SPINE

David Bartle
FRACS

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Overview

- Lumbar spine
  - The motion segment and degenerative cascade
  - Disc pathology
  - Degenerative Spondylolisthesis and Stenosis
- Cervical myelopathy
- The young arthritic knee

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Learning Outcomes

- The lumbar spine as a series of motion segments
- How this model informs understanding and management of lumbar pathology
- Indications for surgical management
- Cervical myelopathy
- The young arthritic knee

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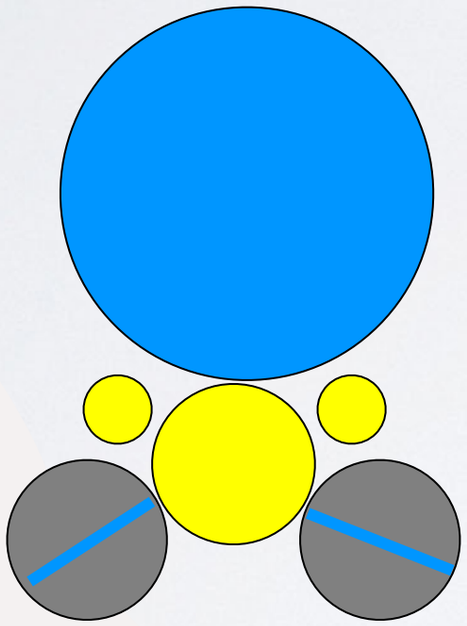
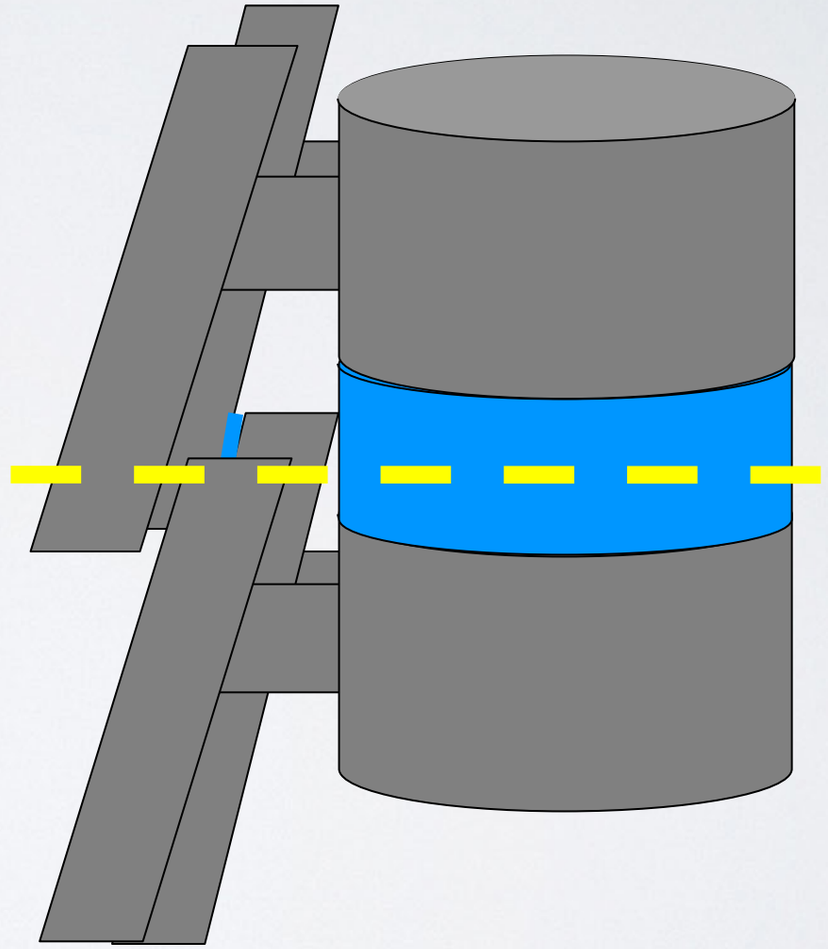
The Motion Segment





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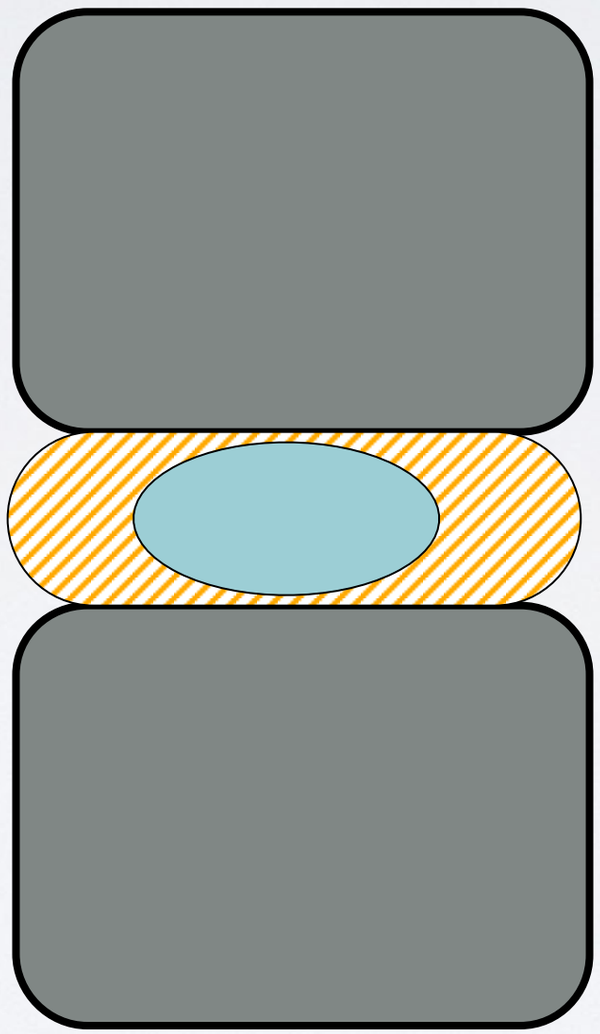
Degenerative Cascade



nucleus pulposis

annulus fibrosis

hyaline cartilage

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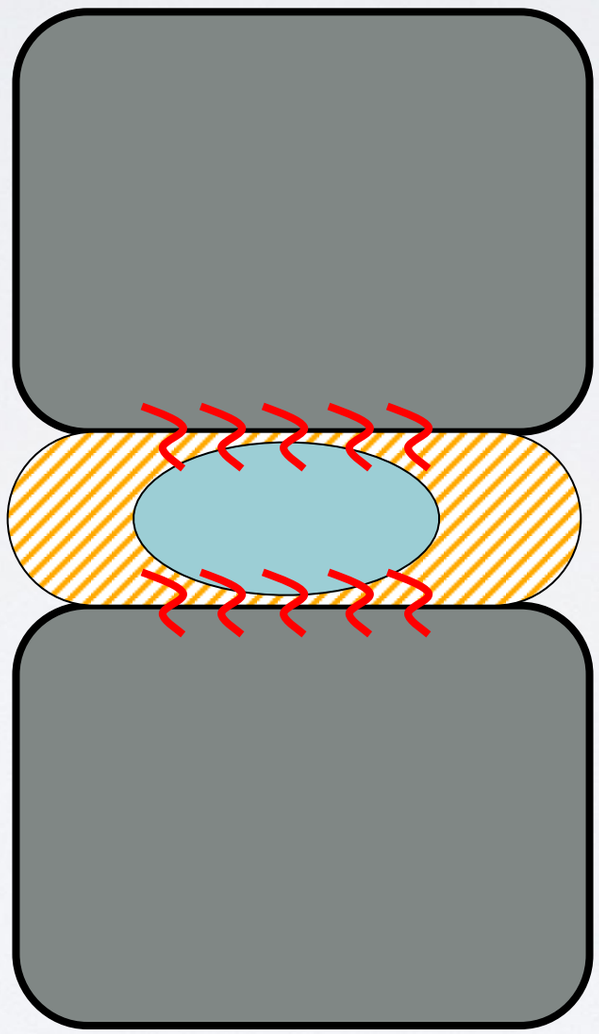
Degenerative Cascade

