NOTES
SPINAL DISORDERS

GENERALLY, WHAT ARE THEY?

PATHOLOGY & CAUSES

- Disorders affecting spinal column
  - Includes vertebrae, intervertebral discs, surrounding structures

RISK FACTORS

- Obesity, extreme exercise/any factor that ↑ spinal column pressure

COMPLICATIONS

- Nerve compression, arthritis, progressive degenerative disease

SIGNS & SYMPTOMS

- Localized pain, stiffness, limited range of motion
- Spine shape irregularities
- Compression → pulmonary, cardiac, gastrointestinal disorders
- Neurologic signs
  - Numbness, paresthesia, weakness, tingling (if nerves affected)

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Detects soft tissue involvement
  - Intervertebral discs, ligaments, nerves

X-ray

- May show osteoarthritis signs
  - Joint pain narrowing, bony spurs

TREATMENT

SURGERY

- If cause irreversible, condition advanced

OTHER INTERVENTIONS

- Malformation
  - Bracing
- Physical rehabilitation, analgesia

DEGENERATIVE DISC DISEASE

osms.it/degenerative-disc-disease

PATHOLOGY & CAUSES

- Progressive intervertebral disc breakdown
- Most common back-pain source
- Accrual of factors → intervertebral disc's nucleus pulposus (mostly water) dehydration → ↓ proteoglycan, collagen → ↓ padding between vertebrae → unable to absorb shock → disc collapse → annular tears, herniation of disc contents into spinal canal → nerve root irritation → nerve impingement → pain

CAUSES

- Multifactorial
  - Accumulation of natural stress, minor injury throughout life
  - Genetic predisposition

RISK FACTORS

- Genetic predisposition, advanced age, menopause, repeated spinal trauma

COMPLICATIONS

- Spine collapse, disc herniation, compression fracture, bony spur growth, neurologic deficit, myelopathy, vertebral artery compression

SIGNS & SYMPTOMS

- Back pain (not correlating to damage's extent), ↓ range of motion
- Pain may radiate
- Tingling, paresthesia, numbness
- Muscle weakness/atrophy
- ↓ deep tendon reflexes
- Headache, dizziness, vertigo

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Evaluates spinal canal, visualizes space available for neural structures
- ↑ signal on T2-weighted images indicate disc dehydration
- Detects annular tears

X-ray

- Detects fracture

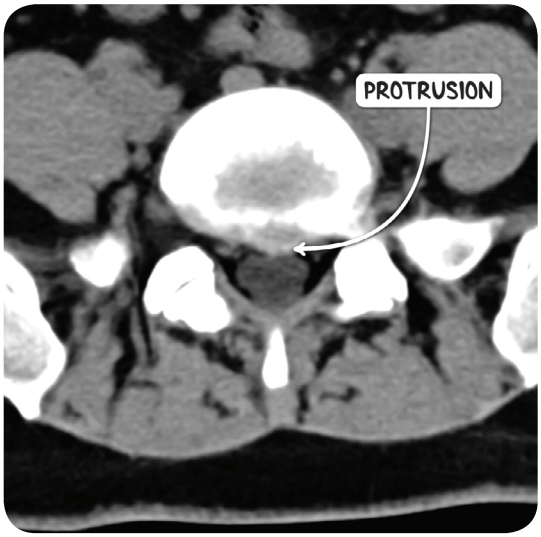

Figure 119.1 An MRI scan of the spine.

TREATMENT

MEDICATIONS

- Pain management
  - Non steroidal anti-inflammatory drugs (NSAIDs), local/epidural corticosteroids

SURGERY

- Corpectomy
  - Vertebral portion removal → enlarge intervertebral space
- Discectomy
  - Herniated disc portion removed
- Nerve root injection
- Intervertebral disc arthroplasty
  - Degenerated discs replaced with artificial discs
- Laminotomy
  - Lamina removal → relieve nerve root pressure

KYPHOSIS

osms.it/kyphosis

PATHOLOGY & CAUSES

- Exaggerated cervical, thoracic, sacral spinal convex curvature
- Greek κυφός *kyphos*, meaning "hump"
- *Cobb angle:* used to measure extent of curvature
  - Angle > 45° classified as kyphosis
- Damage to vertebrae, intervertebral discs/supporting ligaments/muscles → weight-bearing forces asymmetry → further damage to high-pressure area structures → "wedge-shaped" vertebra → spinal curving

