of the population per active surgeon. (Reproduced with permission from Holmer H, Lantz A, Kunjumen T of surgeons, anaesthesiologists, and obstetricians. Lancet Glob Health (a) Figure 37.11 (a) Lateral cervical spine radiograph with a fracture/dislocation at C2/3 sustained by a patient living in a low-income country. (b) The surgeon used a low-risk, low-technology technique, wiring the arch of C1 to the spine of C2 with a piece of stainless steel wire, then laying on corticocancellous bone graft. et al . Global distribution 2015; 3 (Suppl 2): S9–11.) (b)

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Thoracic disc herniation

Thoracic disc herniation

Thoracic disc herniations that require surgical intervention are rare, accounting for less than 2% of all discectomy procedures. Typically , the patient presents with axial pain, radiculopathy or myelopathy . Conservative treatment including non-steroidal anti-inflammatory drugs, physiotherapy and general fitness improvement should be considered initially . If required, thoracic discectomy may be performed via thoracotomy or, for a soft disc prolapse, via a thoracoscopic approach.

Figure 37.2 Cervical total disc replacement. The patient presented with severe left-sided C6 radicu

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Tuberculosis

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This is discussed in Chapters 6 and 43 . Tuberculosis

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modern imaging and equipment

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The key to good surgery in all disciplines is a surgeon who is dedicated to the care of his or her patient, who takes a good history and examination and then o ff ers the best treatment that is available under the circumstances. In a high-income country this will often involve MRI scanning, dissection under microscope control and expensive titanium implants. In a resource-poor, low-income country it may involve just as much time and skill, but often a much more conservative approach. When surgery is needed the surgeon may have to do the best that he or she can with the equipment available. The case in Figure 37.11 illustrates this point well. Note the lateral cervical spine radiograph with a fracture/dislocation at C2/3 sustained by a patient living in a low-income country . The pedicles of C2 are fractured, allowing C2 to subluxate forwards on C3 and compress the spinal cord. The patient was admitted several days after a car crash, holding his head with his hands for stability . In a high-income country where there is imaging and fluoroscopic-guided pedicle screw fixation, the fracture could easily be fixed. In the low-income country , there was no cervical spine instrumentation available and the surgeon used a low-risk, low-technology technique of wiring the arch of C1 to the spine of C2 with stainless steel wire, then laying on corticocancellous bone graft. The reduction was stable, the graft incorporated and the patient was thankful. It is not appropriate to say that this was inadequate treatment compared with the best that the world has to o ff er, because the best that the world has to o ff er was not available. Debnath UK, Freeman BJ, Gregory P et al. Clinical outcome and return to sport after the surgical treatment of spondylolysis in young athletes. J Bone Joint Surg Br 2003; 85 (2): 244–9. Fairbank J, Frost H, Wilson-McDonald J et al. Randomised controlled trial to compare surgical stabilisation of the lumbar spine with an intensive rehabilitation programme for patients with chronic low back pain: the MRC spine stabilisation trial. BMJ 2005; 330 : 1233–8. Fritzell P , Hägg O, Wessperg P et al. V olvo Award in Clinical Science: lumbar fusion versus non-surgical treatment for chronic low back pain. A multi-centre randomised controlled trial from the Swedish Lumbar Spine Study Group. Spine 2001; 26 : 2521–34. Gardner A, Gardner E, Morley T . Cauda equina syndrome: a review of the current clinical and medico-legal position. Eur Spine J 2011; 20 (5): 690–7. Holmer H, Lantz A, Kunjuman T et al. Global distribution of surgeons, anaesthesiologists, and obstetricians. Lancet Glob Health 2015; 3 : S9–11. Janssen ME, Zigler JE, Spivak JE et al. ProDisc-C total disc replacement versus anterior cervical discectomy and fusion for single-level symptomatic cervical disc disease. Seven-year follow-up of the prospective randomized U.S. Food and Drug Administration investigational device exemption study . J Bone Joint Surg Am 2015; 97 (21): 1738–47. Meara JG, Leather AJ, Hagander L et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. Lancet 2015; 386 : 569–624. Patchell RA, Tibb PA, Regine WF et al . Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. Lancet 2005; 366 : 643–8.

Srikandarajah N, Noble A, Clark S, et al. Cauda Equina Syndrome Core Outcome Set (CESCOS): an international patient and healthcare professional consensus for research studies. PLoS ONE 2020; 15 (1): e0225907. Tokala DP , Lam KS, Freeman BJ et al. C7 decancellisation closing wedge osteotomy for the correction of fixed cervico-thoracic kyphosis. Eur Spine J 2007; 16 (9): 1471–8. Waddell G, McCulloch JA, Kummel ED et al. V olvo Award in Clinical Science: non organic physical signs in low-back pain. Spine 1979; 5 : 117–25. Wiltse LL, Newman PH, Macnab I. Classification of spondylosis and spondylolisthesis. Clin Orthop 1976; 117 : 23–9. modern imaging and equipment?

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