

# DEGENERATIVE, TRAUMATIC AND TUMORAL RACHIMEDULAR PATHOLOGY. RACHIMEDULAR INJURIES. MEDULAR COMPRESSION SYNDROMES. PERIPHERAL NERVES



**34484 Pathology of the  
nervous system**

**Neurosurgery**

**Topic 22**

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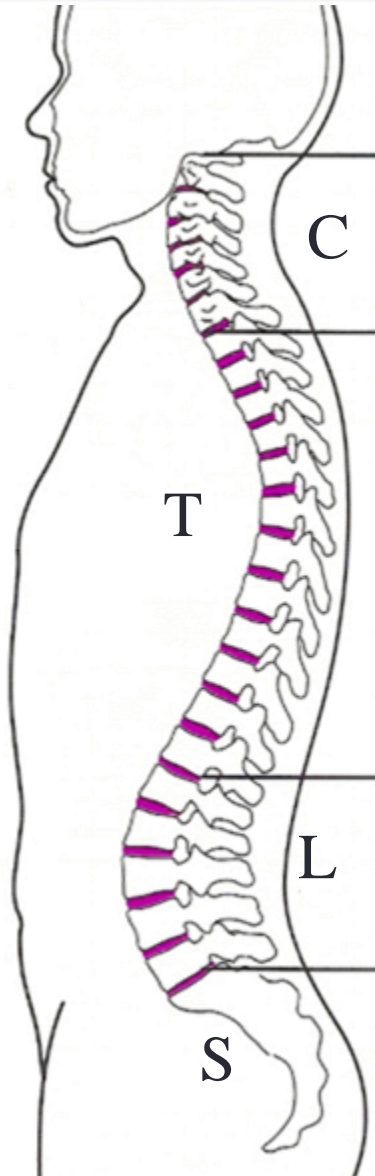
# Key points to be developed

## • Lumbar spine

- Basics: low back pain, low back pain, acute / chronic
- Lumbar disc herniation
- Lumbar spinal canal stenosis
- Spondylolisthesis
- Spondylodiscitis
- Sacroiliac pain

## • Dorsal (thoracic) spine

- Herniated disc



## • Cervical spine

- Cervicalgia and cervical myelopathy
- Cervical disc herniation
- Cervical spinal canal stenosis

## • Spinal tumours

## • Spinal cord injuries

- SDR spinal cord injury

## • Peripheral nerves



# LUMBAR SPINE

## • Definitions

- **Lower back pain** = pain in the lumbar area
  - Irradiation to buttocks and thighs UP TO knee
  - If it exceeds the knee = radiculopathy
- **Radiculopathy** = root dysfunction
  - Pain, sensory disturbance, trophic disorders affecting root distribution
  - Loss of muscle strength, hyporeflexia
- **Cauda equina syndrome** = multiple affected lumbosacral nerve roots
- **Mechanical dysfunction**
  - Pain that improves when unloading (decubitus) and worsens when loading (sitting, standing)
  - Possible spinal instability
- **Myelopathy** = spinal cord injury (cervical or thoracic, not lumbar)



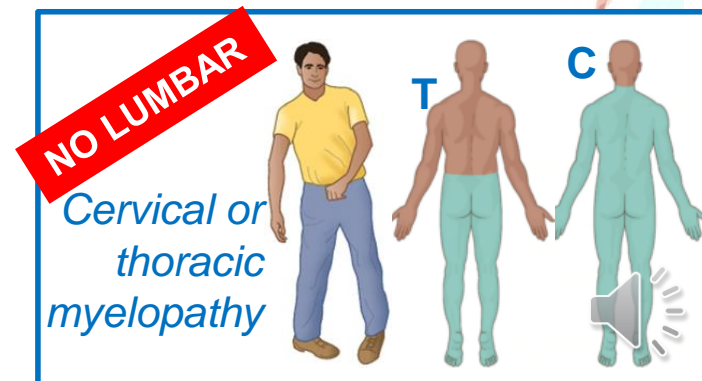
Low back pain



Radiculopathy  
(lumbosciatica)



Mechanical  
dysfunction



**NO LUMBAR**

Cervical or  
thoracic  
myelopathy

# Lower back pain



- **Very common**

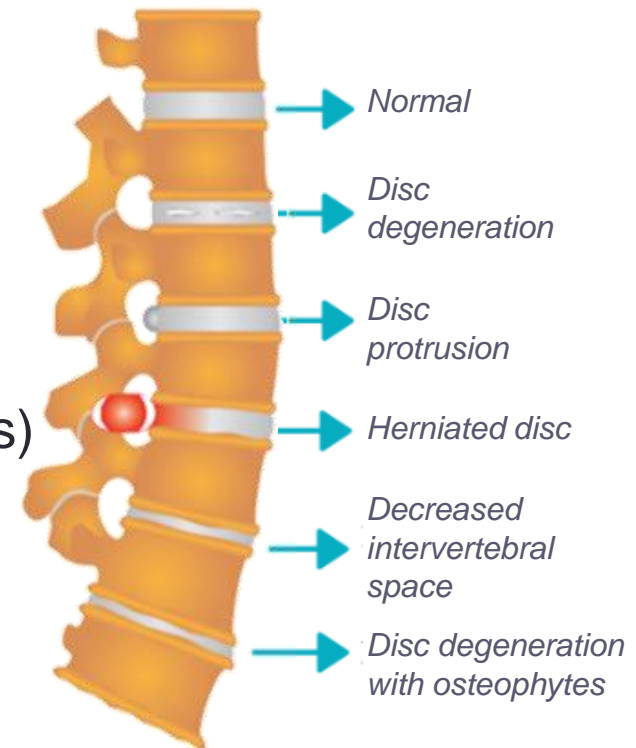
- second most frequent reason for medical consultation
- Most frequent cause of incapacity for work > 45 years
- 15% of sick leave

- **Non-specific diagnosis**

- It's just a definition ("lumbar area pain")
- Cause unknown 90% cases
- Mechanical alteration (overstrain) +++
- Serious etiologies (infection, trauma, tumours)
- Only 1% radiculopathy or discopathy
- Rule out serious pathology!

- **Conservative treatment 4 weeks**

- NSAIDs, physiotherapy, moderate physical activity ...
- 90% improve, but frequent recurrence



*Disc pathology associated  
 with lower back pain*



# Acute lower back pain

- Duration <6 weeks
  - The most frequent
  - Usual cause = overexertion
    - *Musculoskeletal origin*
- Clinical features "not serious"
  - Severe low back pain
  - Self-limited, recurring
- Treatment = conservative, symptomatic
  - Bed rest (<2 days)
  - NSAIDs and muscle relaxants (<15 days)
  - Postural reeducation and rehabilitation
  - Moderate exercise > 2 - 6 weeks
- New evaluation in 2 weeks →



If pain > 1 month (or signs of severity)

- Complementary tests
- Assessment by specialist





# Acute lower back pain

## • Signs of suggestive serious etiology

- *First episode <20 years or> 50 years (Fx, Mx)*
- *Background*
- *Cancer, severe systemic disease*
- *Spinal trauma*
- *Chronic lung infection*
- *Consumption of drugs*
- *Immunosuppression (corticosteroids, transplantation, HIV)*
- Pain > 1 month, in all postures and with no relief following rest
- Neurological disorders > 1 root
  - *Sphincter incontinence (cauda equina syndrome)*
- Others
  - *Fever, weight loss, and abdominal mass*



If pain > 1 month (or signs of severity)

- Complementary tests
- Assessment by specialist



# Chronic lower back pain

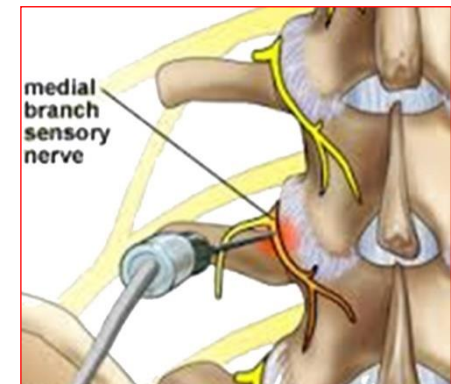
- Duration > 3 months
- Etiology: degenerative
  - Degenerative disc disease
    - <45 years
    - Pain on bending over (flexion)
  - Facet arthropathy
    - >50 years
    - Pain upon standing up
    - Worsens with spinal extension
- Symptomatic treatment
  - Weight loss, smoking cessation (toxic), NSAIDs, RHB ...
- Surgical treatment?



**Degenerative disc disease**

**<45 years old:**

*Lumbar disc prosthesis*



**Facet joint arthropathy**  
**>50 years:**

*Facet joint denervation  
 ± Lumbar arthrodesis*

# Lumbosciatica

- **Lumbar pain radiating to the lower limb following a nerve root distribution**

- At least to the calf, usually to the foot
- Improvement in lateral decubitus (foetal position)
- Gets worse with
  - *Valsalva manoeuvres*
  - *Leaning forward*
  - *Lifting weights*

- **Clinical complaints according to affected nerve roots**

- Stiffness  $\pm$  scoliotic attitude
- Loss of muscle strength, muscle atrophy
- Hypoesthesia
- Loss of reflexes

- **Neuroimaging tests (MRI)**



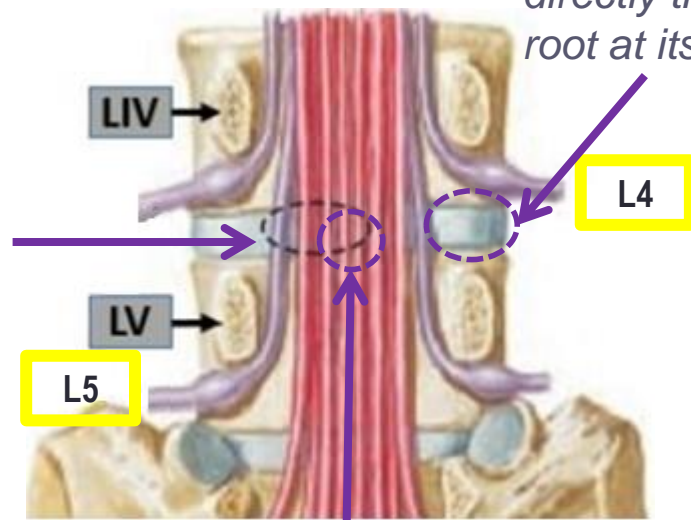


# 1. Lumbar disc herniation

- Herniated disc = "Degeneration of the intervertebral disc with partial or total rupture of the annulus, and emigration of the nucleus pulposus"
- Location  $L_5-S_1 > L_4-L_5 > L_3-L_4$
- High → diabetic plexopathy, psoas hematomas



**Post-lateral disc herniation:**  
 Compresses the nerve root that goes out **BELOW** its level



**Extreme-lateral disc herniation:**  
 Compresses directly the nerve root at its level

**Central disc herniation:**  
 May involve lower roots ( $S_1$ )



# 1. Lumbar disc herniation

## • Clinical features → radiculopathy

– Lower back radiating in a nerve root distribution (lumbosciatica)

- *Electric-like pain, paraesthesia*
- *Distribution through the corresponding dermatome*
- *↑ with Valsalva manoeuvres, when sitting and with gait*

– Antalgic position

– ↓ Affected nerve root osteo-tendon reflex

– Weakness, muscle atrophy

– Cauda equina syndrome (central disc herniation)

- *Loss of sphincter control*
- *Paraparesis, saddle block anaesthesia*



Standing

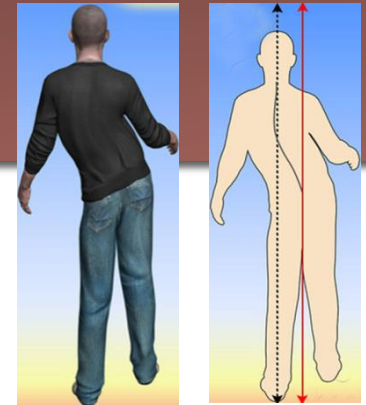


Scoliotic  
attitude



Standing  
+ flexed knee

# Lumbar spine examination

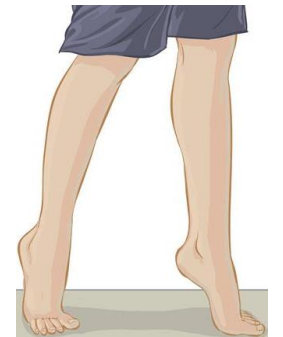


*Antalgic gait*

- Gait
  - Spontaneous → antalgic (paravertebral contracture), paretic, spastic ...
  - Tiptoes
  - Heels



*Heel gait:  
foot dorsi-flexion strength (L<sub>5</sub> root)*



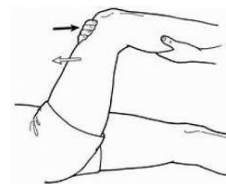
*Walking on tiptoes:  
plantar flexion strength (root S<sub>1</sub>)*



- Motor exam
- Osteotendinous reflexes
- Sensation
- Nerve root elongation manoeuvres
- **CERVICAL SPINE EXAM**

# Lumbar spine examination

- Gait
- Motor exam
  - Bilateral and comparative
  - Muscle atrophy → Measurement thigh and calf
  - Muscle strength (0-5 / 5)
- Osteotendinous reflexes
- Sensation
- Nerve root elongation manoeuvres