TYPES

- May also be caused by trauma/iatrogenic causes (surgery)

Postural

- Most common, occurs all ages

Structural

- Osteoporosis, tumors, tuberculosis (Gibbus malformation), ankylosing spondylitis, fractures, arthritis

Congenital

- Vertebral malformation/*in utero* fusion

Scheuermann's kyphosis

- Adolescent onset, type of osteochondrosis (disordered cartilage ossification)
- Vertebral disc intrudes into end plates in anterior ossification areas (Schmorl's nodes on X-ray)

RISK FACTORS

- Poor posture, weak back muscles, older age, vertebral fracture, osteoporosis, degenerative disc disease, arthritis
- Genetic disease affecting bone, ligaments
  - Osteogenesis imperfecta, Marfan syndrome, Ehler–Danlos syndrome, mucopolysaccharidosis, glycogen storage disease

COMPLICATIONS

- Sternal/vertebral fracture
- Cardiac disease
- Imbalance → fall, fracture risk
- Neurologic
  - Nerve compressions
- Respiratory
  - ↓ pulmonary function
- Gastrointestinal dysfunction
  - Dysphagia, reflux, hernias

SIGNS & SYMPTOMS

- Anterior thoracic pain, dyspnea, limited mobility
- Convex spinal curvature
- Dysphagia, reflux

DIAGNOSIS

- Clinical diagnosis
  - Curvature measurement using flexicurve ruler

DIAGNOSTIC IMAGING

X-ray

- *Sagittal plane:* > 45° Cobb angle
  - Lines drawn above first, last deviating vertebra → draw perpendicular lines to those → angle where they close is Cobb angle

TREATMENT

SURGERY

- Reserved for significant pulmonary/neurologic impairment cases

OTHER INTERVENTIONS

- Milwaukee brace
  - Improves proprioception, helps support back muscles
- Physical therapy strengthens back muscles
- Pain management

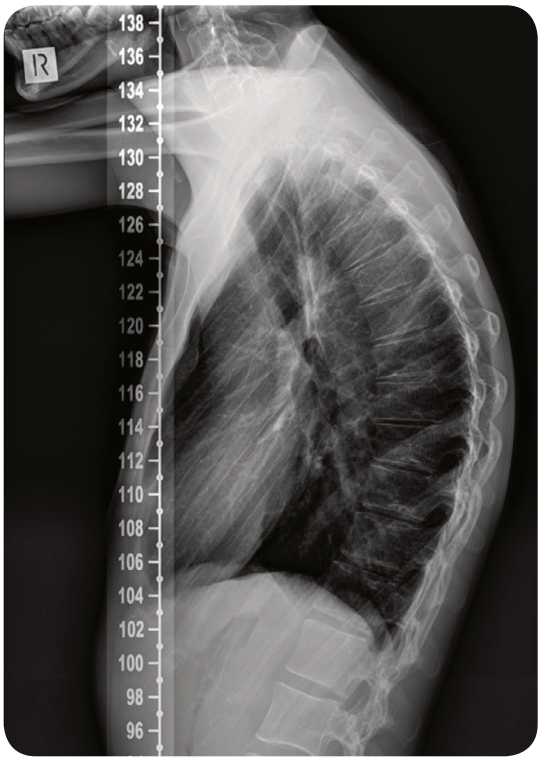

Figure 119.2 A lateral X-ray image of the spine demonstrating marked thoracic kyphosis secondary to Scheuermann's disease.

LORDOSIS

osms.it/lordosis

PATHOLOGY & CAUSES

- Exaggerated inward curvature of lumbar, cervical spine
- Greek *lordōsis*, from *lordos*, meaning "bent backward"
- Bone/neuromuscular imbalance → weight-bearing force asymmetry → further damage to high-pressure area structures/compensatory muscle spasms → spinal curving

CAUSES

- High spine flexibility, lower limb imbalance
- Hip imbalance; improper lifting, squatting
- Muscle strength imbalance (e.g. weak hamstrings; tight hip flexors)
- Obesity
- Osteoporosis
- Spondylolisthesis, discitis
- Temporary lordosis during pregnancy

RISK FACTORS

- Poor posture, muscle strength imbalance
- Musculoskeletal
  - Osteoporosis, spondylolisthesis
- Genetic
  - Achondroplasia, Ehler–Danlos syndrome