Infant



blood vessels

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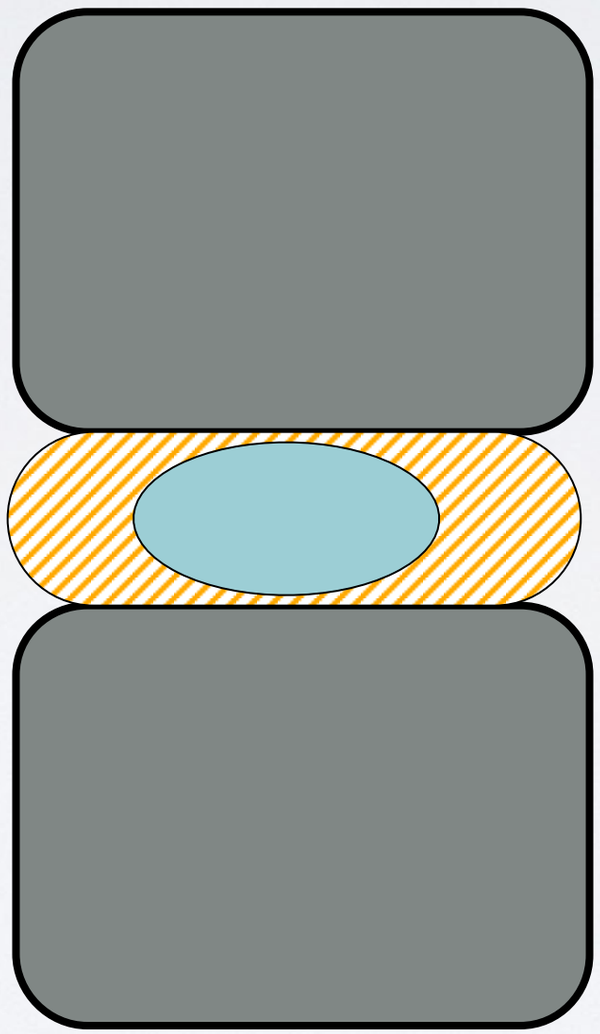
Degenerative Cascade

Child



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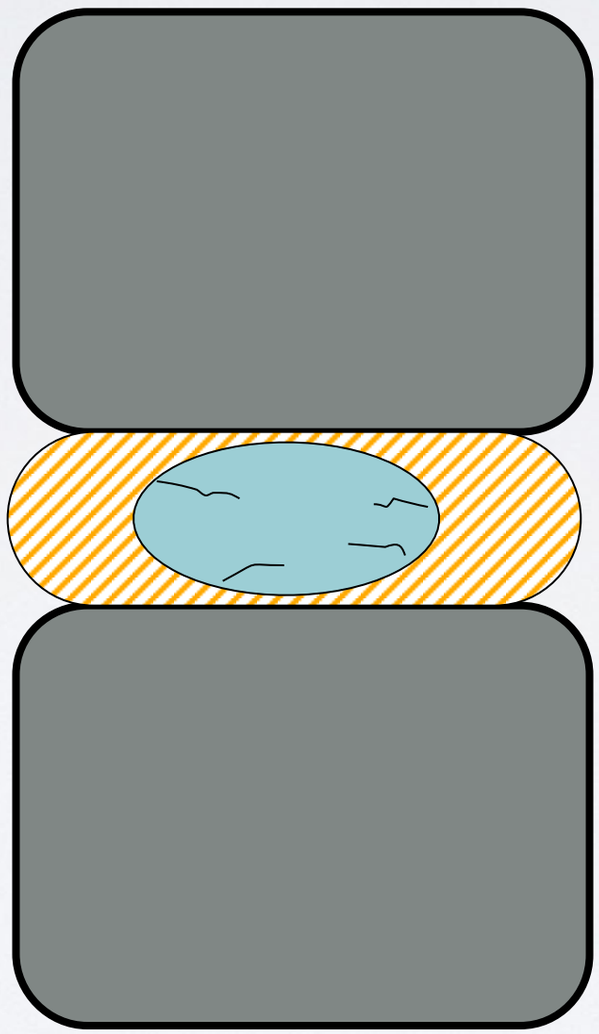
Degenerative Cascade

Adolescent



nuclear clefts

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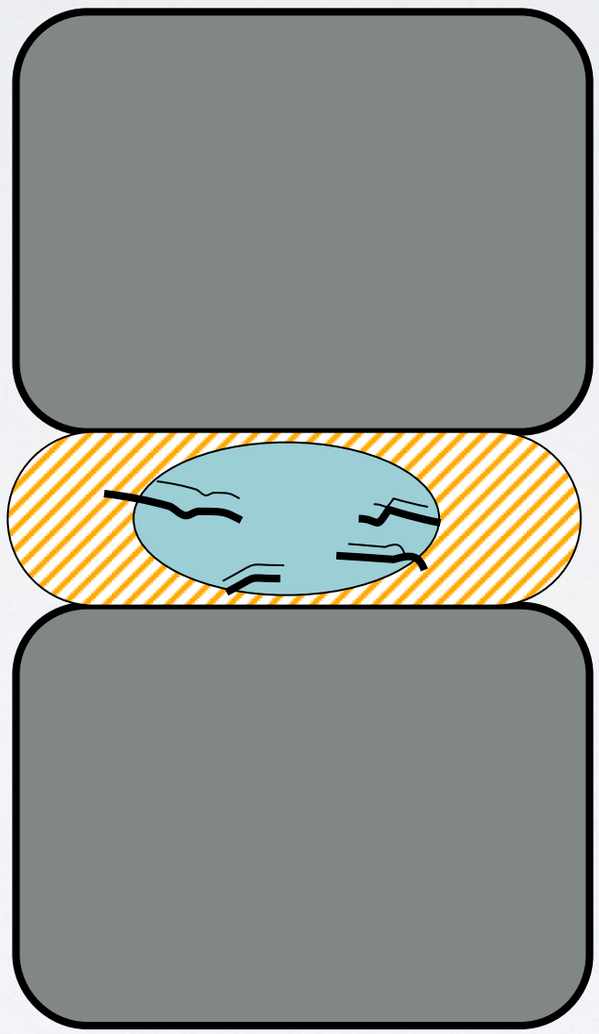
Degenerative Cascade

Young adult



nuclear and
annular clefts
annular tears

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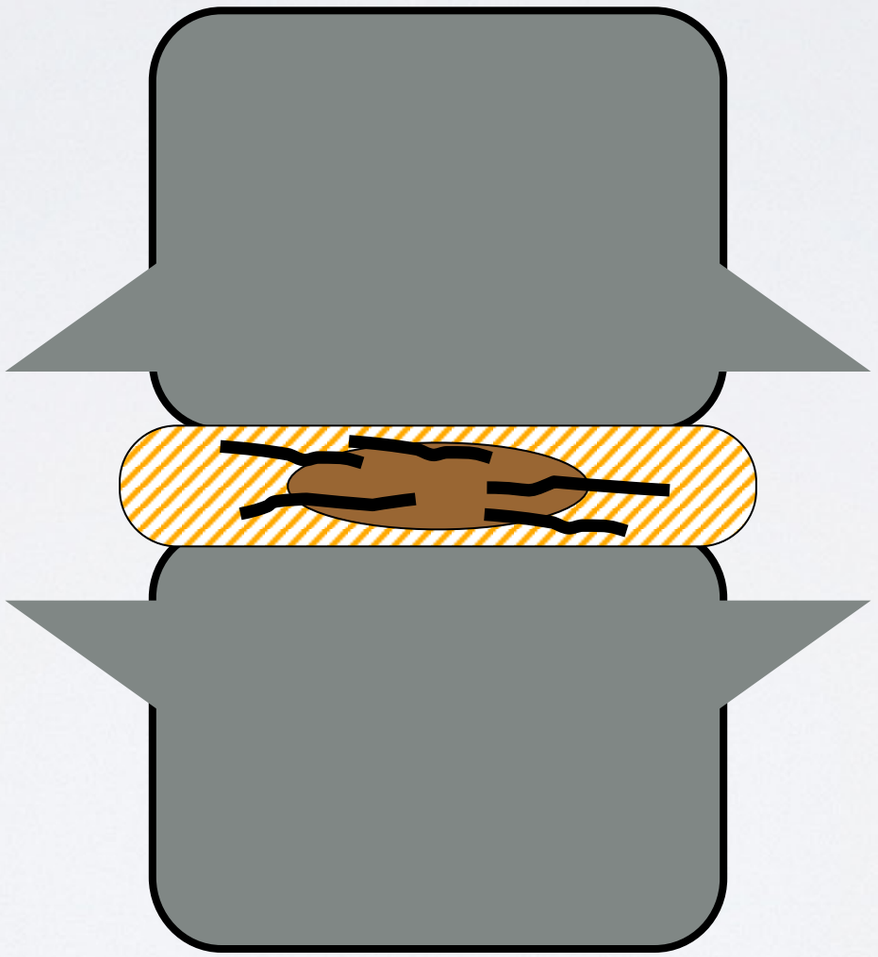
Degenerative Cascade