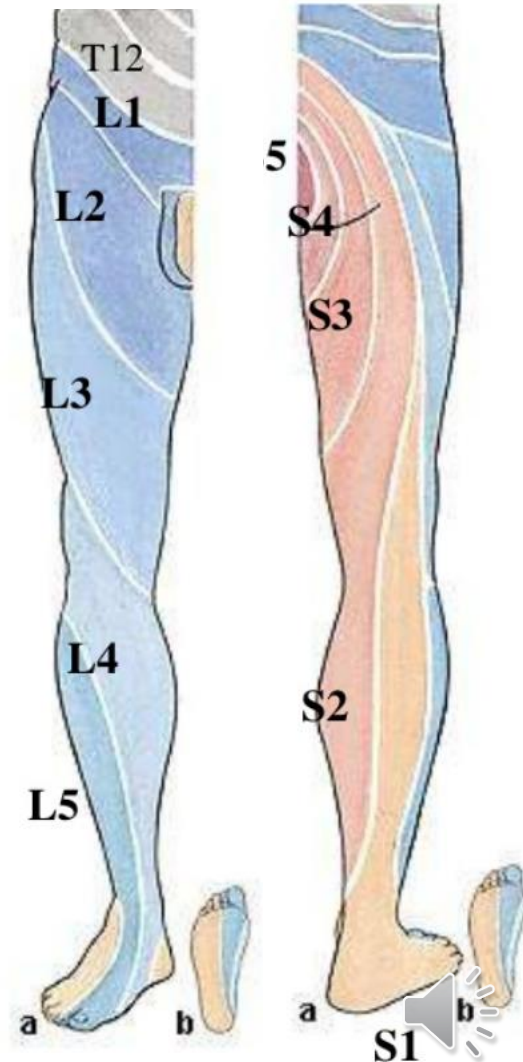
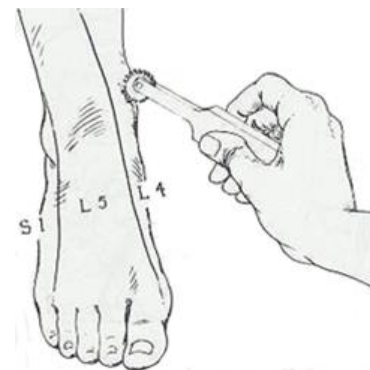
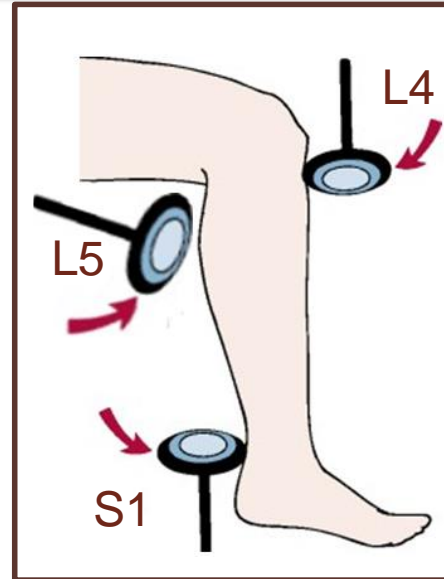


Weakness foot dorsi-flexion ( $L_5$  nerve root)



# Lumbar spine examination

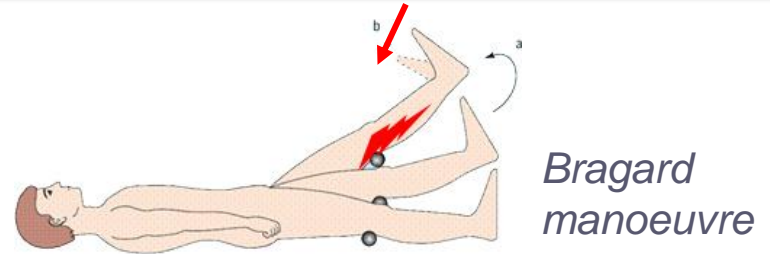
- Gait
- Motor exam
- Osteotendinous reflexes
  - Patellar (knee jerk) = L<sub>4</sub>
  - Ischiotibial = L<sub>5</sub>
  - Achilles (ankle jerk) = S<sub>1</sub>
- Sensation
- Nerve root elongation manoeuvres



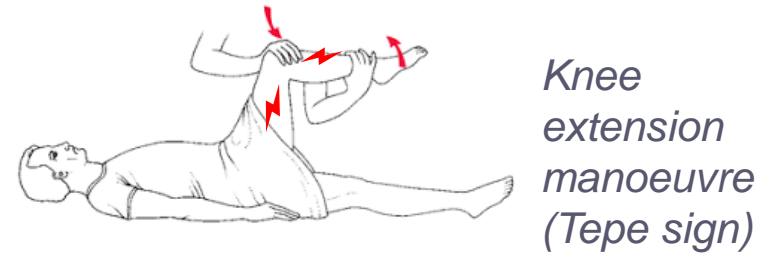


# Lumbar spine examination

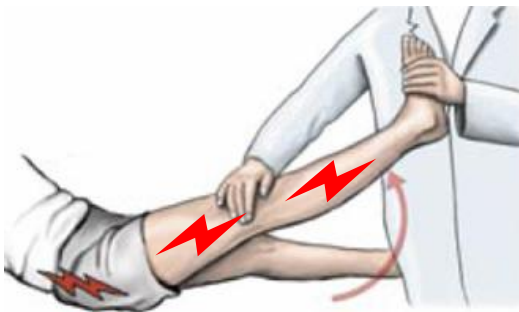
- Gait
- Motor examination
- Osteotendinous reflexes
- Sensation
- Nerve root elongation manoeuvres



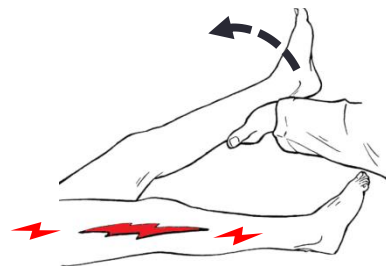
*Bragard manoeuvre*



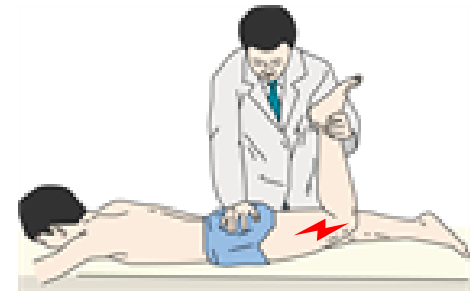
*Knee extension manoeuvre (Tepe sign)*



*Lasegue manoeuvre*



*Contralateral pain = Sign of Fajersztajn*

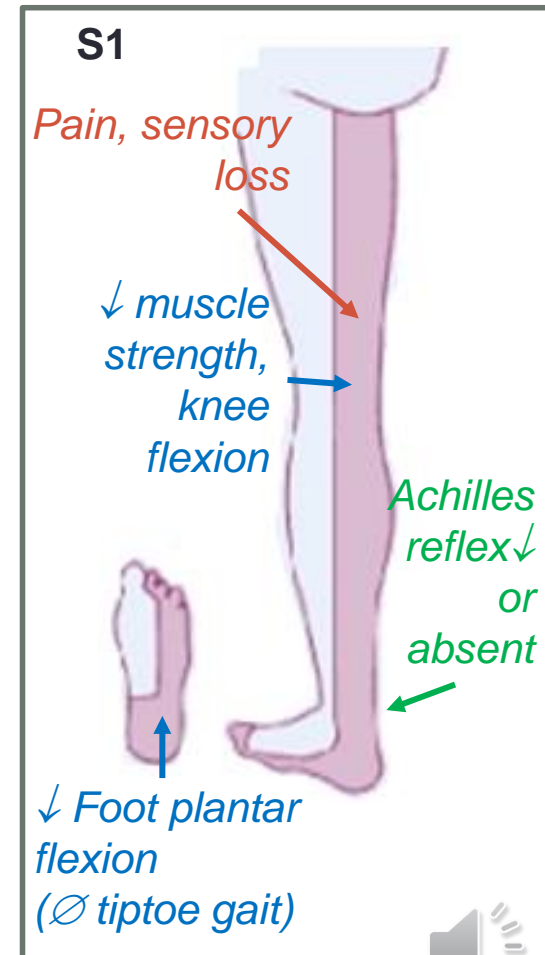
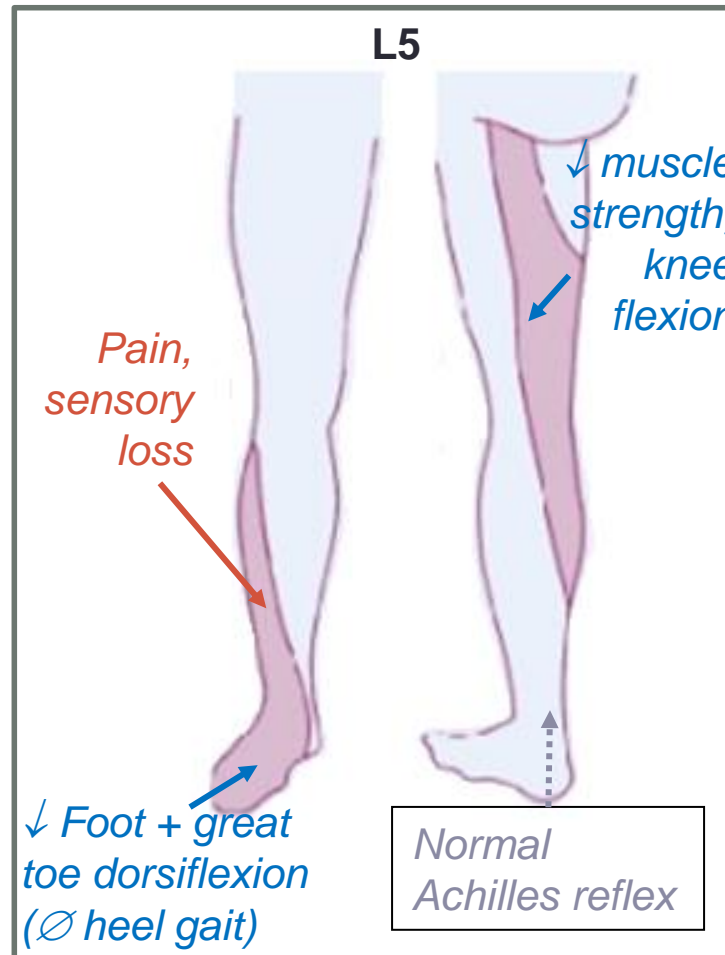
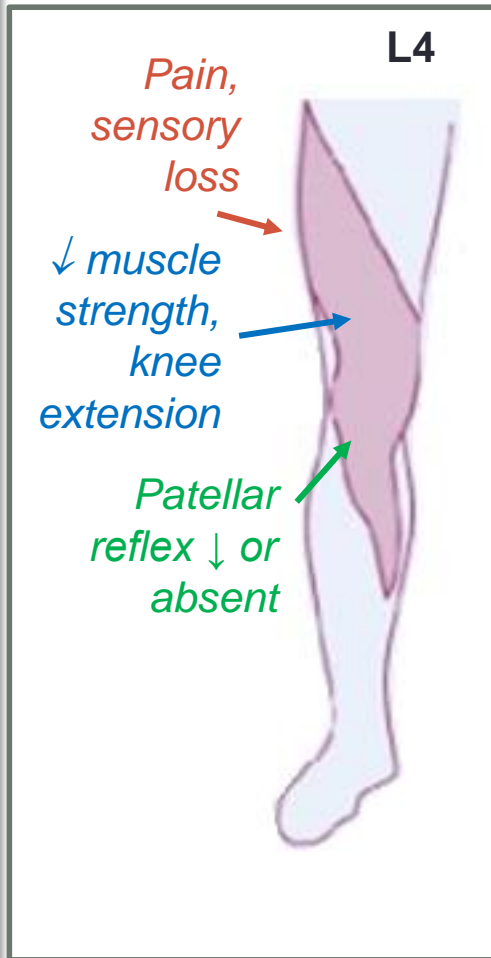