COMPLICATIONS

- Degenerative disc disease, nerve compression

SIGNS & SYMPTOMS

- Lower-back pain
- Apparent ↑ lower-back curvature

DIAGNOSIS

- Physical examination reveals ↑ degree of lower-back curvature, muscle tightness

DIAGNOSTIC IMAGING

MRI

- Detects nerve compression

X-ray

- Confirms curvature degree
- Lamina, neural arch of vertebrae may form divert 'V' on anteroposterior lumbar spine radiograph

TREATMENT

OTHER INTERVENTIONS

- Boston brace
  - ↓ disc stress, muscle strengthening
- Physical therapy to strengthen, balance back muscles
- Pain management

Figure 119.3 A lateral X-ray image of the spine in an individual with hyperlordosis of the lumbar spine.

SCOLIOSIS

osms.it/scoliosis

PATHOLOGY & CAUSES

- Lateral spinal curvature in coronal plane, commonly coexists with rotational curvature
- Bone/neuromuscular imbalance in vertebral/paravertebral area → weight-bearing force asymmetry → further damage to high-pressure area structures → spinal curving
- Sometimes associated with kyphosis, lordosis

Classification according to etiology

- Structural (intrinsic)
- Postural (compensatory)

Classification according to shape

- C/S shaped
- Direction
  - Projection of curvature apex defined with segment involved (most common right-thoracic with left-lumbar presentation)

CAUSES

- Congenital
- Idiopathic
  - Most common; infantile, juvenile, adolescent/early–late onset
  - Multifactorial (environmental, genetic factors)
- Secondary
  - Osteopathic (Marfan syndrome), neuromuscular, neuropathic (neural palsy), myopathic, neurofibromatosis

RISK FACTORS

- Family history
- Obesity
- Lower limb fracture → limb length difference → compensatory scoliosis
- Sudden growth
- Bone tumors, neuromuscular/neural disorders (e.g. Duchenne muscular dystrophy)
- Advanced bone maturity at presentation, biologically-female individuals
  - More severe progression

COMPLICATIONS

- Chest wall abnormalities → respiratory compromise, cardiac complications
- Low self-esteem, depression
- Spinal nerve damage, hemiplegia

Figure 119.4 An individual with thoracic and lumbar scoliosis. The uneven position of the scapulae is clearly visible.

SIGNS & SYMPTOMS

- Visible spinal curvature, fanning of ribs on one side, uneven musculature
- Back pain
- Difficulty breathing
- Intestinal compression → gastrointestinal difficulty

DIAGNOSIS

DIAGNOSTIC IMAGING

X-ray

- Cobb angle
  - Lines drawn above first, last deviating vertebra → draw perpendicular lines to those → Cobb angle > 10°

OTHER DIAGNOSTICS

Physical examination

- Adams Forward Bend Test
  - Shows torsion, shoulder, pelvis misalignment, unparallel scapulae

TREATMENT

SURGERY

- Cobb angle > 45°
  - Vertebral fusion surgery

OTHER INTERVENTIONS

- Cobb angle < 30°
  - Watchful waiting (frequent check ups estimating curve angle, physical therapy)
- Cobb angle > 30°
  - Boston brace

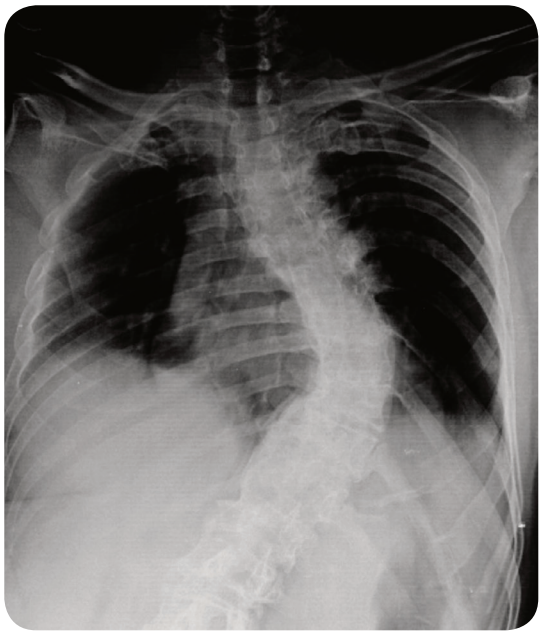

Figure 119.5 A plain chest radiograph demonstrating spinal scoliosis.