The mature adult



narrowing
bulging
extensive clefts
nuclear disorganisation
osteophytes

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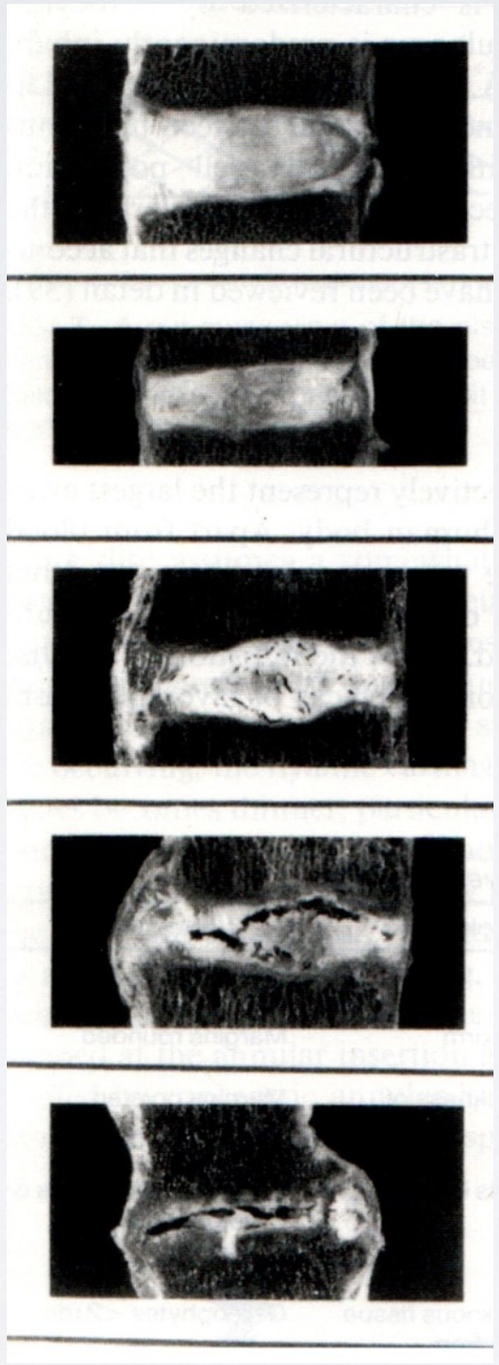
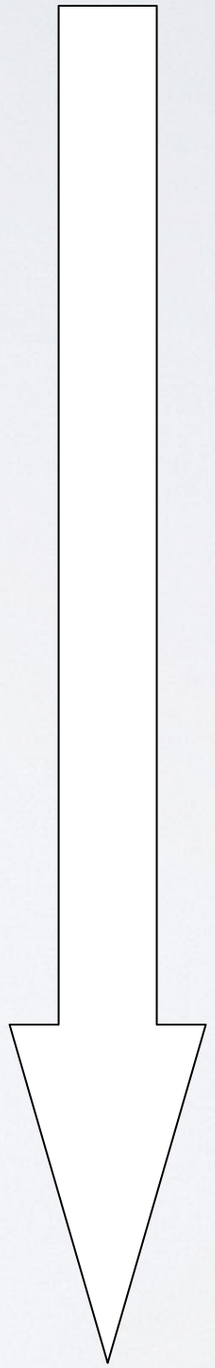
Degenerative Cascade





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Degeneration

Starts in the teenage years

By age 50, 97% of us have degenerative changes

Universal with varying rates at different levels

Most common at the lower lumbar spine

Reflects maximal torsional, shear and compressive loads

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3-Joint Complex

Disc	Facet	Phase	Pathoanatomy	Clinical
Circumferential Tears	Synovitis	Dysfunctional		
Radial Tears	Continuing degeneration	↓	Disc herniation	Sciatica
Internal Disruption	Capsular laxity	Unstable	Instability	LBP +/- Sciatica
Disc Resorption	Subluxation	↓	Nerve entrapment	Sciatica
Osteophytes	Hypertrophy	Stable	Stenosis	Stenosis

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DISC HERNIATION

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Disc Herniation

Disc	Facet	Phase	Pathoanatomy	Clinical
Circumferential Tears	Synovitis	Dysfunctional		
Radial Tears	Continuing degeneration	↓	Disc herniation	Sciatica
Internal Disruption	Capsular laxity	Unstable	Instability	LBP +/- Sciatica
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Osteophytes	Hypertrophy	Stable	Stenosis	Stenosis

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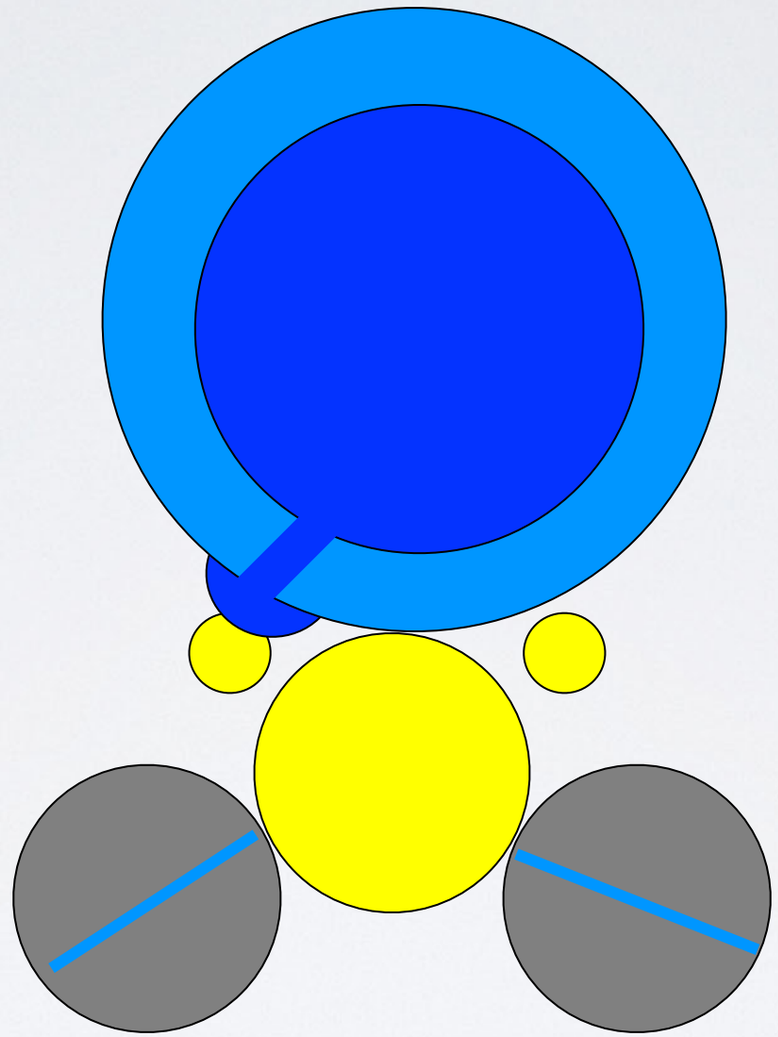
Disc Herniation

- Part of the degenerative cascade
- Posterior migration of nuclear material
- Pain due to a combination of
  - Inflammation - early
  - Compression - late



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Terminology

Outer annular fibres intact

protrusion

Outer annular fibres penetrated
PLL may be intact
or penetrated

extrusion

Loss of contact between prolapsed fragment and disc

sequestration

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Disc Herniation - History

- Often preceded by a traumatic event
- Dermatomal Pain +/- Paraesthesia and Weakness
- Exclude Red Flags
  - Unexplained weight loss, fevers, chills, history of cancer, significant trauma, progressive weakness, and bowel or bladder incontinence or dysfunction.
- Consider
  - Vascular pathology, Peripheral nerve-related, MSk