*Femoral stretch test or O'Connell manoeuvre (inverted Lasegue test)*



# 1. Lumbar disc herniation

- Clinical suspicion

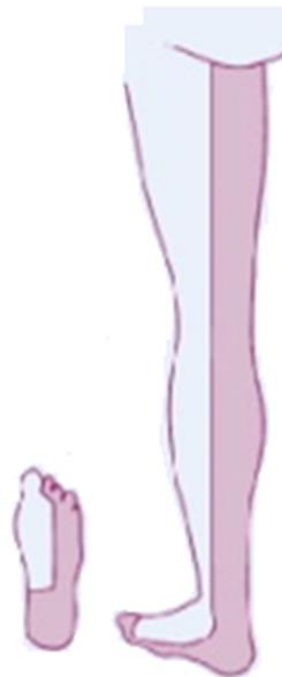


# 1. Lumbar disc herniation

## • Diagnosis

### – CLINICAL FEATURES + NEUROLOGICAL EXAM

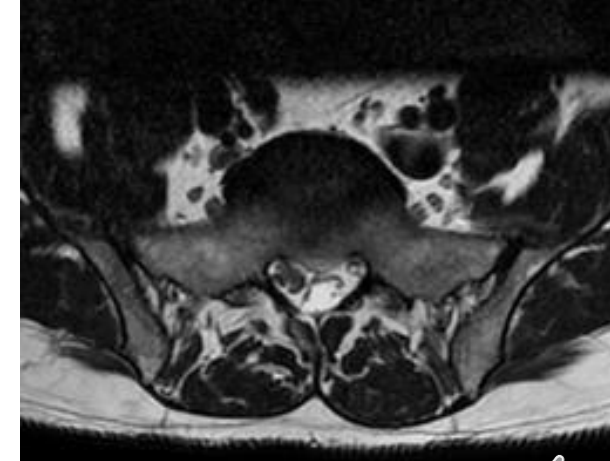
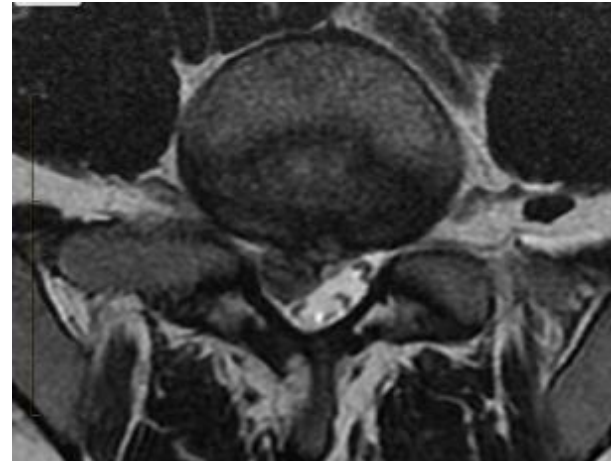
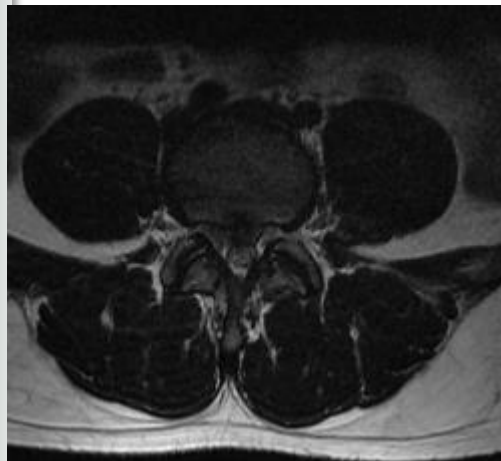
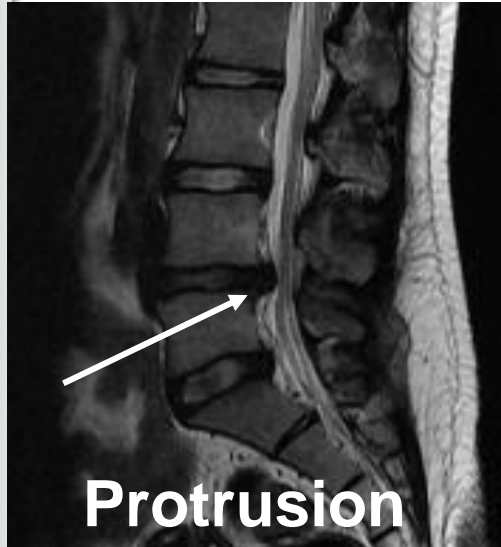
- *MRI → **Confirms** anatomical location and hernia morphology*
  - *AN IMAGE IS NOT DIAGNOSTIC !!*
  - *24% asymptomatic people present an image of a herniated disc (36% if > 60 years)*
  - *4% have an image of spinal canal stenosis (22% if > 60 years)*
- ### – Electromyography → Establishes motor nerve conduction status and delimits the number of affected roots
- *Clarifies how much damage is present in the conduction and in which nerve roots"*



*MRI T2 sagittal and axial.  
Left L<sub>5</sub>-S<sub>1</sub> disc protrusion*



# 1. Lumbar disc herniation



# 1. Lumbar disc herniation

- Conservative treatment

- Initially and for 4-6 weeks (90% improve)

- Surgical treatment

- Indications

- *Cauda equina syndrome= URGENT*
- *Progressive neurological deficit*
- *Clinical symptoms <1 month, but it is important if*
  - Pain +++, loss of foot dorsi-flexion
- *Clinical symptoms > 1 month, having anatomical-clinical correspondence*
  - Clear anatomical correlation
  - Frequent relapses despite treatment

- Surgical options

- Multiple
- Indication depends on the case

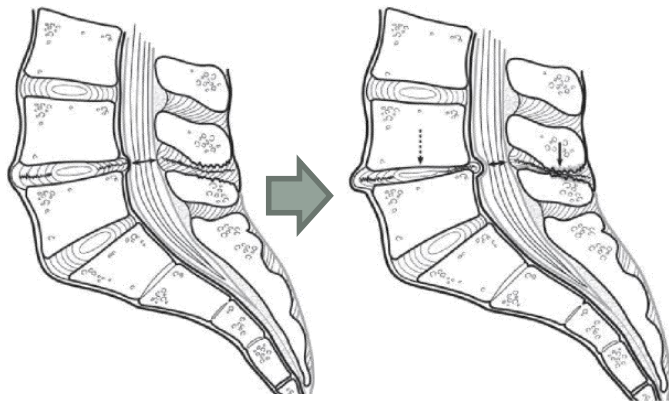


- Percutaneous or laser nucleotomy
- Disc radiofrequency
- Intradiscal ozone therapy (O<sub>3</sub>)
- Lumbar microdiscectomy
- Microdiscectomy + nucleus pulposus implant
- Discectomy + arthrodesis
- Discectomy + lumbar disc prosthesis





## 2. Degenerative disc disease



- Degeneration of the intervertebral disc
- The disc loses its ability to obtain oxygen and glucose
  - Possible rupture of the annulus → Herniated disc
  - Possible degenerative changes in the zygapophyseal joints
- Age 30 – 50 years (♂ > ♀)
- Clinical symptoms
  - Low back pain ± sciatica
    - *Gets worse by leaning forward, sitting, getting in and out of a car, lifting weights*



# 2. Degenerative disc disease

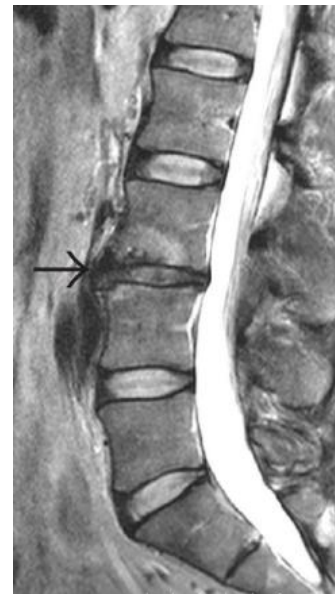
## • Evolution

- Initial pain → outbreaks of pain due to instability → Spontaneous restabilisation → ↓pain



## • Diagnosis = MRI

- Disc degeneration = disc collapse + cartilaginous plaque degeneration (no nucleus-annulus difference)



*Degenerative disc disease L3-L4. Sagittal MRI T2.*



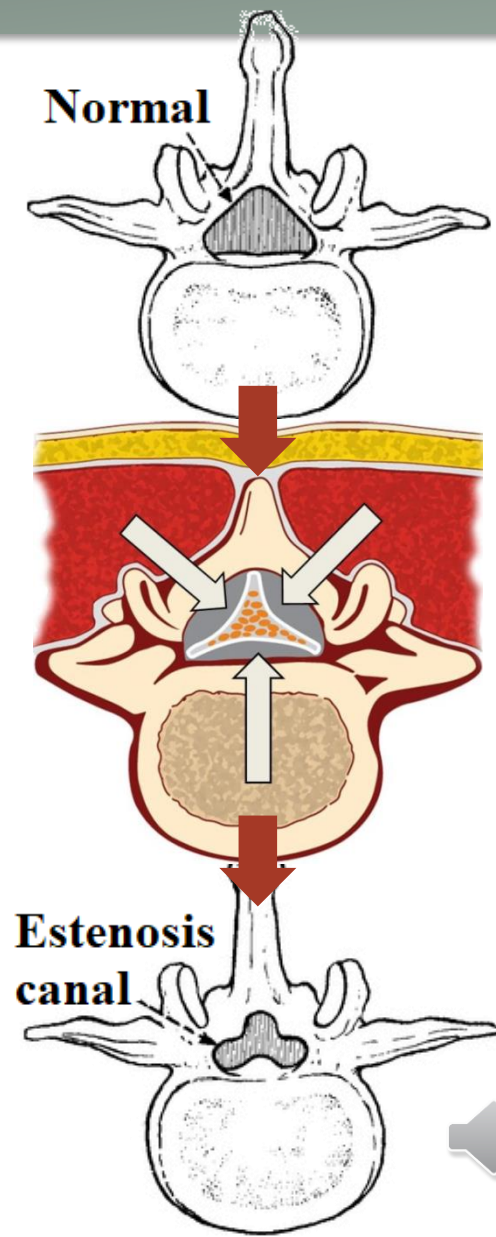
*Degenerative disc disease L5-S1. Above TC and TC-3D. Down WITH SYR Sagittal T2*

## • Treatment

- Conservative (no smoking, posture, exercises ...)
- Surgical

# 3. Lumbar spinal canal stenosis

- Spinal canal stenosis = spinal canal diameter reduction
  - Compression of structures + vascular involvement of the spinal cord (cervical, thoracic) or cauda equina nerve roots (lumbar)
  - Etiology
    - *Congenital (achondroplasia)*
    - *Acquired (spondylosis, spondylolisthesis, Paget disease, acromegaly, post-traumatic ...)*
    - *Mixed = + frequent, incidence ↑ with age*
- Lumbar area
  - Disc degeneration with facet hypertrophy + yellow ligament
  - ± Disc protrusion
  - ± Spondylolisthesis



# 3. Lumbar spinal canal stenosis

- Level  $L_4-L_5 > L_3-L_4 > L_2-L_3 > L_5-S_1$
- Clinical features
  - Elderly males
  - Chronic lumbosciatic or lower back pain
    - $\uparrow$  with hyperextension (particularly if herniated disc)
  - Bilateral distribution, without defined dermatomes
  - Neurogenic claudication
    - pain + numbness and paresthesia after walking a distance or descending slopes (lumbar extension)
  - Improves with bending over
    - when climbing slopes or leaning forward (anthropoid or grocery cart posture), unlike vascular claudication

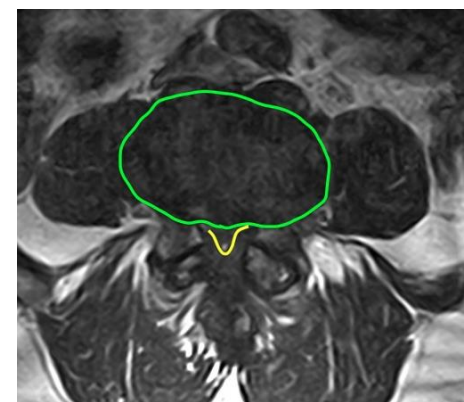
Pain





# 3. Lumbar spinal canal stenosis

- Physical examination
  - Posture: spinal flexion
  - Extension induces pain
  - Neurological examination: normal in 18%
  - ↓ Patellar and Achilles reflexes
  - Possible coexistence of CERVICAL spinal canal stenosis
- Spine stable except if spondylolisthesis or degenerative scoliosis
- Treatment = surgical



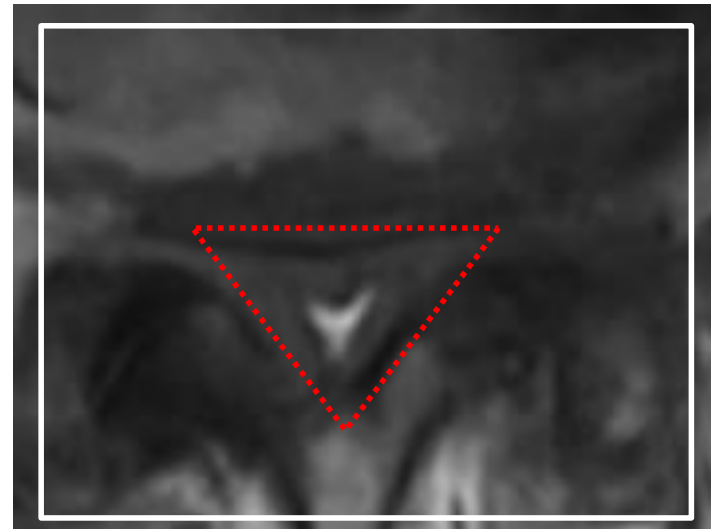
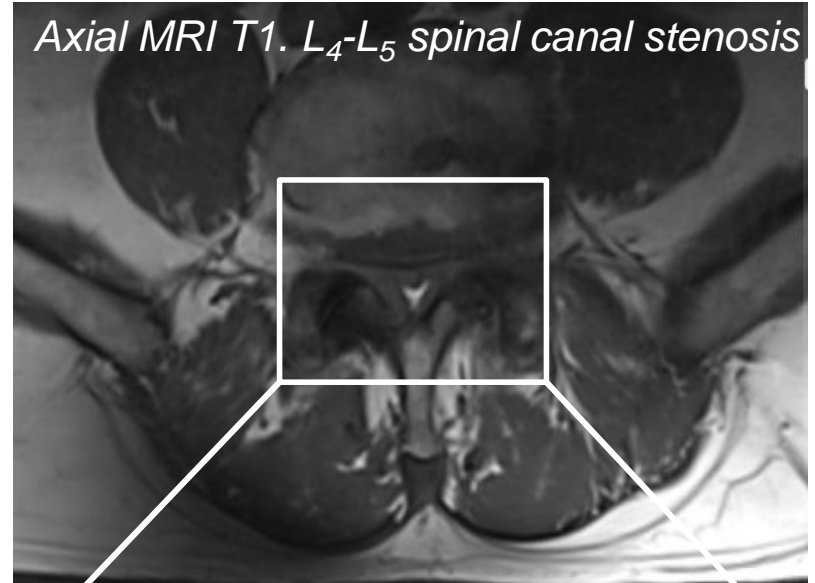
Severe lumbar canal stenosis. The narrow spinal canal is the small triangle depicted by the yellow line 