SPINAL DISC HERNIATION

osms.it/spinal-disc-herniation

PATHOLOGY & CAUSES

- Middle portion of intervertebral disc (*anulus pulposus*) herniates through tear in outer portion (*anulus fibrosus*) of disc
  - AKA slipped disc
- Weakening of intervertebral disc's outer circle → outer ring tear → inner ring bulging out of spinal column → local nerve compression
- Disc protrusion
  - Outer ring intact but middle portion of disc bulges
  - May → herniation

RISK FACTORS

- Obesity, advanced age, heavy lifting, degenerative disc disease, trauma

COMPLICATIONS

- Nerve impingement
- Sciatica
- Cauda equina syndrome (compression of nerve roots controlling bowel, bladder, legs)

SIGNS & SYMPTOMS

- Continuous pain in certain position, level dependent on injury extent, often unilateral (may present bilaterally)
- Sciatica
  - Lumbar/sacral nerve root compression → pain radiating down legs
- Other symptoms
  - *Sensory:* numbness, paresthesia
  - *Motor:* chronic atrophy, weakness

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Confirm diagnosis

OTHER DIAGNOSTICS

History

- History of heavy lifting, bone degenerative disease

Clinical exam

- Straight leg raise test
  - Individual lies supine, clinician passively raises leg → pain indicates disc herniation

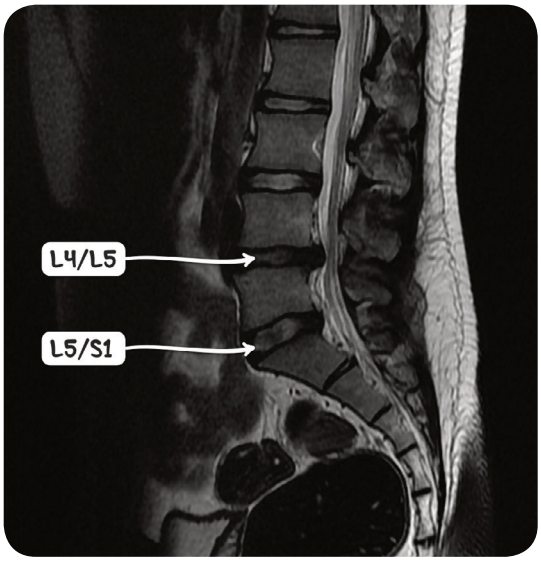

Figure 119.6 An MRI scan of the spine in the sagittal plane demonstrating protrusion of the L4/L5 and L5/S1 intervetebral discs.

TREATMENT

MEDICATIONS

- Pain, inflammation control
  - NSAIDs, local corticosteroids

SURGERY

- Repair
  - In neurologic signs, nerve compression cases

OTHER INTERVENTIONS

- Physical rehabilitation, weight loss

SPINAL STENOSIS

osms.it/spinal-stenosis

PATHOLOGY & CAUSES

- Common chronic condition characterized by narrowing of spinal canal/intervertebral foramina
  - More common in cervical, lumbar regions

CAUSES

- Aging
  - Bone spurs grow into canal, ligaments thicken, slipped discs
- Skeletal disease (e.g. rheumatoid arthritis, osteoarthritis, Paget disease, ankylosing spondylitis, spondylosis, degenerative disc disease)
- Congenital (e.g. achondroplasia, spinal dysraphism)
- Other causes
  - Trauma, fracture, neoplasm, idiopathic

RISK FACTORS

- Obesity, advanced age, family history

COMPLICATIONS

- Cauda equina syndrome
  - Bilateral leg weakness, urinary incontinence
  - Spinal cord narrowing → nerve root compression (L3–S4) → bowel incontinence/sexual dysfunction
  - Neurologic emergency (requires immediate surgical decompression)

SIGNS & SYMPTOMS

- Canal diameter < 10mm
- Neurogenic claudication
  - Discomfort, sensory loss/leg weakness (buttocks, calves)
  - Symptomatic when active (e.g. walking, standing); with lumbar extension
  - Relieved by rest, lying down, waist flexion (squatting, leaning forward)
  - Back pain may coexist
- Radicular pain
  - Pain radiates along dermatome
- Neurologic symptoms
  - Typically bilateral if nerve compression is involved
  - Numbness, weakness, paresthesia, limb pain, urinary/bowel incontinence, sexual dysfunction

DIAGNOSIS

DIAGNOSTIC IMAGING

CT myelogram

- Shows detailed spinal canal contours (if MRI contraindicated)