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Disc Herniation - Examination

- Coronal and sagittal alignment
- Gait assessment
- Myotomal and dermatomal assessment
- Sciatic nerve stretch test SLR (L3-S1)
  - Sensitivity of 90%, Specificity of 10-100%
- Femoral nerve stretch test (L1-3)

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MOTOR

KEY MUSCLES

	R	L	
C2			
C3			
C4			
C5	☐	☐	Elbow flexors
C6	☐	☐	Wrist extensors
C7	☐	☐	Elbow extensors
C8	☐	☐	Finger flexors (distal phalanx of middle finger)
T1	☐	☐	Finger abductors (little finger)
T2			
T3			
T4			
T5			
T6			
T7			
T8			
T9			
T10			
T11			
T12			
L1			
L2	☐	☐	Hip flexors
L3	☐	☐	Knee extensors
L4	☐	☐	Ankle dorsiflexors
L5	☐	☐	Long toe extensors
S1	☐	☐	Ankle plantar flexors
S2			
S3			
S4-5			

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT= not testable

☐ Voluntary anal contraction (Yes/No)

TOTALS ☐ + ☐ = ☐ **MOTOR SCORE**

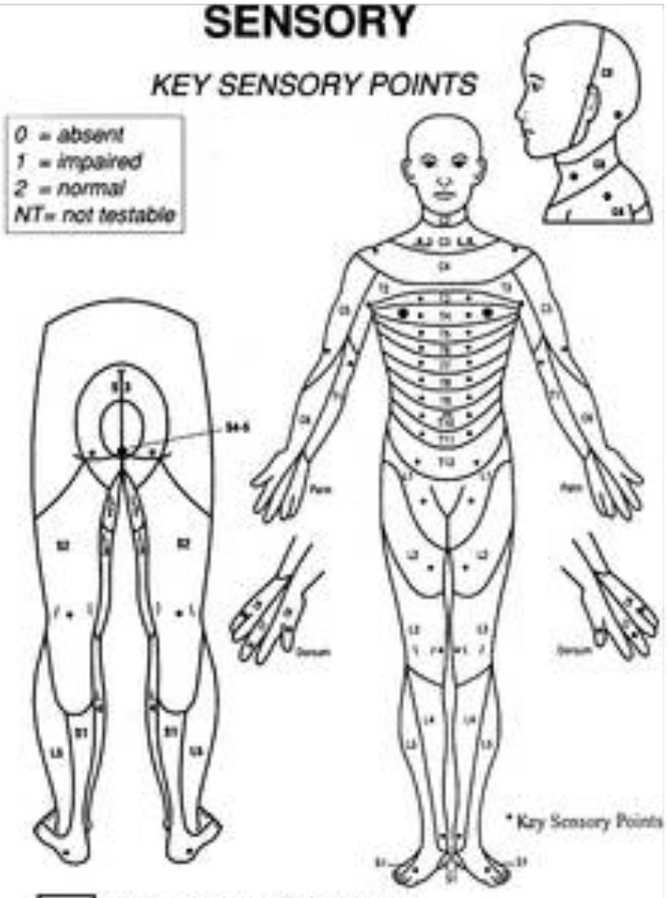
(MAXIMUM) (50) (50) (100)

SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

0 = absent
1 = impaired
2 = normal
NT= not testable



☐ Any anal sensation (Yes/No)

TOTALS ☐ + ☐ = ☐ **PIN PRICK SCORE** (max: 112)

TOTALS ☐ + ☐ = ☐ **LIGHT TOUCH SCORE** (max: 112)

(MAXIMUM) (56) (56) (56) (56)

NEUROLOGICAL LEVELS
The most caudal segment with normal function

	R	L
SENSORY	☐	☐
MOTOR	☐	☐

COMPLETE OR INCOMPLETE? ☐
Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE ☐

ZONE OF PARTIAL PRESERVATION
Partially innervated segments

	R	L
SENSORY	☐	☐
MOTOR	☐	☐

Version 4p
OHC 1996

Investigations

- In the absence of Red flags imaging is generally not required.
- For patients with refractory or worsening symptoms, plain radiographs are helpful.
- Erect views provide the most information.
  - Alignment, intervertebral spaces, spondylosis
  - Exclude other pathology

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When to refer

- Red flags
  - Unexplained weight loss, fevers, chills, history of cancer, significant trauma, progressive weakness, and bowel or bladder incontinence or dysfunction.
- Pain not adequately managed with common analgesics
- Progressive or debilitating weakness

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How we can help

- Advanced imaging
- Reassurance and Education
- Epidural or foraminal steroid injections
- Discectomy
  - Patients treated within 6 months do better
  - 80% improvements in neurologic deficit

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Disc Herniation

Disc	Facet	Phase	Pathoanatomy	Clinical
Circumferential Tears	Synovitis	Dysfunctional		
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Disc Resorption	Subluxation	↓	Nerve entrapment	Sciatica
Osteophytes	Hypertrophy	Stable	Stenosis	Stenosis

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DEGENERATIVE SPONDYLOLISTHESIS

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Spondylolisthesis

Disc	Facet	Phase	Pathoanatomy	Clinical
Circumferential Tears	Synovitis	Dysfunctional		
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Spondylolisthesis

- **Degenerative**

- Forward slip of one vertebra on another

- In the presence of an intact neural arch

- Associated with degeneration of the involved segment

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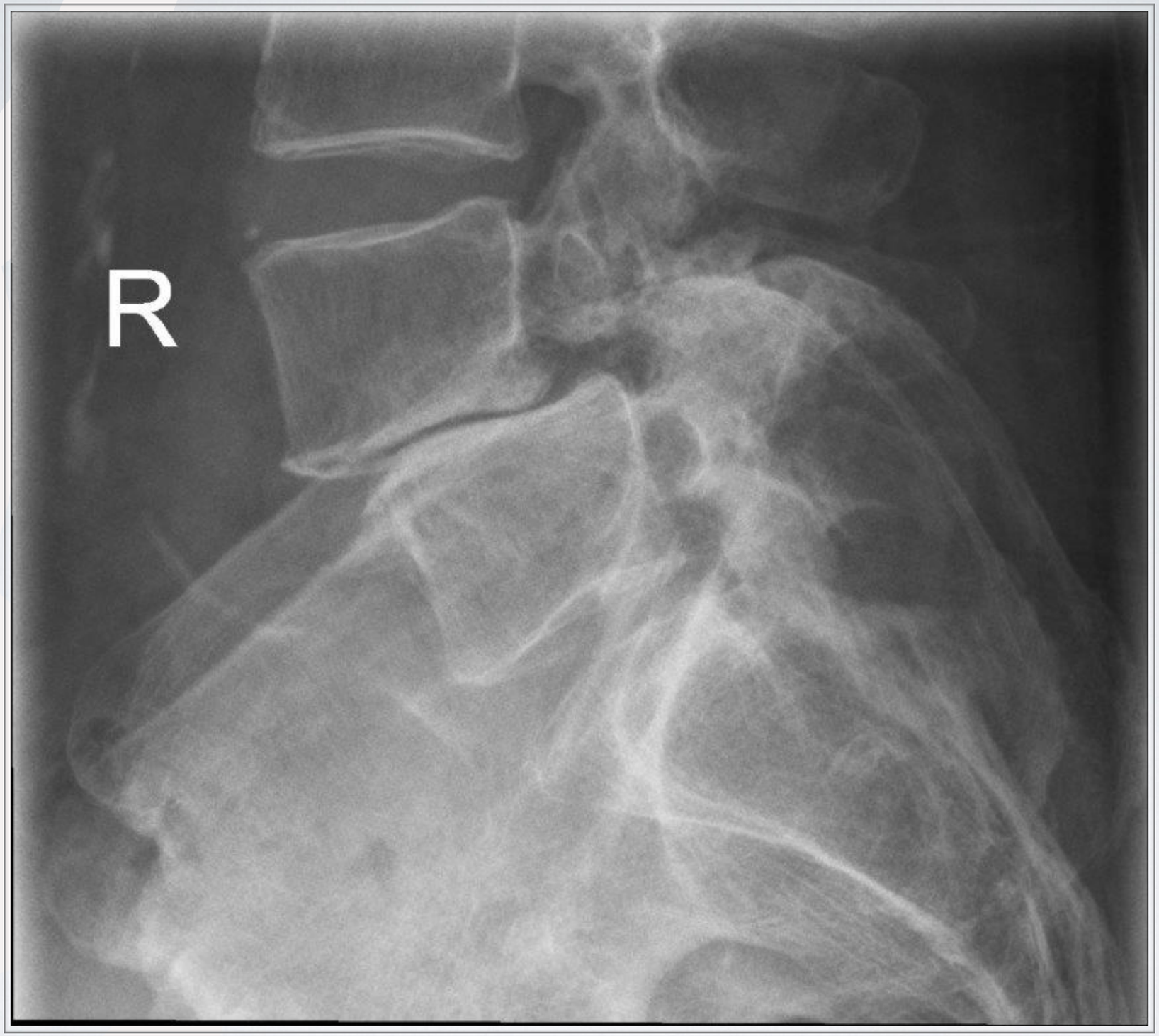