# 3. Lumbar spinal canal stenosis



*SAGITT MRI T2.  
Multilevel disc disease  
plus L<sub>4</sub>-L<sub>5</sub> spinal canal  
stenosis*

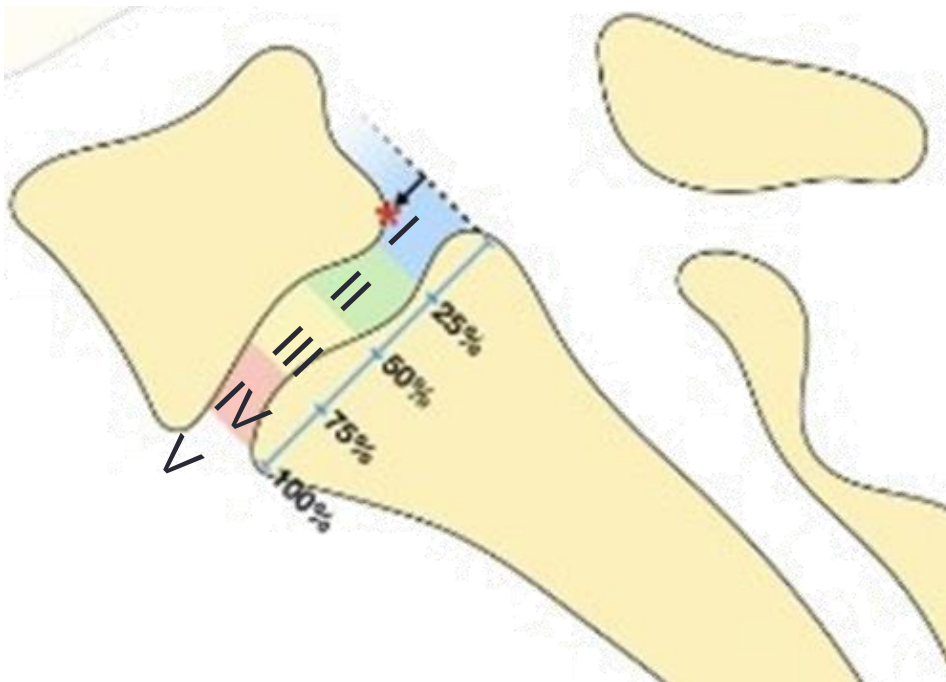
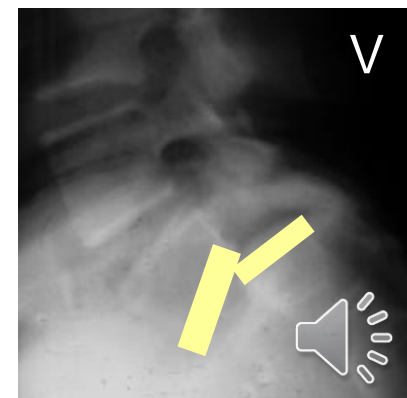
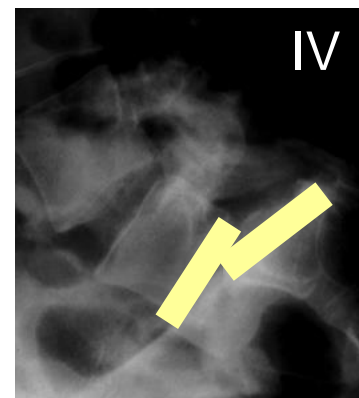
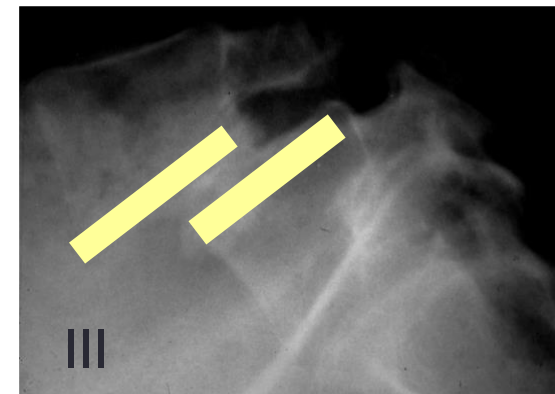
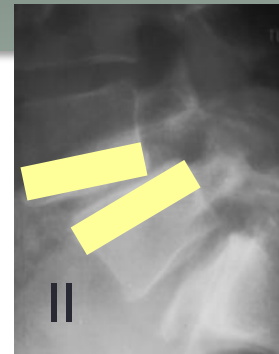
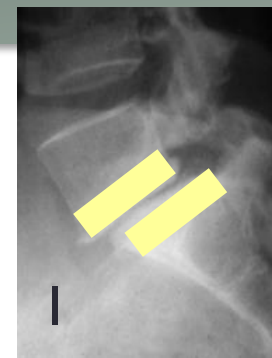


▽ *Width that the  
spinal canal  
should have*



# 4. Spondylolisthesis

- Forward displacement of one vertebra over the one immediately below
- Degrees 1 to 5 according to slippage
- Treatment = surgical



# 5. Spondylodiscitis

- Infection of disc and adjacent vertebrae
  - Most common in lumbar region, one level (65%)
  - Most common germ = Staph. aureus (60%)
- Clinical symptoms
  - Low back pain +++ intense, well localized, that ↑ with any movement and is relieved by bed rest
  - Fever?
- Diagnosis
  - RM
  - Confirmation = puncture biopsy - antibiogram
- Treatment
  - Immobilization (bed ⇔ corset)
  - IV antibiotics 4 - 6 weeks → per antibiotics 4 - 6 weeks



*Discitis L4-L5. RM sagittal T1 (top) and T1 C+ fatsat (bottom)*

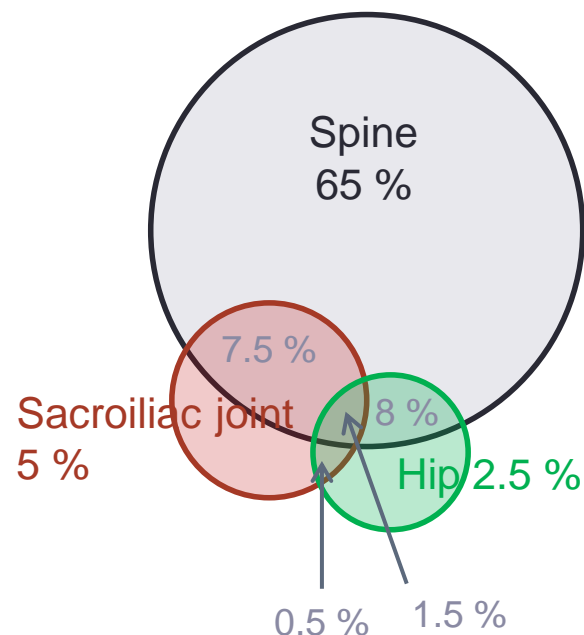


# 6. Other causes of lumbosacral pain

- Lower back pain differential diagnosis

<b>INESPECÍFICO (70 %)</b>	<b>DOLOR REFERIDO (2 %)</b>
Lumbalgia mecànica	Aneurisma aorta Enf pèlvicas Enf GI Enf renal
<b>DOLOR MECÀNIC (27 %)</b>	<b>DOLOR NO MECÀNIC (1 %)</b>
Degeneració discal o facetària Hernia discal Estenosis de canal Fx osteoporòtica Fx traumàtica Enf congènita Espondilosis Dolor discogènic Inestabilitat	Neoplasia (mieloma múltiple, ca metastàtic...) Artritis inflamàtoria Infecció (osteomielitis, discitis, abscesos)

- Anatomical origin nonspecific and pain mechanical in nature
  - 10% unidentifiable source





# 6. Other causes of lumbosacral pain

- Sacroiliac joint pain

- Sacroiliac dysfunction → Swelling and pain
- "Lumbosciatica" but lower back pain, buttocks > legs
  - *Women*
  - ↑ *"by leaning on one leg" (rolling over in bed, hopping on one leg, climbing stairs, taking long strides), sitting down, and driving through potholes*
  - *Fingertip pointing to the "thong triangle" = Fortin sign*
  - *Common cause of pain after lumbar spinal arthrodesis*
- **NEGATIVE** image (plain X-ray, CT, MRI)
  - *Possible sacroiliitis (MRI)*
- Diagnosis = local anesthesia infiltration
- Conservative treatment
  - *NSAIDs (Indomethacin), sacroiliac girdle*
- Surgical treatment = SI arthrodesis



# THORACIC SPINE

- Disc herniation very uncommon (<1% disc hernias)

- Young person 20 - 40 years old, traumatic antecedent (25%) - fall, abrupt turn
- Degenerative disease (rare)
- Level below T<sub>8</sub> (75%)
- 25% in T<sub>11</sub>- T<sub>12</sub>

- Clinical symptoms

- Pain (60%)
- Sensory (23%) or motor (18%) changes
- Usually myelopathy
- Spastic paraparesis

- Treatment = surgical

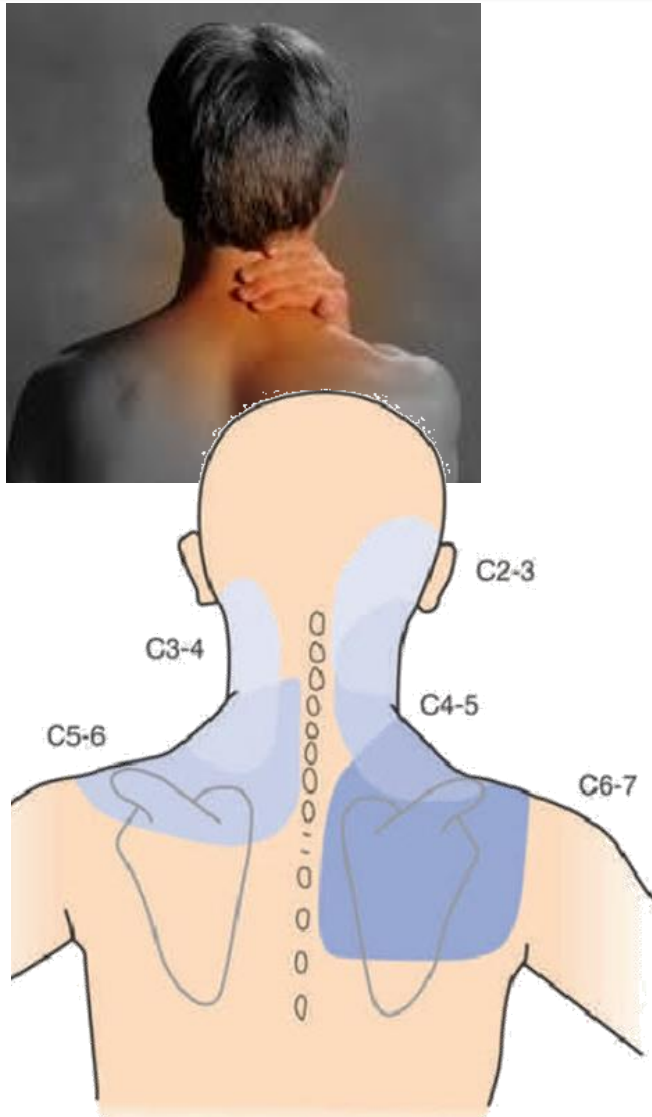
*Sagittal T2 MRI. Thoracic herniation at T11 level with syringomyelia*



*44 years, herniated disc T6-T7 calcified and protruded. Left, CT scan. Right, MRI*



# CERVICAL SPINE



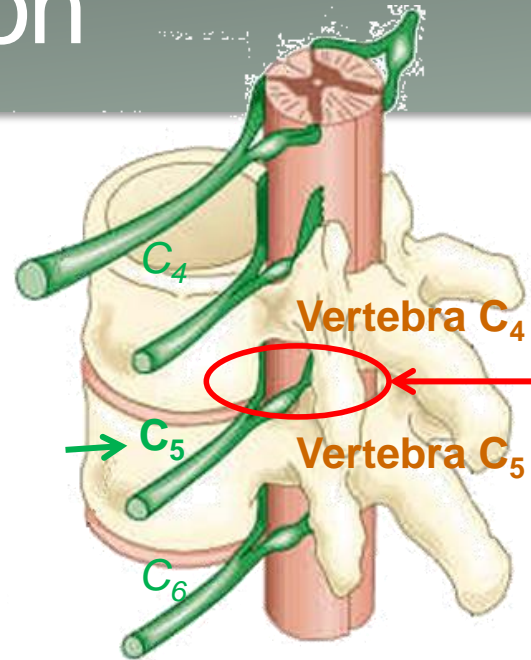
- Almost everything said for lumbar spine applies, except:
  - Pain has a cervical distribution
  - Differential diagnosis with:
    - *Skull base disorders*
    - *Shoulder pathology (scapulohumeral periarthritis)*
- Cervical nerve root radiculopathy
  - Differential diagnosis with brachial plexus lesion due to neoplasia
- Spinal canal stenosis
  - Cervical myelopathy



# 1. Cervical disc herniation

## • Clinical features

- Nerve root foramen very close to disc below = a small herniation does much damage
- There are 7 cervical vertebrae but 8 nerve roots = roots come out of the UPPER nerve root foramen level
- Roots protrude too horizontally → disc herniation clamps the nerve root
- C<sub>4</sub>-C<sub>5</sub> hernia → C<sub>5</sub> radiculopathy