MRI

- Spinal canal narrowing, nerve compression

TREATMENT

MEDICATIONS

- Pain medications (NSAIDs), epidural steroid injections

SURGERY

- Decompression (advanced disease, complications)

OTHER INTERVENTIONS

- Physical therapy, weight loss

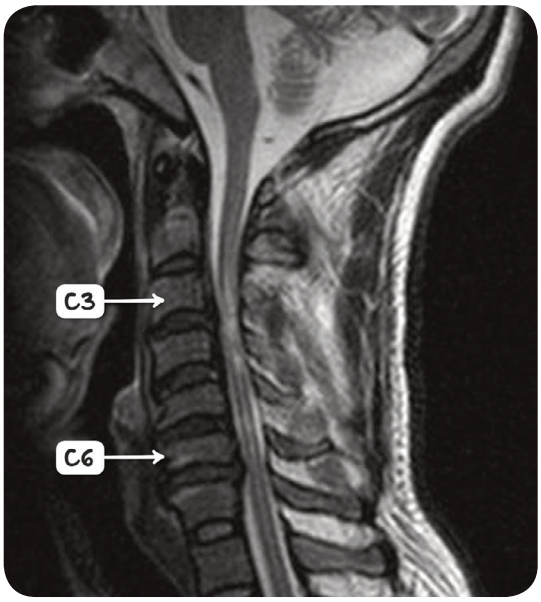

Figure 119.7 An MRI scan of the cervical spine demonstrating spinal stenosis from C3 to C6 resulting in cord compression.

SPONDYLITIS

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PATHOLOGY & CAUSES

- Chronic vertebrae, vertebral joint inflammation
- AKA spondyloarthritis
- Autoimmune/infectious agent attacks vertebra → inflammatory cells invade site → inflammation, damage to bone, cartilage; thick paravertebral ossification formation
- Spondylodiscitis
  - Vertebrae, intervertebral disc inflammation

CAUSES

- Infectious
- E.g. Pott's disease (osteoarticular tuberculosis); Staphylococcus aureus
- Autoimmune
- Ankylosing spondylitis, rheumatoid arthritis

RISK FACTORS

- Family history
- Immunocompromised state
- Spinal surgery/invasive intervention history

COMPLICATIONS

- Osteoporosis, osteopenia
- Fractures
- Neurologic
- Spinal cord compression, cauda equina syndrome

SIGNS & SYMPTOMS

- Localized pain
  - Segment-dependent
- Gradual symptom onset
  - Autoimmune disease
- Limited movement
- Spinal stiffness
- Symptoms worse in morning, improve with exercise

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Shows calcifications in column; may reveal erosive disease

X-ray

- Asymmetric parasyndesmophytes visualization (paravertebral soft-tissue calcifications)

LAB RESULTS

- Blood tests
  - Infectious cause
- Genetic testing
  - Autoimmune cause

OTHER DIAGNOSTICS

- History of joint pain
- Positive autoimmune disease/exposure history

TREATMENT

MEDICATIONS

- Infectious cause
  - Antibiotics
- Autoimmune disease
  - Disease modifying rheumatoid medications (sulfasalazine, local corticosteroids)
- Pain management (NSAIDS, opioids); severity-dependent

SURGERY

- Severe cases

OTHER INTERVENTIONS

- Physical therapy to strengthen back muscles

SPONDYLOLISTHESIS

osms.it/spondylolisthesis

PATHOLOGY & CAUSES

- Spontaneous anterior/posterior vertebral body slippage over one below it
  - Most commonly affects lumbosacral articulation
- Vertebral joint dysfunction → joint instability → vertebral body slipping from original position

CAUSES

- Lytic/isthmic
  - Most common
  - Multiple *pars interarticularis* microfractures; usually affects athletes
- Degenerative
  - Pseudospondylolisthesis, arthritis, osteoporosis
- Dysplastic
  - Congenital posterior spinal dysplasia elements; usually presents with adolescent growth spurt

- Pathologic
  - Vertebral lesions; neoplastic/infectious infiltration
- Traumatic
  - Facet(s)/pars interarticularis fracture; post-surgical complication

RISK FACTORS

- Genetic predisposition
- Competitive sports (dancing, gymnastics)
- Extreme growth spurt, muscle weakness
- Spinal malformation (Scheuermann's kyphosis)
- Biologically-female individuals