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Spondylolisthesis

- Almost always L4/5 (90%)
- Rarely at L5/S1
- Slip never exceeds 30%

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Epidemiology

- 4 times more common in women
- Seen in 10% of women over age 60

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Clinical Findings

- Neurogenic claudication
  - Central stenosis, buttock and leg pain
  - Relieved by sitting or leaning forward
- Radicular pain
  - Usually L5 but sometimes L4

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Spondylolisthesis

- **Isthmic**

- Basic defect is a pars interarticularis defect

- Almost always at L5/S1

- Acquired condition, associated with weight bearing

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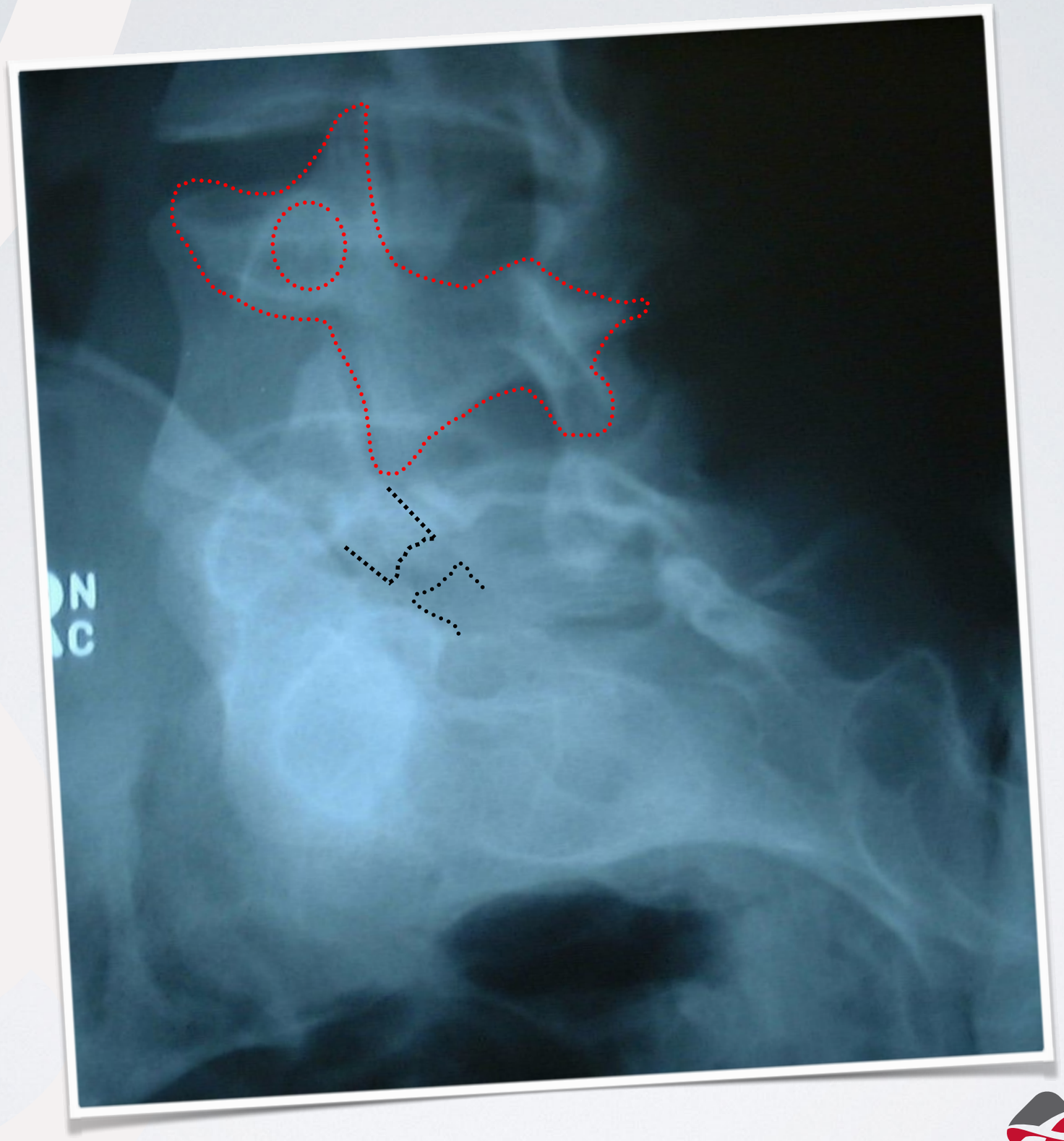

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Spondylolisthesis

Disc	Facet	Phase	Pathoanatomy	Clinical
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SPINAL STENOSIS

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Spinal Stenosis

Disc	Facet	Phase	Pathoanatomy	Clinical
Circumferential Tears	Synovitis	Dysfunctional		
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Spinal Stenosis

- Narrowing of the spinal canal with nerve compression
- Causing leg pain and neurogenic claudication

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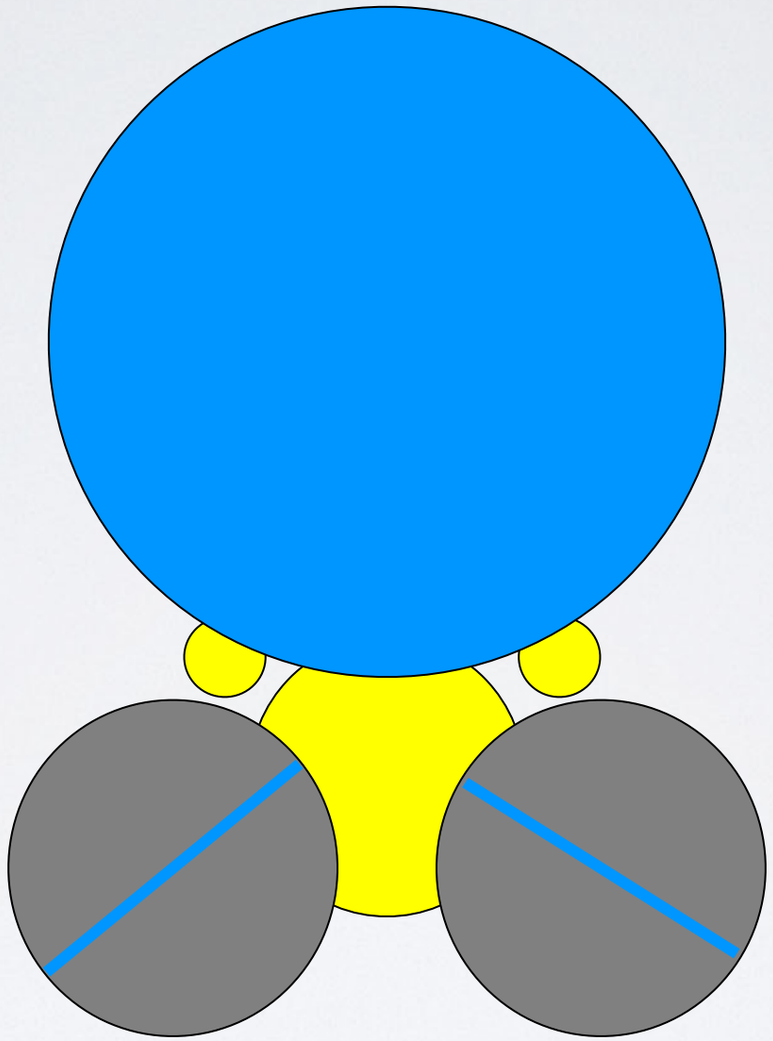