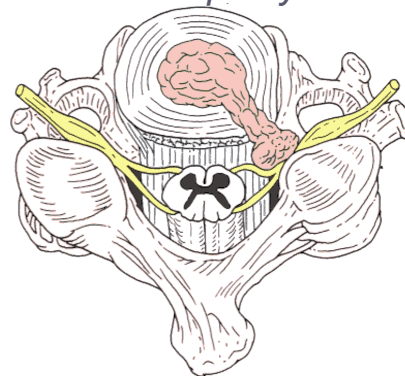


Herniation at C<sub>4</sub>-C<sub>5</sub> level affects C<sub>5</sub> root

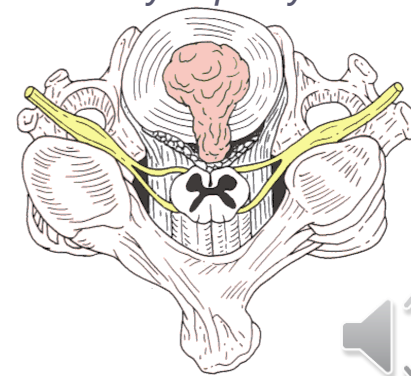
## • Clinical symptoms

- Radiculopathy (lateral)
  - Improves with hand over head
  - Gets worse when lifting weights
  - No identifiable trauma
- Possible cervical myelopathy
  - Central disc herniation

Lateral disc herniation = radiculopathy



Central disc herniation = myelopathy





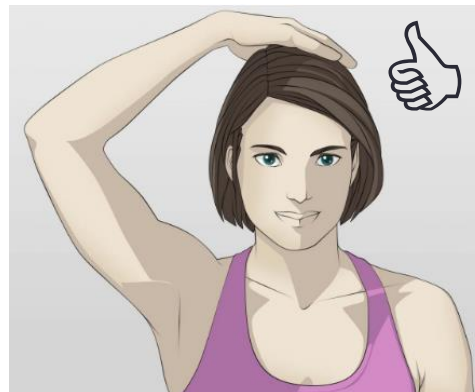
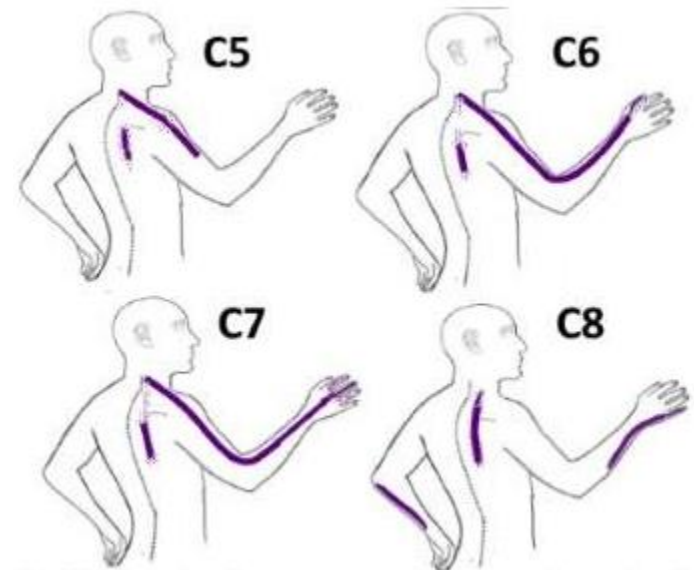
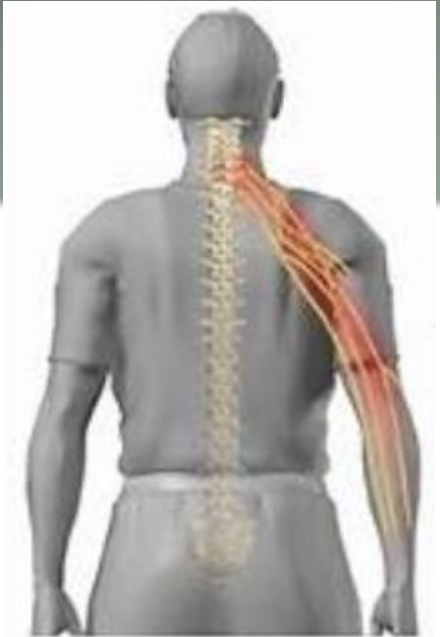
# 1. Cervical disc herniation

- Cervicobrachial

- Cervical pain radiating to the upper limb distal to the elbow

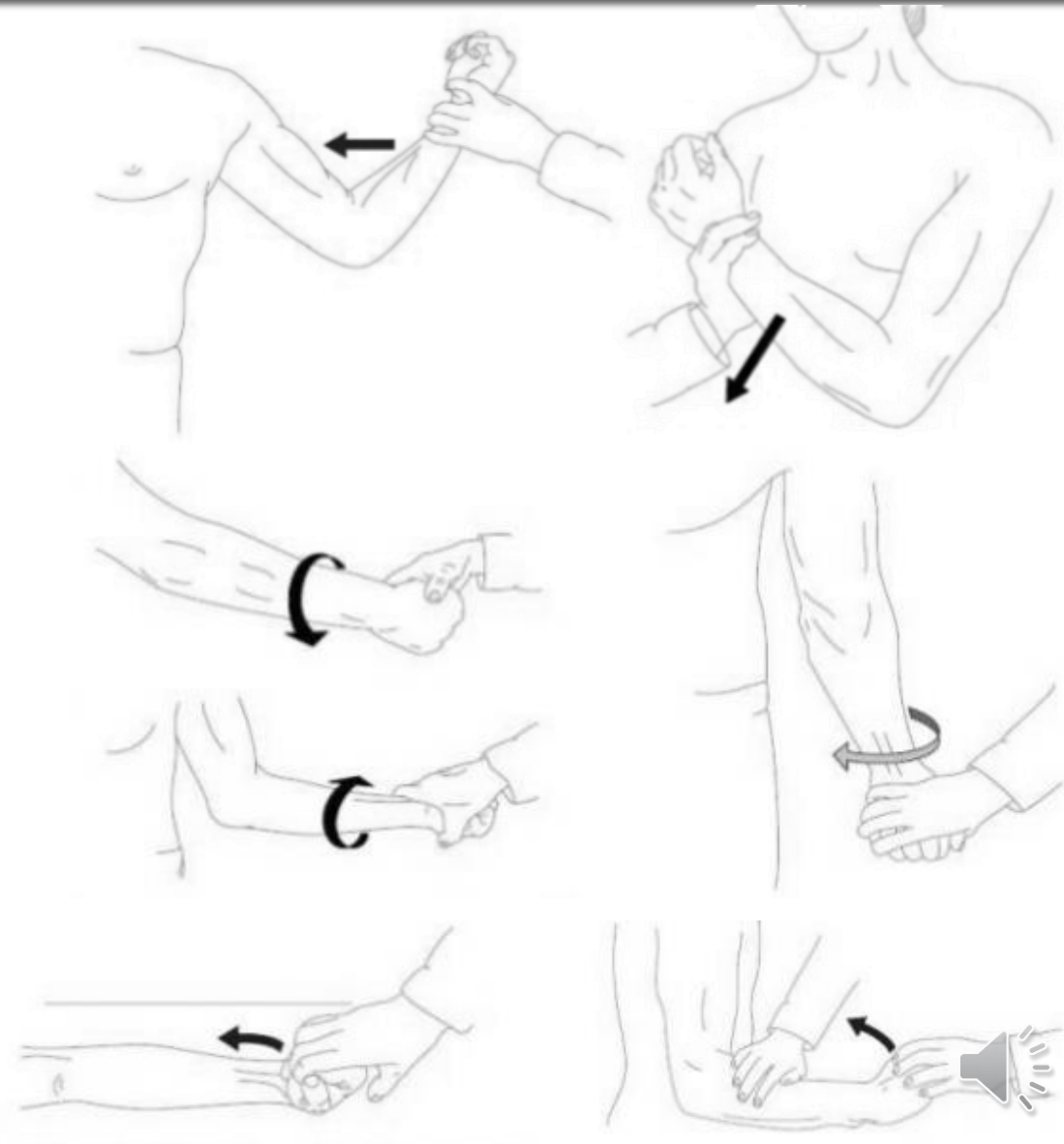
- Neurological examination

- Most affect C<sub>5</sub>-C<sub>6</sub> and C<sub>6</sub>-C<sub>7</sub> disks = C<sub>6</sub> and C<sub>7</sub> nerve roots
- Spurling's sign
- Hand over head relief
- Possible cervical myelopathy



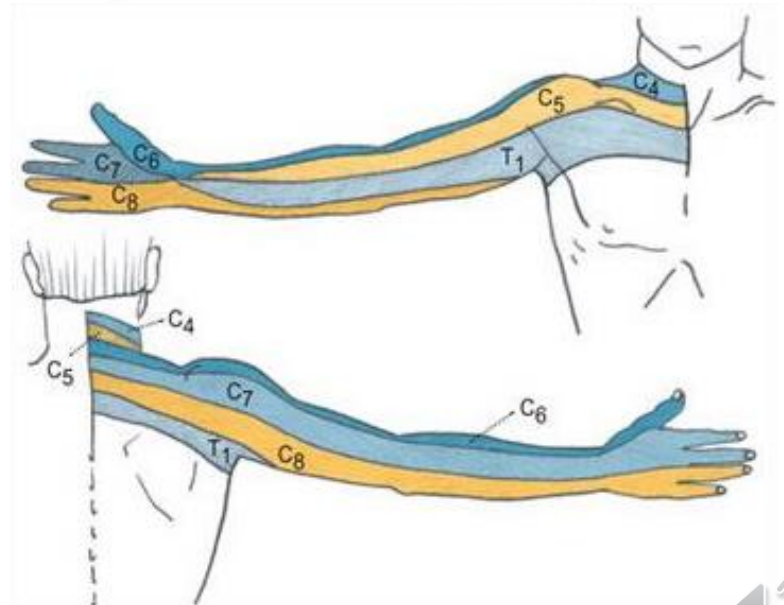
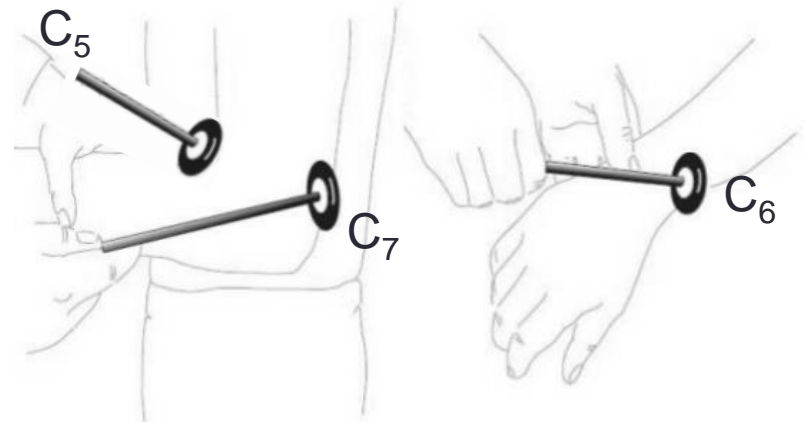
# Cervical spine examination

- Motor examination
- Osteotendinous reflexes
- Sensation
- Nerve root compression manoeuvres
- LUMBAR SPINE EXAM



# Cervical spine examination

- Motor exam
- Osteotendinous reflexes
  - C<sub>5</sub> - Bicipital
  - C<sub>6</sub> - Styloradial reflex (and biceps reflex)
  - C<sub>7</sub> - Tricipital
- Sensation
- Root compression manoeuvres



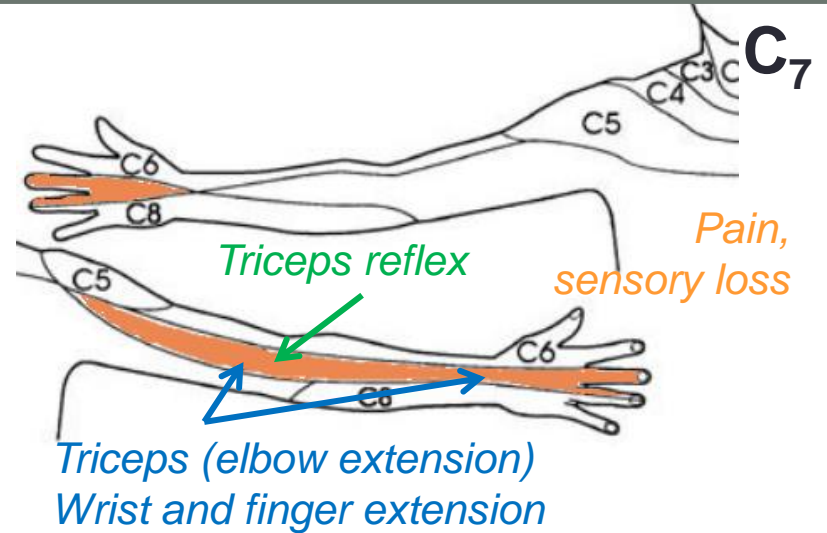
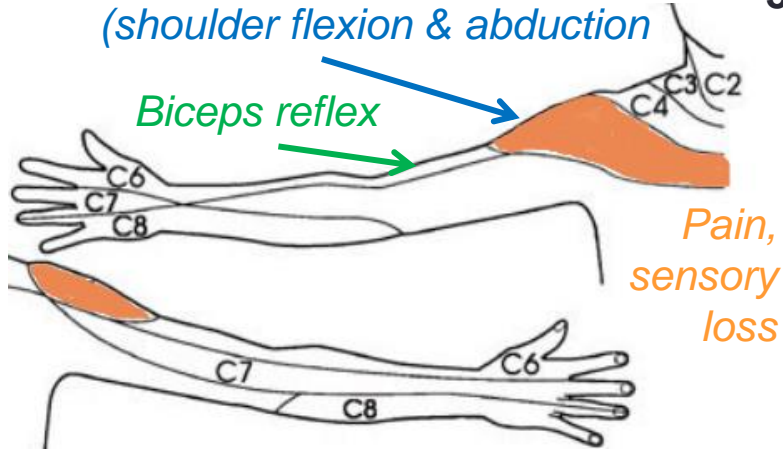
*Spurling's sign*