COMPLICATIONS

- Intervertebral disc degeneration
- Spinal stenosis

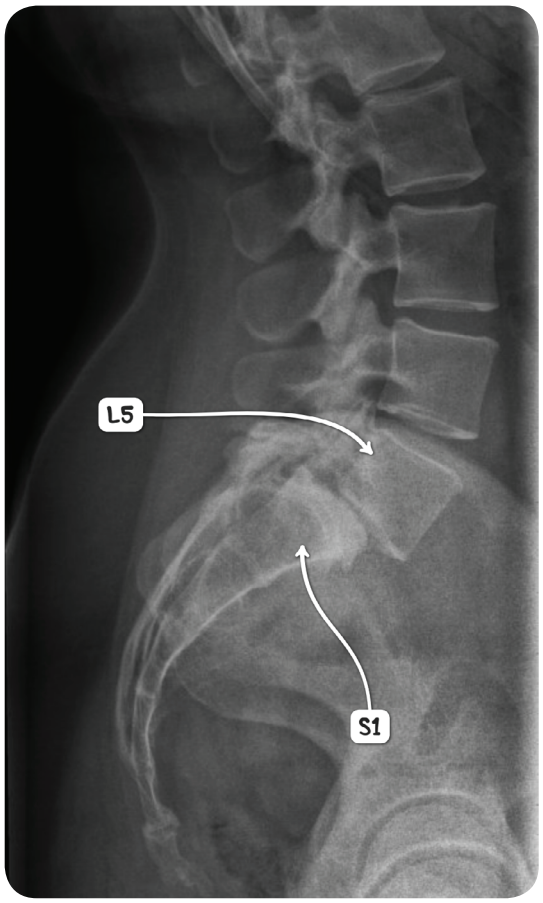

Figure 119.8 A lateral X-ray image of the spine demonstrating spondylolisthesis at L5/S1.

SIGNS & SYMPTOMS

- Chronic back pain/stiffness, posterior leg compartment tightness
  - Pain ↑ with activity, ↓ with rest
- Limited range of motion
- Change in gait (often waddling)
- Forward flexion with development of transverse abdominal crease
- Hip, knee flexion malformations
- Sciatic nerve involvement signs (radiating pain down legs)

DIAGNOSIS

DIAGNOSTIC IMAGING

X-ray or CT scan

- Shows altered vertebral body alignment

TREATMENT

MEDICATIONS

- Pain management (e.g. NSAIDs)

SURGERY

- Repair
  - If persistent pain/neurologic symptoms, vertebral sliding is > 50%

OTHER INTERVENTIONS

- Orthoses (lumbar corset)
  - May help reestablish proprioception, strengthen muscles
- Physical therapy to strengthen back muscles

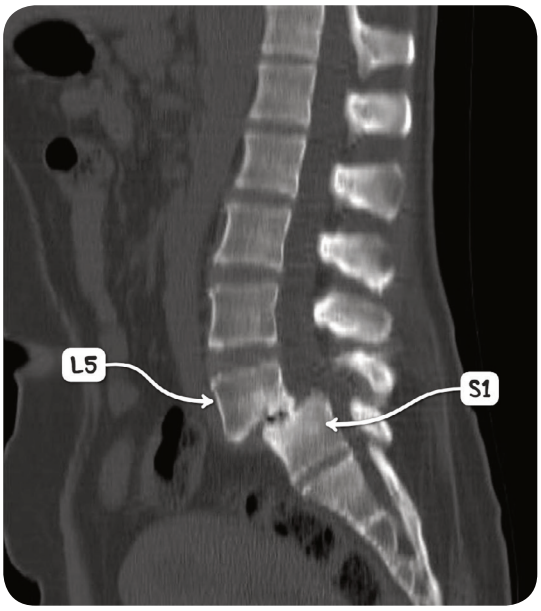

Figure 119.9 A CT scan of the spine in the sagittal plane demonstrating spondylolisthesis of the L5/S1 intervertebral joint.