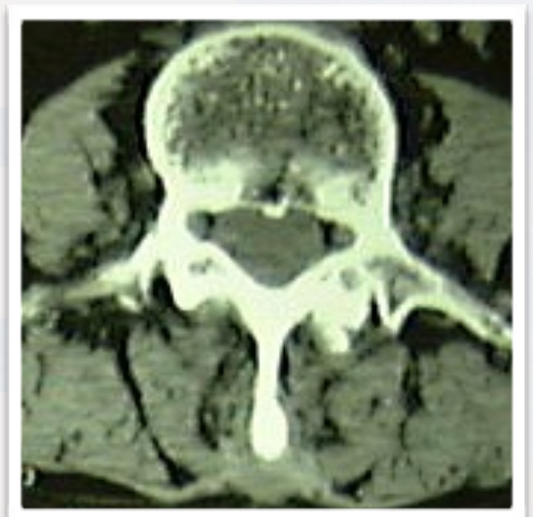

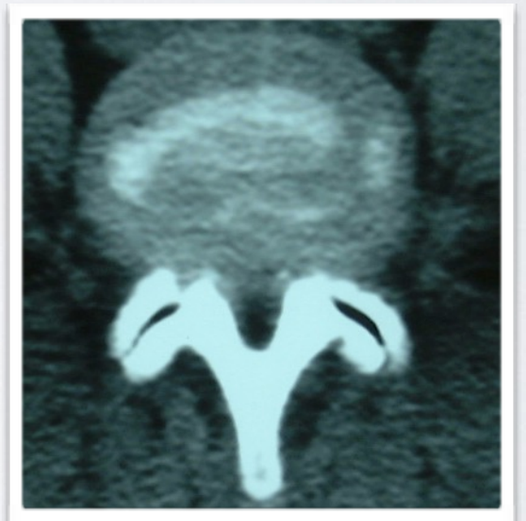

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Stenosis - Epidemiology

- Present in 10% of those over age 60.
- Very uncommon under age 40.
- Diagnosis often missed or delayed as it can easily be confused with other diagnoses
- More common in males

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Stenosis - History

- Neurogenic claudication
  - Lower extremity pain, heaviness, numbness, and subjective weakness
  - Brought on by standing and walking
  - Improved with flexion or sitting down
  - Both limbs are commonly affected
  - Distribution is rarely dermatomal, often centred in the buttocks and frequently extending below the knees.

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Stenosis - Examination

- Physical examination findings are not consistent
- Approximately a quarter have a motor deficit, sensory deficit or depressed asymmetric reflexes.
- Examination is most important for ruling out other causes
  - Vascular
  - Hip OA
  - Myelopathy
  - Peripheral neuropathy

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Stenosis - Investigations

- Exclude other diagnoses
- Erect plain film radiographs

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Non-operative management

- Patient education
- Aerobic exercise
- Green prescriptions and weight loss
- Medications, physiotherapy, bracing, and injections

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Stenosis compared with Degenerative Spondylolistheis

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Spinal Stenosis

Disc	Facet	Phase	Pathoanatomy	Clinical
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Disc Resorption	Subluxation	↓	Nerve entrapment	Sciatica
Osteophytes	Hypertrophy	Stable	Stenosis	Stenosis

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Comparison

- Degen Spondylolithesis
  - An unstable phase
  - More common in women
  - Back pain can be particularly troublesome
  - Radiculopathy more dermatomal

- Stenosis
  - A stable phase
  - More common in men
  - More likely to be over several levels

When to refer

- Persisting pain and disability not being adequately controlled with simple analgesics

- Non-operative measures have been exhausted

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How we can help

- Advanced imaging
- Reassurance and further education
- Epidural steroid injections
- Laminectomy for stable spines
- Lumbar fusion procedures for unstable spines or for extensive stenosis requiring extensive decompression

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What is new

- Navigation for spinal instrumentation
  - Improved screw placement
  - Less muscle elevation
  - Less blood loss
  - New options

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Spinal Stenosis

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CERVICAL MYELOPATHY

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Cervical Myelopathy

- Results from static or dynamic spinal cord compression.
- Secondary to loss of disc height, osteophytes, OPLL, ligament flavum thickening, loss of lordosis.
- Clinical dysfunction secondary to ischemia, inflammation, oedema, and demyelination.

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Cervical Myelopathy

- Signs and Symptoms
  - Depend on the disease severity, chronicity, levels of involvement.

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History

- Difficulty in fine motor functions
- Unsteady gait
- Diffuse weakness or numbness.
- If the condition is severe, the patient may have disturbance in bowel and bladder function

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Examination

- Upper and Lower Limb abnormalities
- Long tract signs include hyperreflexia, clonus, the Babinski sign, the Hoffman sign, and an inverted radial reflex.
- With concomitant nerve root compression, concurrent lower motor neuron findings may be seen in the upper extremities.

Investigations

- Plain films - spondylotic changes, foraminal compromise, alignment, intervertberal disc height
- MRI - Soft tissue components
- +/- CT - OPLL
- EMG studies

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Natural History

- Progressive
- Limited non-operative measures

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When to refer

- Early, once a clinical diagnosis has been made

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How we can help

- Advanced imaging
- Confirming the diagnosis
- Operative management
  - ACDF, laminoplasty, cervical fusion

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THE YOUNG ARTHRITIC KNEE

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Issues

- Ageing population
- People are wishing to stay active for longer, and will live longer
- How to address the gap between loss of function and arthroplasty options
- The sustainable approach to knee arthritis

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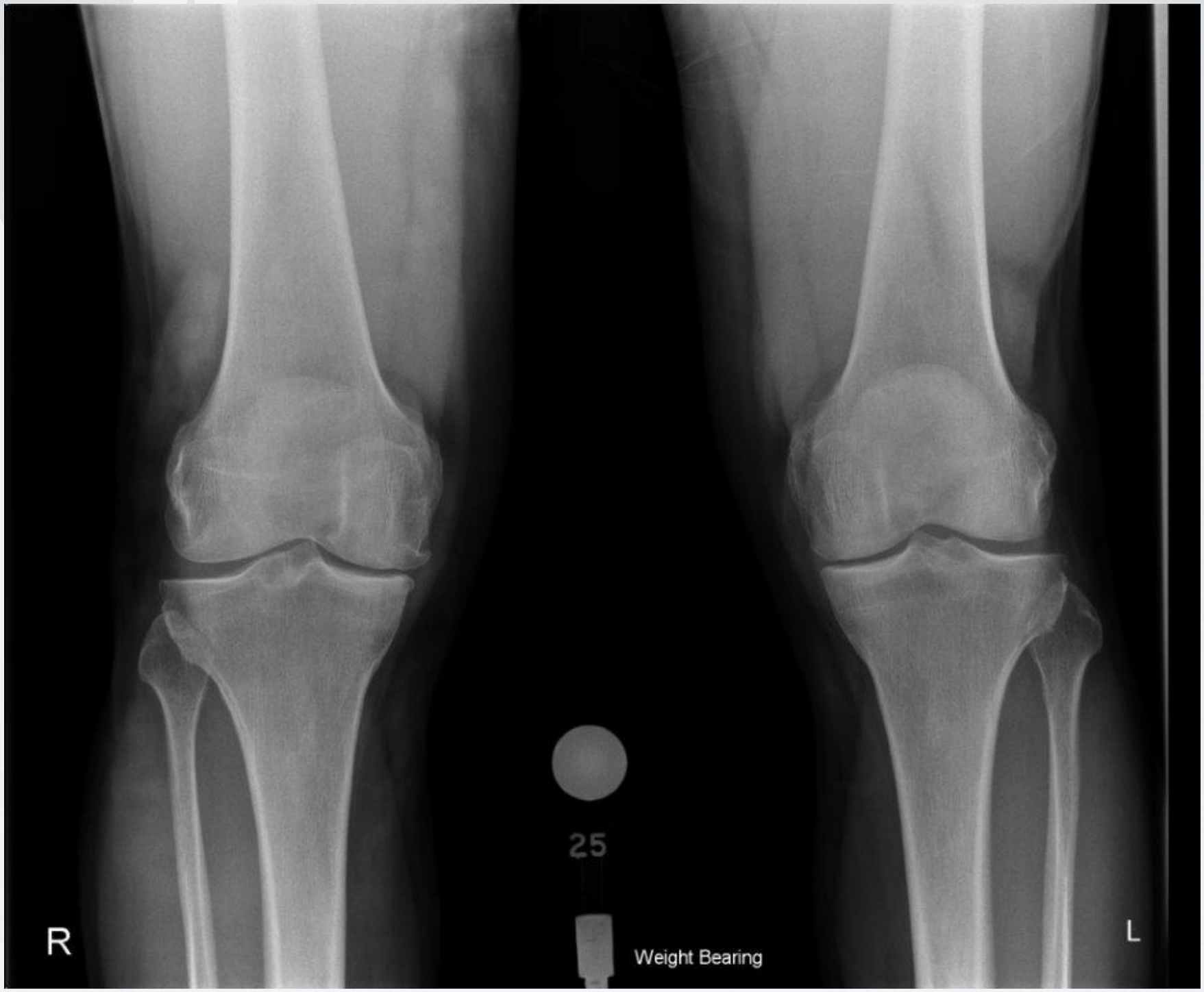