# 1. Cervical disc herniation

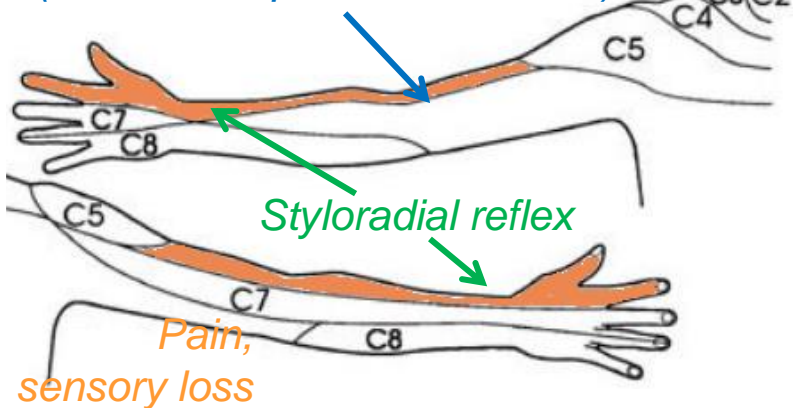
*Deltoids + supra and infraspinatus  
(shoulder flexion & abduction)*

**C<sub>5</sub>**



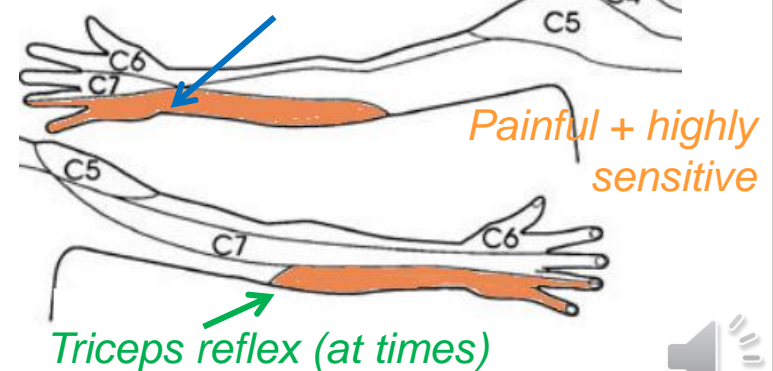
*Biceps and long supinator  
(shoulder separation & flexion)*

**C<sub>6</sub>**



*Finger flexion. Hand intrinsic  
hand muscles*

**C<sub>8</sub>**





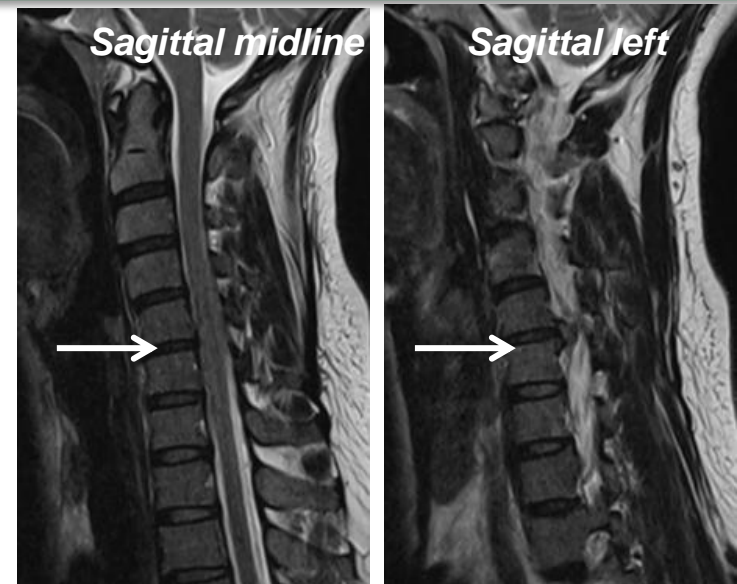
# 1. Cervical disc herniation

## • Diagnosis

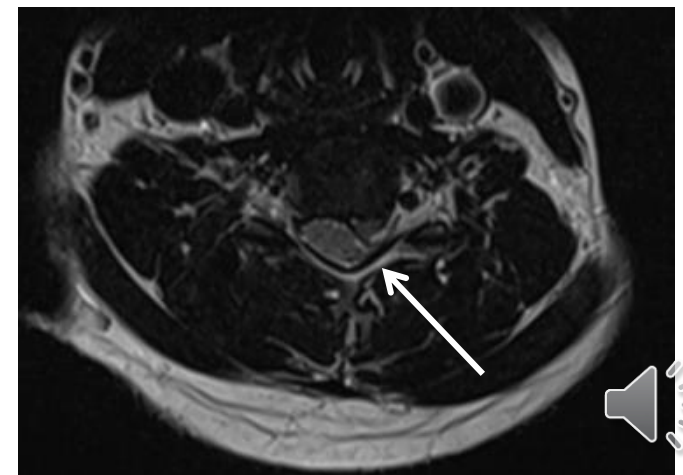
- Image = cervical MRI
  - *Root ± compressed spinal cord*
- EMG = degree of nerve root involvement

## • Treatment

- Conservative → improve 95%
- Cervical collar, NSAIDs, muscle relaxants
- Surgical - indications:
  - *Radiculopathy refractory to medical treatment*
  - *Severe nerve root involvement*
  - *Cervical myelopathy*
- Anterior discectomy with interbody fusion

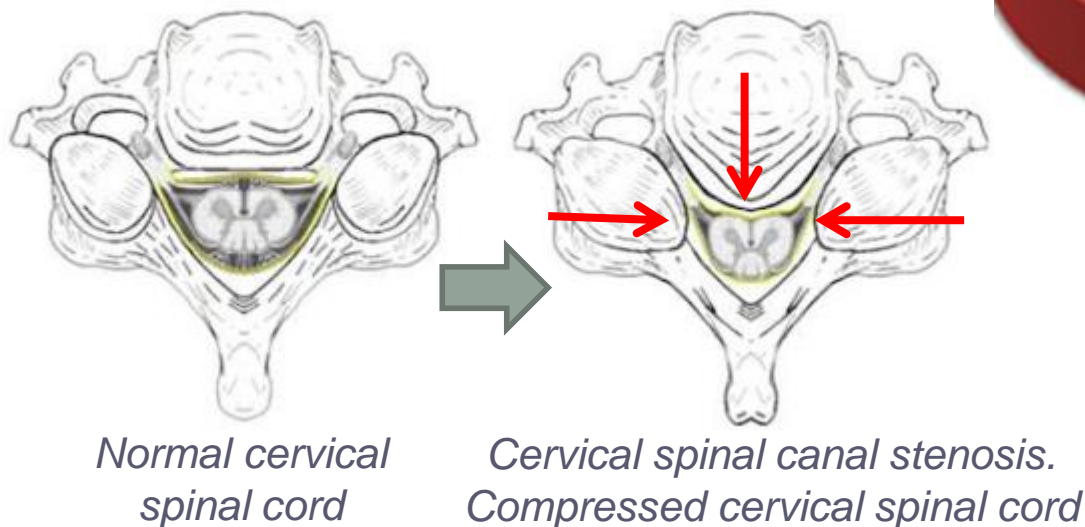
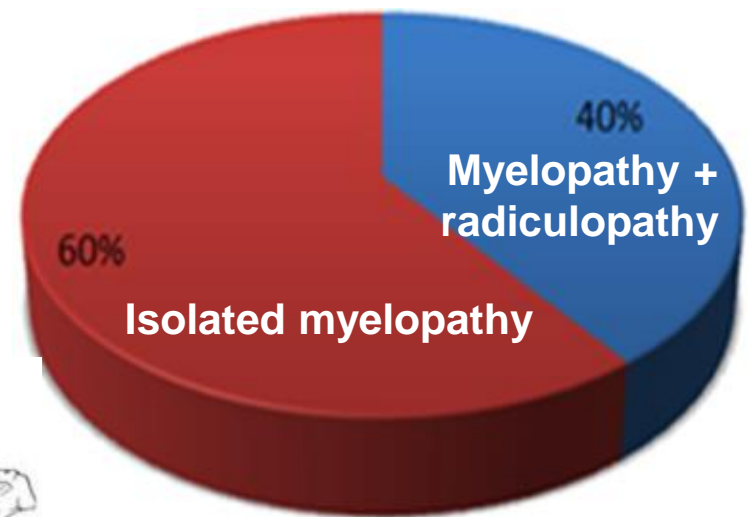


MRI T2 sagittal and axial. Cervical disc herniation C<sub>5</sub>-C<sub>6</sub> (radiculopathy C<sub>6</sub>) left



# 2. Cervical spinal canal stenosis

- "Spondylotic" cervical myelopathy
  - Spondylosis = most common cause of myelopathy > 50 years
  - Clinical symptoms when spinal canal stenosis > 30%
  - Pathophysiology
    - *direct compression*
    - *ischemia (vascular compromise)*
    - *microtrauma due to spondylosis*



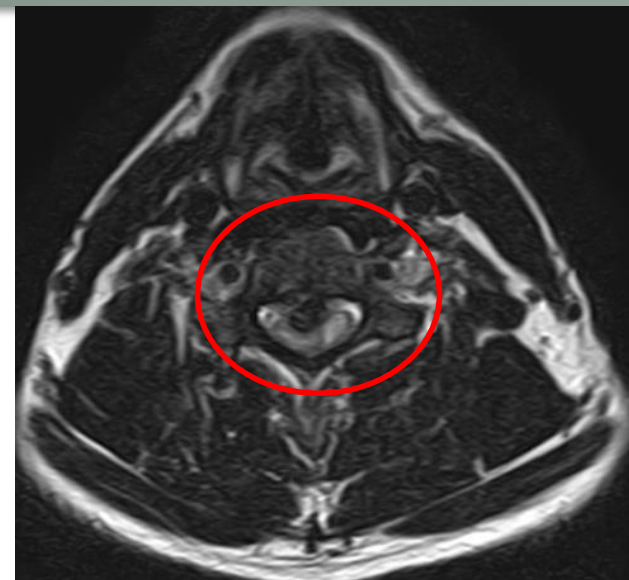
## 2. Cervical spinal canal stenosis

- Myelopathy symptoms
  - Nerve root signs in upper limbs + spasticity and polykinetic reflexes in lower limbs ( $\pm$  urge incontinence)
  - Early signs
    - *MMSS clumsiness (buttoning clothes, holding a cup)*
  - Medium term
    - *Gait troubles, leg weakness*
    - *Brachialgia 40%, cervicalgia 8%*
  - Long-term
    - *Sphincter dysfunction (50%): urgency, frequency*
- Motor examination
  - Nerve root + SPINAL CORD COMPRESSION
  - Triceps ( $C_7$ ) & intrinsic muscle hand ( $C_8$ ) weakness
  - Arm weakness (30%), lower limb proximal weakness



## 2. Cervical spinal canal stenosis

- Diagnosis = MRI ± CT scan
  - Spinal canal → therapeutic options
  - Spinal cord → demyelination, syringomyelia, atrophy, edema, necrosis ... → prognosis
  - Differential diagnosis (Chiari type I malformation, tumour ...)
- Treatment = surgical
  - Discectomy + anterior cervical arthrodesis ± interbody graft (bone or prosthesis)



*Axial and sagittal T2 MRI. C<sub>5</sub>-C<sub>6</sub> spinal canal stenosis and signal enhancement due to myelomalacia and gliosis*





# 3. Cervical + lumbar spinal stenosis

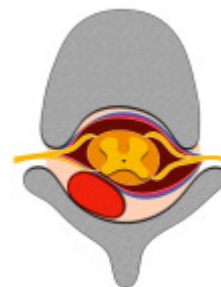
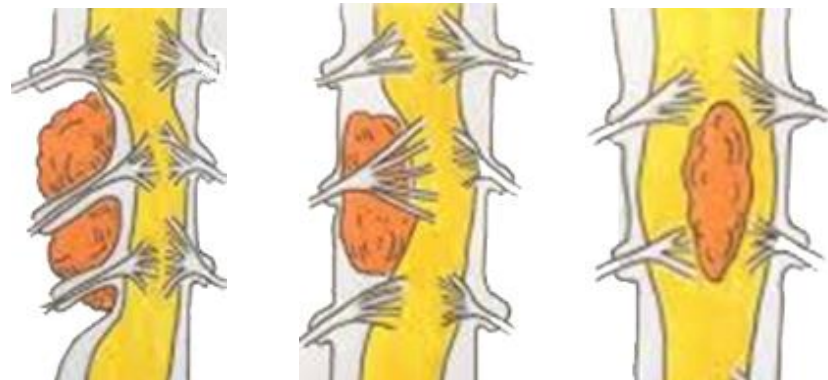


- All the areas of spine age at the same time !
  - Old age ("all the bones of the same patient get old at the same time")
  - Patients come for weak legs + low back pain
- But on examination ...
  - Clinical predominance of cervical myelopathy >> lower limb neurogenic claudication
- Treatment
  - 1<sup>st</sup> cervical decompression + arthrodesis
  - 2<sup>nd</sup> if required, lumbar decompression ± arthrodesis