SPONDYLOLYSIS

osms.it/spondylolysis

PATHOLOGY & CAUSES

- *Pars interarticularis* vertebral defect, mostly lumbar area
  - May be unilateral/bilateral
- Extreme lumbar spine stress → spinal overextension with rotation → vertebral arch fracture/separation

CAUSES

- Unknown, occasionally appears asymptomatically

RISK FACTORS

- Extreme sports during adolescence

COMPLICATIONS

- Sciatica, spondylolisthesis, spinal malformations

SIGNS & SYMPTOMS

- Pain, lumbar spine pressure sensation, focal tenderness
- Unilateral pain radiates into corresponding side's leg
- Painful lumbar spine extension
- Antalgic gait
  - Stance phase of gait shorter than swing phase as means of avoiding pain
- ↑ lumbar lordosis
- Hamstring tightness

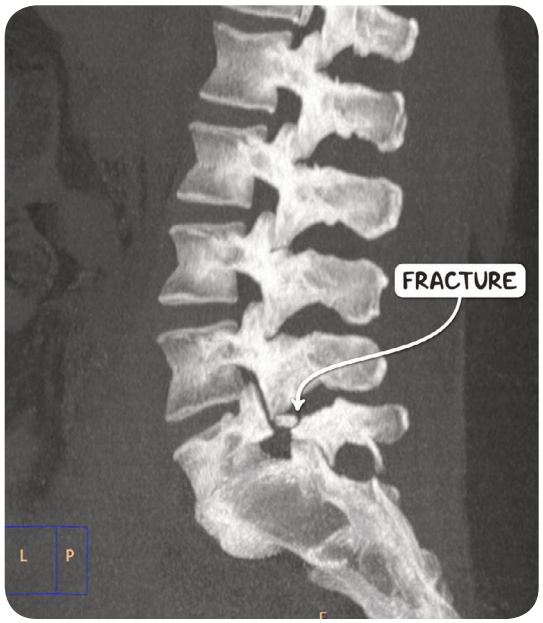

Figure 119.10 A CT scan of the spine in the sagittal plane demonstrating spondylolisthesis of the L5/S1 intervertebral joint.

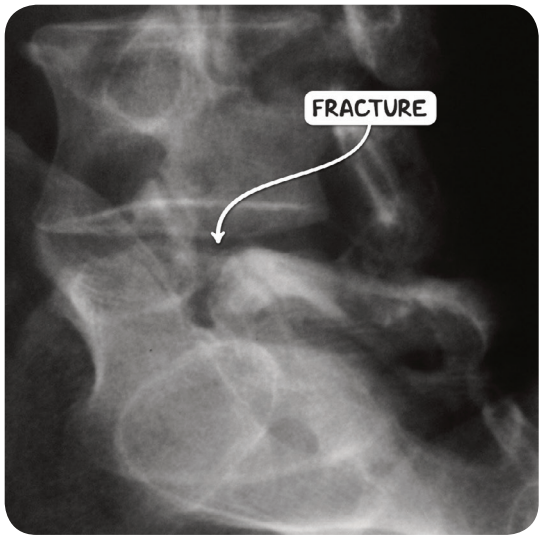

Figure 119.11 A plain radiograph of the spine shows the "scotty dog sign" in a case of spondylolysis.

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Used if neurological findings; visualizes soft tissue, neural structures

X-ray/CT scan

- Lucency in region of *pars interarticularis*
- Description
  - Collar/"broken neck on the Scotty dog" in lateral oblique view

OTHER DIAGNOSTICS

- Clinical exam
  - Stork test (ask to stand on one leg, lift the other hip), tenderness on palpation in fracture area

TREATMENT

MEDICATIONS

- Pain management

OTHER INTERVENTIONS

- Boston brace
- Physical therapy to strengthen back muscles

SPONDYLOSIS

osms.it/spondylosis

PATHOLOGY & CAUSES

- Spinal column degeneration, compression
- Spinal osteoarthritis → degeneration of vertebral bodies, joints, foramina → intervertebral space narrowing → compression, damage to nerve roots

CAUSES

- Osteoartritis, trauma, postural

RISK FACTORS

- Obesity, older age, hyperkyphosis/ hyperlordosis

COMPLICATIONS

- Nerve compression, vertebrobasilar insufficiency, spinal disc protrusion, myelopathy

SIGNS & SYMPTOMS

- Progressive pain in affected spinal region, ↓ range of motion
- If nerves involved
  - Paresthesia, radiating pain, numbness

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Shows nerve impingement and disc abnormalities

OTHER DIANOSTICS

- Clinical exam
  - *Cervical compression test:* lateral flexion of head causes pain in neck, shoulder on same side

TREATMENT

MEDICATIONS

- Pain management

SURGERY

- Alleviate neural impingement

OTHER INTERVENTIONS

- Braces
- Physical therapy to strengthen back muscles