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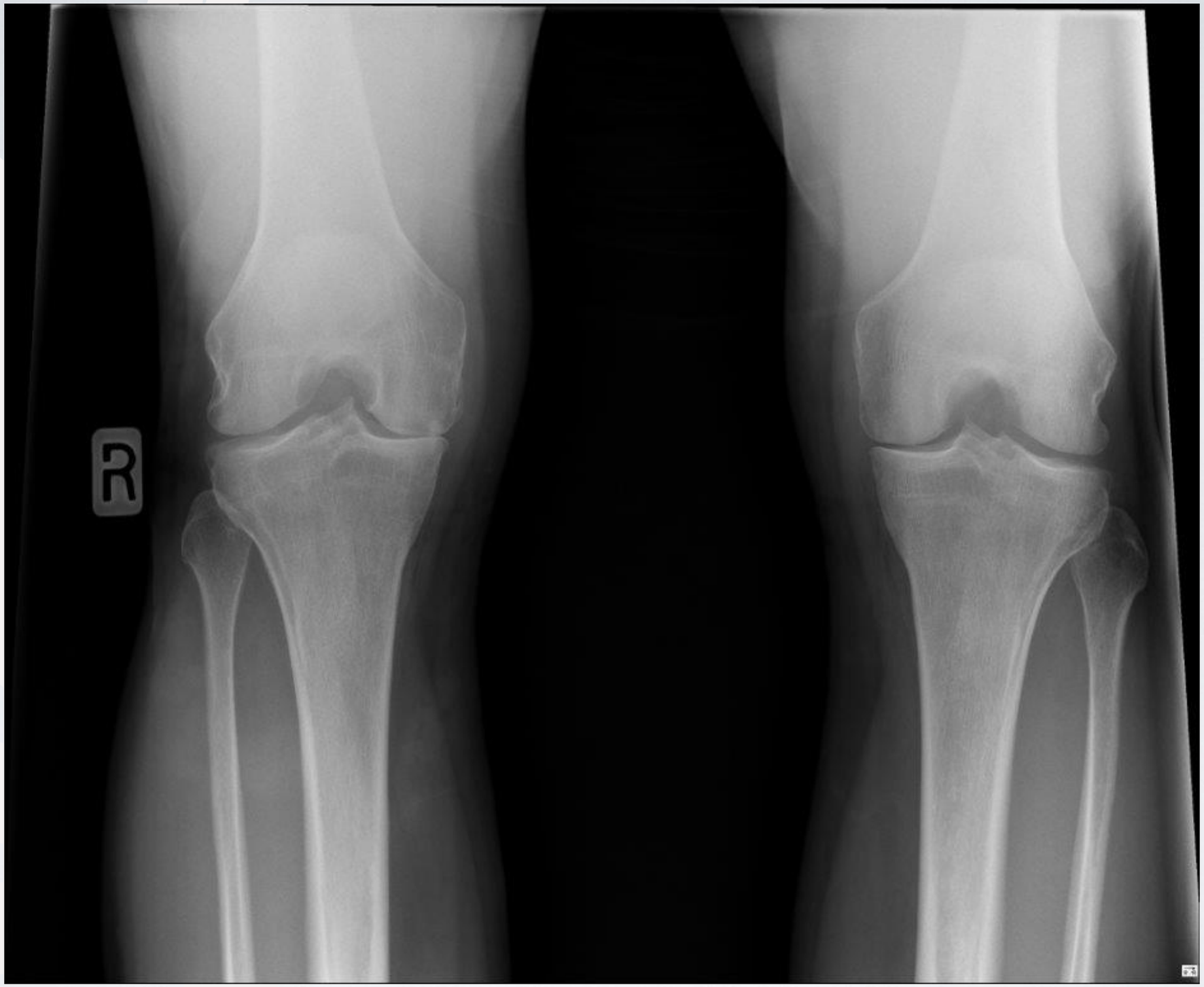

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HIGH TIBIAL OSTEOTOMY (HTO)

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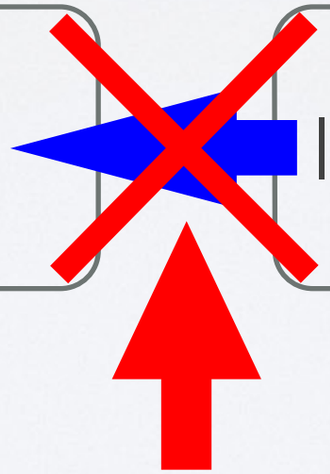
Concept

Malalignment
Chondral injury

Shifting mechanical axis

Progression of disease



Increase in compartment load

Osteotomy

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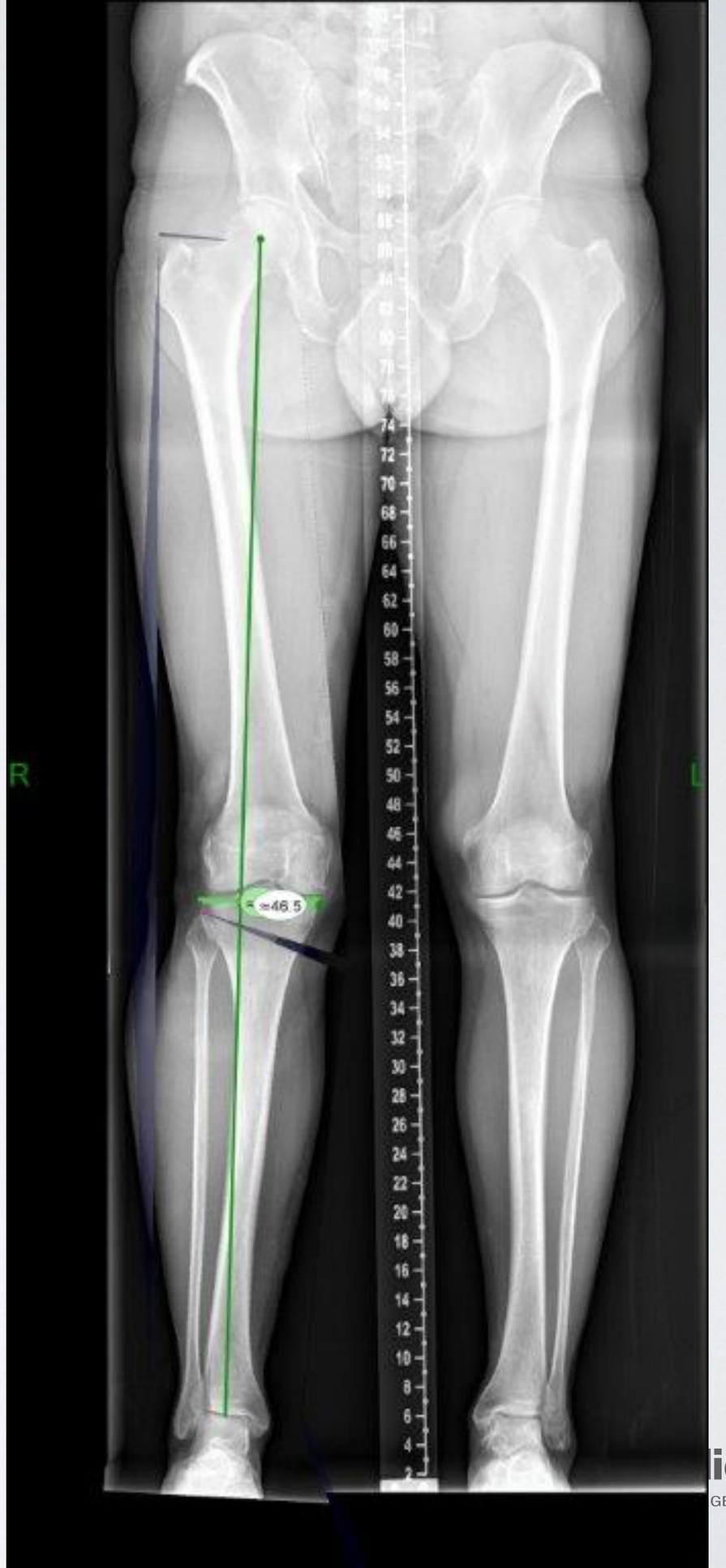