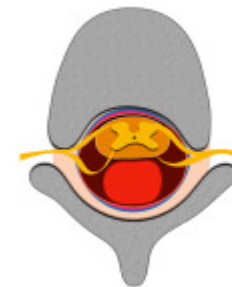


# SPINAL TUMOURS

- 15% of CNS tumours
  - Metastases = most frequent spinal tumour
  - Primary spinal tumours = mostly benign
- **Classification**
  - **Extradural** (94%)
    - *Metastases >> chordoma*
  - **Intradural extramedullary** (5-6%)
    - *Meningioma and neurinoma*
  - **Intramedullary** (1-2%)
    - *Ependymoma, astrocytoma*
- **Diagnosis** = MRI
- **Treatment** = Surgery, radio  $\pm$  chemo
  - Depending on histology & location)



Extradural



Intradural  
extramedullary

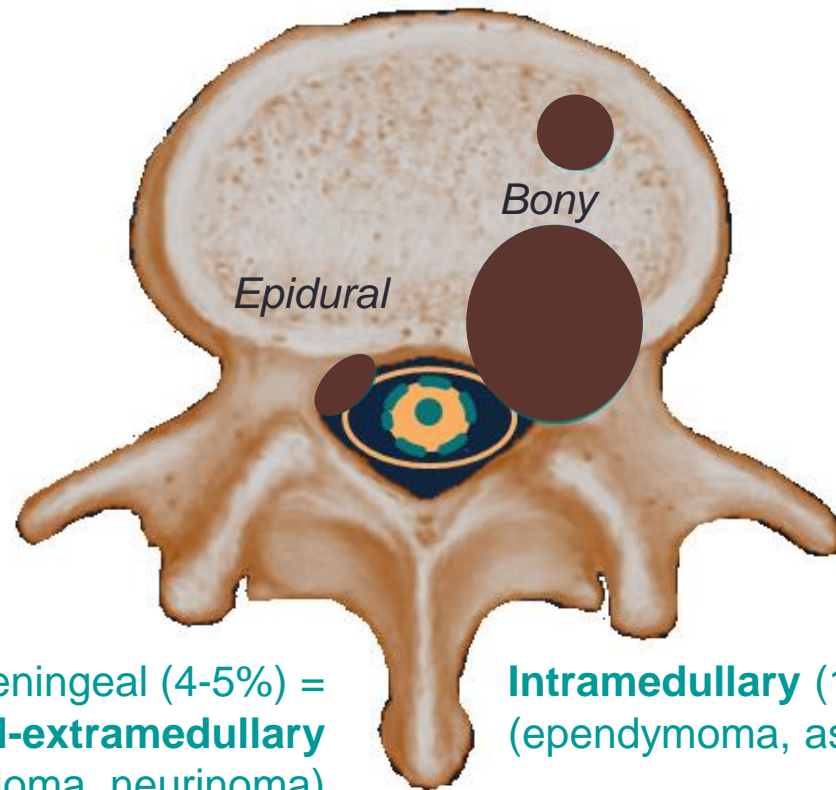


Intramedullary

# Spinal tumours



**Extradural 94 %**  
(Metastasis >> chordoma)



Leptomeningeal (4-5%) =  
**intradural-extramedullary**  
(Meningioma, neurinoma)

**Intramedullary (1-2%)**  
(ependymoma, astrocytoma)

**Intradural 6 %**

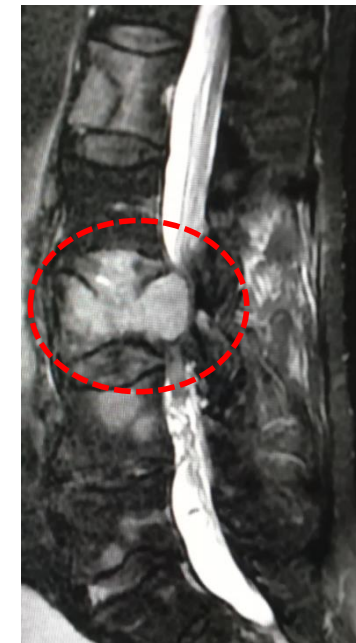
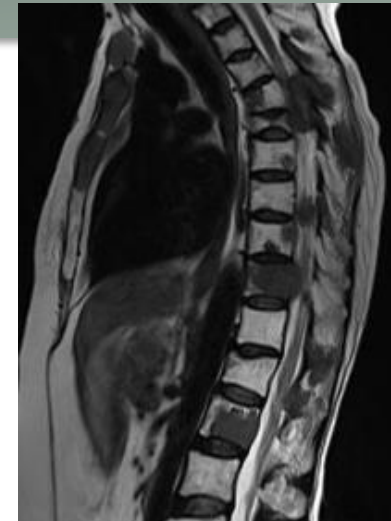




# Spinal tumours

## 1. Metastasis

- Most common spinal tumour (97%)
- Most common extradural tumour
- Location ↑ thoracic vertebrae
- Origin = lung (adenocarcinoma) > breast > prostate, kidney, gastrointestinal
- 50 - 70% cancer patients present vertebral metastases
- Clinical symptoms
  - *Local pain (95%), possible pathological fractures*
    - It does not improve lying down
  - *Motor / bladder dysfunction → weakness, urgency / urinary retention.*





# Spinal tumours

## 2. Ependymoma

- 60% intramedullary tumours
- Filum terminale > other locations

## 3. Astrocytoma (glioma)

- 33% of intramedullary tumours
- Most common malignant intramedullary tumour



*RM T2 and T1 C+ fatsat.  
Intramedullary ependymoma*



*RM T2. Intramedullary  
ependymoma*

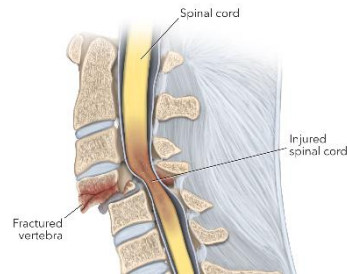


*RM T2 and T1 C+ fatsat.  
Intramedullary astrocytoma*



# SPINAL INJURIES

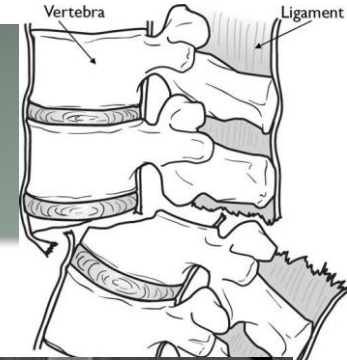
- Trauma involving spinal column  $\pm$  spinal cord  $\pm$  spinal nerve roots
  - SPINAL CORD INJURY
  - Spinal stability
- Epidemiology
- 0.2% hospital admissions
  - C<sub>1</sub>-C<sub>2</sub> (the most frequent in children), C<sub>4</sub>-C<sub>6</sub> and T<sub>11</sub>-L<sub>2</sub>
  - Young adult male 20-30 years
  - Mortality 5 - 20%
  - Neurological complications in 20% of cases
  - Etiology
    - Traffic, work (falls), diving in shallow water, sports accidents, assaults ...



*TC y RM sag stir. C<sub>6</sub>-C<sub>7</sub> fracture-dislocation. Spinal cord injury*



*CT scan. T<sub>7</sub>-T<sub>8</sub> fracture dislocation. Spinal cord section*

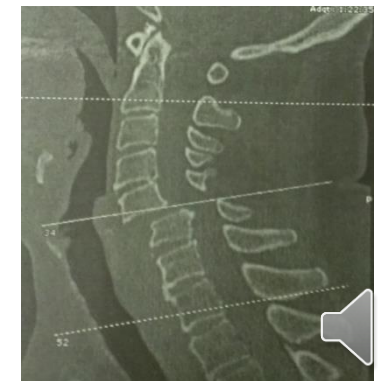


- **Spinal instability**

- Loss of the ability of the spine to maintain physiological (biomechanical) relationships between each vertebra
- Can induce spinal cord / nerve root injury, deformity, or pain
- Depends on the integrity of the spinal column structures

- **Injury level (disagreement)**

- Lower level that maintains normal neurological function
- Lowest level with motor function  $\geq 3/5$  + thermo-analgesic sensitivity (+) in the "intermediate zone"



# Terminology

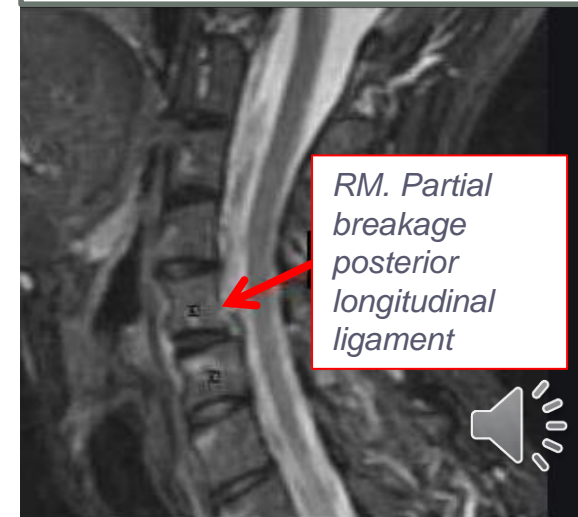
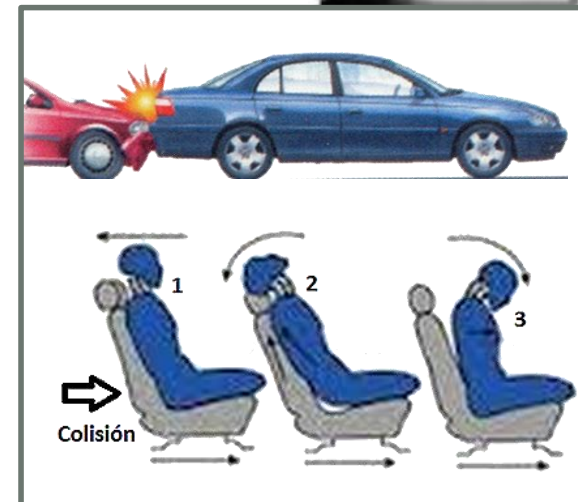
- Complete spinal cord injury
  - Neither sensory nor motor function three levels below the injury
- Incomplete spinal cord injury
  - If residual sensory / motor function three levels below the injury
    - *Sacral reflex (+) does not indicate an incomplete spinal cord injury*
  - Spinal cord syndromes: central, anterior, posterior, Brown-Séquard (spinal cord hemisection)
- Spinal shock (24 - 48 h duration )
  - No polysynaptic reflexes distal to the lesion
  - Hypotension due to NO sympathetic nerve function plus ↓venous return due to muscle paralysis ± haemorrhage (from other injuries).
  - Priapism





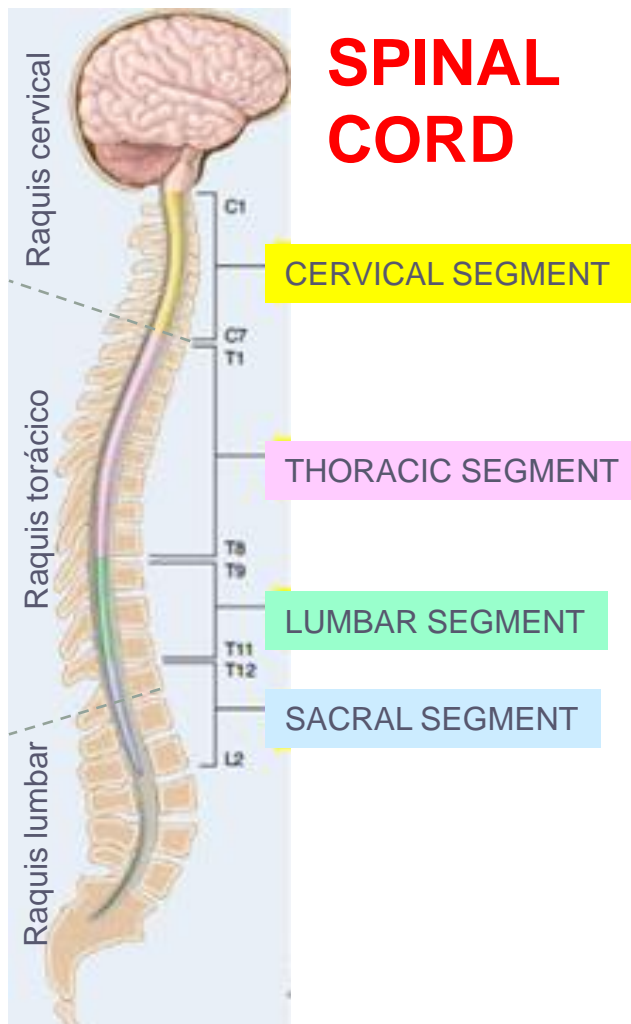
# 1. Whiplash

- “Whiplash”
  - Cervical musculoligamentous traumatic injury (no fracture, dislocation, or hernia)
  - Cause: sudden flexion-extension
- **Clinical symptoms** (in hours or days)
  - Neck pain, ↓mobility, weakness, nausea ...
- **Diagnosis** = clinical symptoms + "negative" radiological findings
  - Rx, CT scan → loss of cervical lordosis
  - MRI → prevertebral edema, ligamentous damage
  - Exclusion of other injuries
- **Conservative treatment**
  - Cervical collar, NSAIDs, physiotherapy
  - 55% improve in 3 months → 80% in 2 years