Effects

- Mechanical
- Biological
- 'X' factor

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Results

- Survivorship

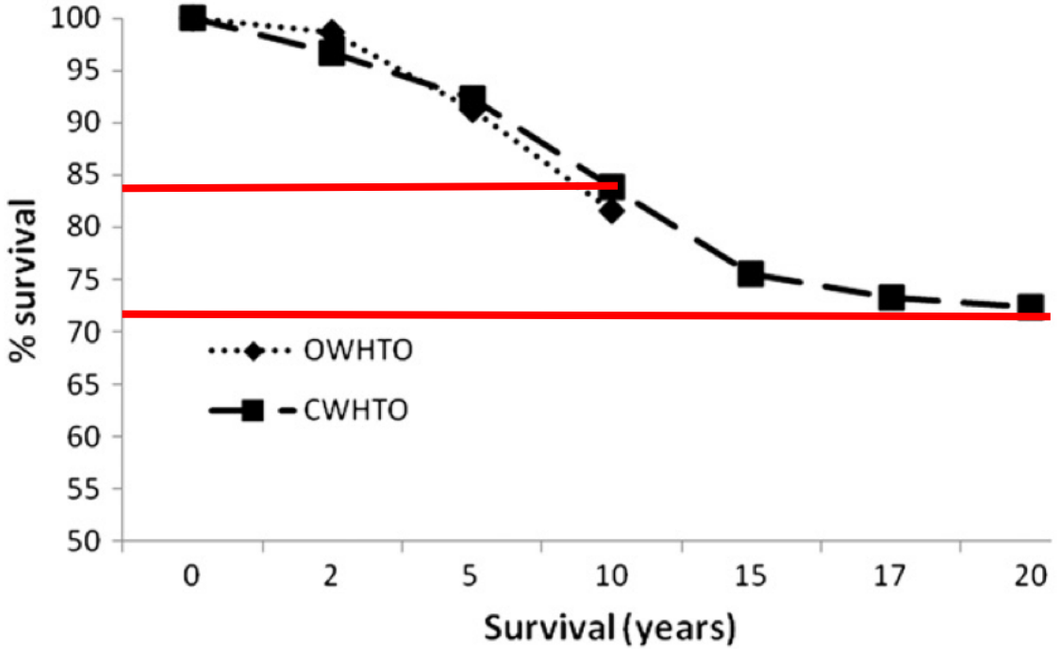

Fig. 2. Survival comparison of OWHTO and CWHTO. Although length of follow-up was longer following CWHTO, there was no significant difference in survival between the two groups at the available comparative time points.

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Who is suitable

- Young (<60), Active and Motivated patients
- Mal-alignment (tibia / joint space)
- Preserved lateral compartment and ROM
- Non-inflammatory
- Non-smoker, Modest BMI

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When to refer

- Non-operative management has failed
- Ongoing symptoms
- Those seeking surgical options

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How we can help

- Assess for suitability for an HTO
- Discuss the spectrum of options
- Plan surgical management
  - Extent of correction, adjusting slope for CR, combining with other procedures

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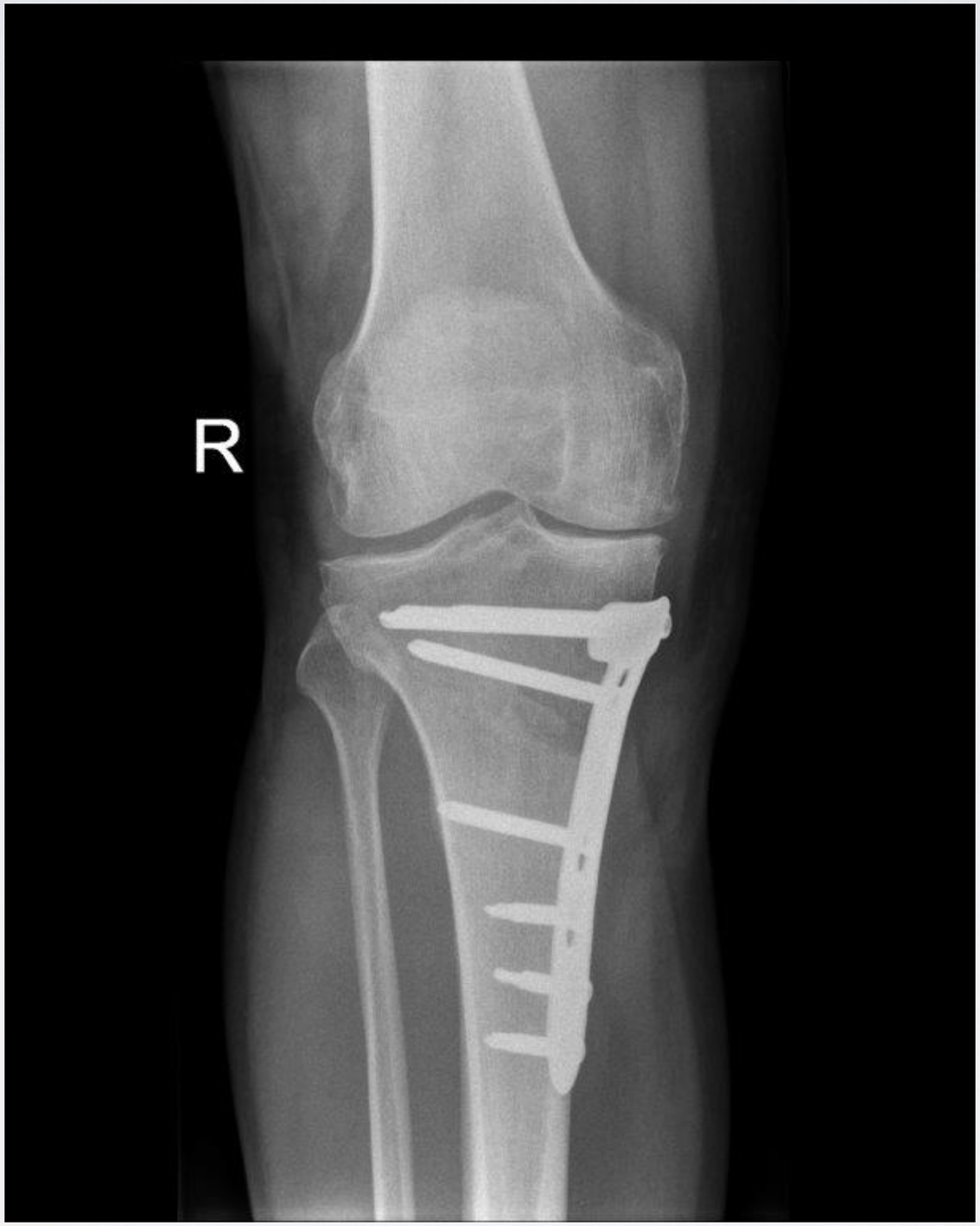

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Learning Outcomes

- The lumbar spine as a series of motion segments
- How this model informs understanding and management of lumbar pathology
- Indications for surgical management
- Cervical myelopathy
- The young arthritic knee

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Questions?

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