# 2. Spinal cord injuries

## SPINAL COLUMN



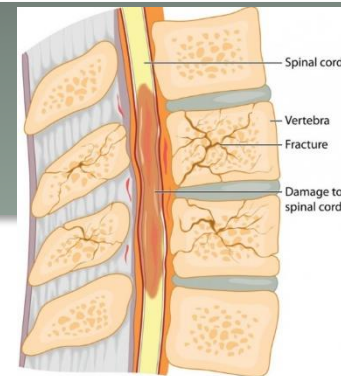
## SPINAL CORD

## ¿REMEMBER?

- Anatomical relationships
  - 8 cervical spinal nerve roots emerge ABOVE their equivalent vertebra
  - Rest (thoracic, lumbar, sacral) go out below
- Bone growth > spinal cord
  - $T_2-T_{10}$  → add +2 to the number of spinous processes
  - $T_{11}-L_1$  → contains spinal cord from  $L_1$  to coccygeal
  - $L_1$  → conus medullaris



## 2. Spinal cord injuries



### • Spinal shock

- Initial phase after spinal cord injury
  - *Nerve tissue damage (irreversible) + whole pathway dysfunction (reversible)*
- No polysynaptic reflexes distal to the lesion
  - *Bulbospongiosus (= bulbospongiosus reflex or “Osinski”) = contraction of the anal sphincter in response to squeezing the glans or clitoris*
- Hypotension due to NO sympathetic nervous system function + ↓venous return due to muscle paralysis ± haemorrhage (from other injuries). Priapism
- After spinal shock phase
  - *If bulbospongiosus reflex reappears → good prognosis*
    - If it does not reappear + ∅ rectal tone + ∅ perineal tenderness → Complete lesion

**Areflexic flaccid paralysis ⇔ Spastic and hyperreflexia paralysis due to medullary automatism**

## 2. Spinal cord injuries

- Residual injury after spinal cord shock phase

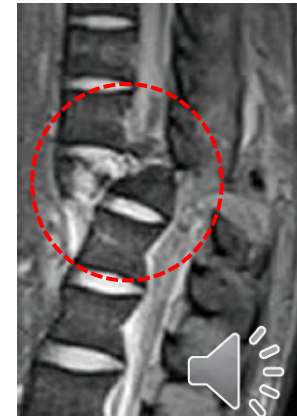
DEGREE OF INJURY	DESCRIPTION
COMPLETE A	No motor or sensory function below the lesion up to S4-S5
INCOMPLETE B	Preservation of <b>SENSORY</b> function. No motor function below the lesion up to S4-S5
INCOMPLETE C	Preservation of sensory function. <b>MOTOR function &lt; 3</b> in half of infralesional muscles
INCOMPLETE D	Preservation of sensory function. <b>MOTOR function ≥ 3</b> in half of the infralesional muscles
NORMAL E	<b>Normal</b> sensory and motor function





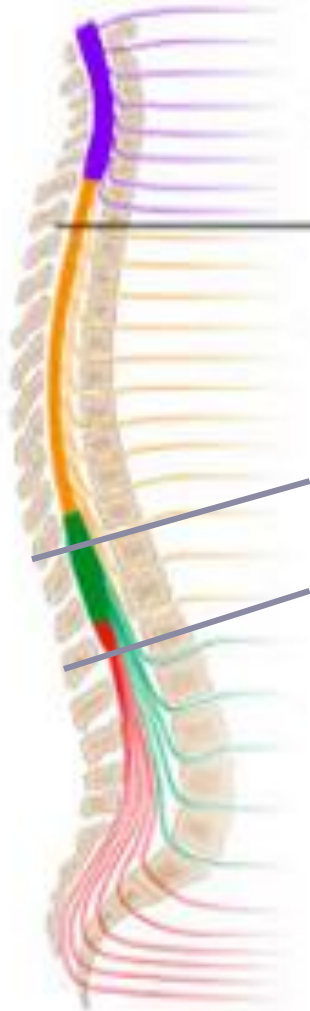
# 2. Spinal cord injuries

- Complete spinal cord injury
  - No sensory or motor function 3 levels below the injury
    - $\emptyset$  voluntary movement, toilet training
    - Hypotension, bradycardia (according to level)
    - Intestinal / bladder paralysis, priapism, impaired sexual function
  - Critical level = C<sub>3</sub> → "Bulbar / cervical dissociation"
    - Respiratory  $\pm$  cardiac arrest
    - Quadriplegia + respiratory assistance
  - Etiology → Traffic, dive



# 2. Spinal cord injuries

- Complete spinal cord injury



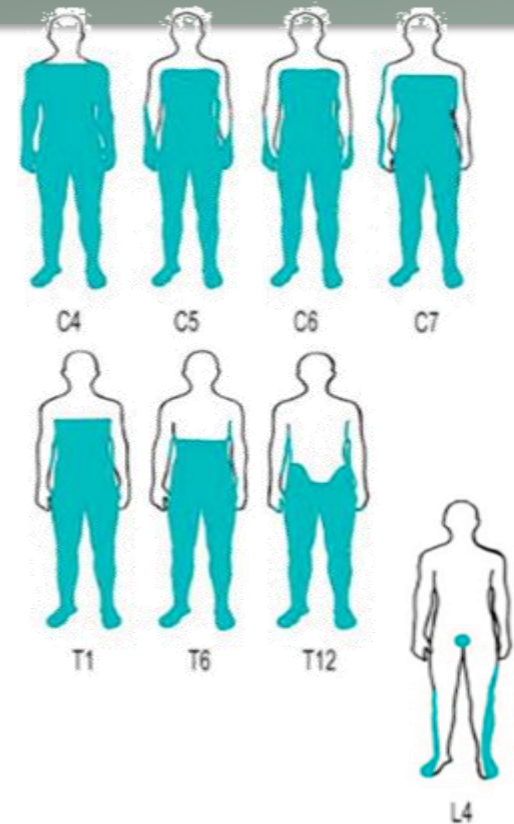
**C<sub>1</sub> – C<sub>4</sub>** = respiratory tetraplegia

**C<sub>5</sub> – T<sub>1</sub>** = tetraplegia

**Distal a T<sub>1</sub>** = paraplegia (flaccid → spastic)

**L<sub>2</sub> – S<sub>2</sub>** = FLACCID paralysis MMII without Achilles reflex, **automatic bladder**

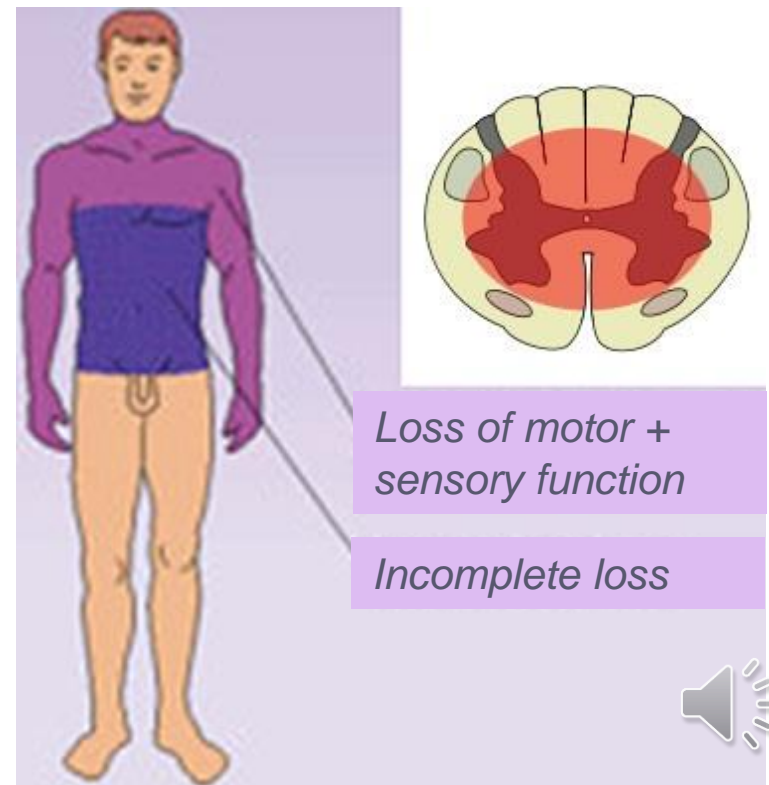
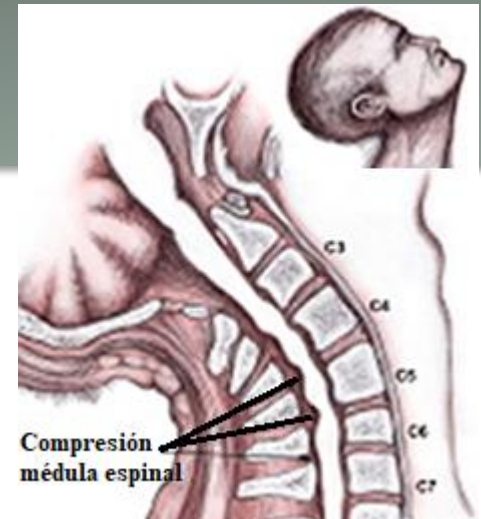
**S<sub>3</sub> – S<sub>5</sub>** = Saddle anesthesia, normal motor function, sexual/intestinal/urinary vegetative disorders (atonic bladder, urine overflow)



# 2. Spinal cord injuries

## • Spinal cord syndromes

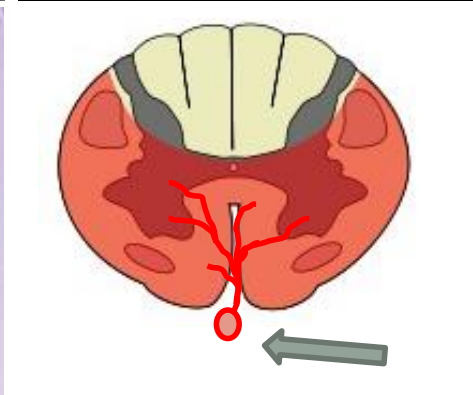
- Central spinal cord syndrome
  - *Most common spinal cord injury*
  - *Hyperextension in the elderly (stenosis, ischemia)*
  - *Central spinal cord area (vascular deficit, edema)*
  - *Clinical (syringomyelia, spinal cord tumours)*
  - *Upper limbs >> lower limb weakness*
  - *Myelopathy → sphincter dysfunction*
  - *MRI diagnosis*
  - *Treatment = surgical decompression*
- Anterior spinal cord syndrome
- Brown-Séquard syndrome



## 2. Spinal cord injuries

- Spinal cord syndromes

- Central spinal cord syndrome
- Anterior spinal cord syndrome
  - *Anterior medullary artery infarction*
  - *Most common vascular medullary syndrome*
  - *Paraplegia (tetraplegia over C<sub>6</sub>)*
  - *Sensory dissociation*
  - *Diagnosis = MRI*
  - *Treatment only possible if there is compression causing the injury*
- Brown-Séquard syndrome



- *Loss of motor function + pain and temperature.*
- *Position, vibration and touch sensations preserved*

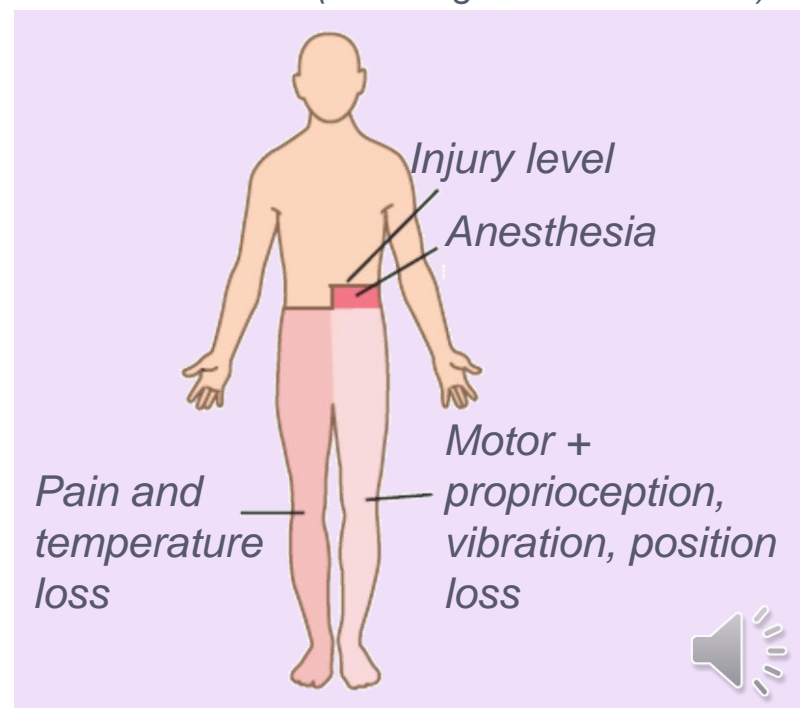
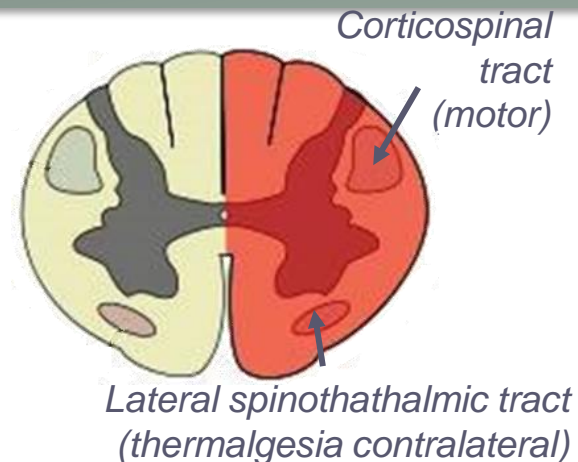
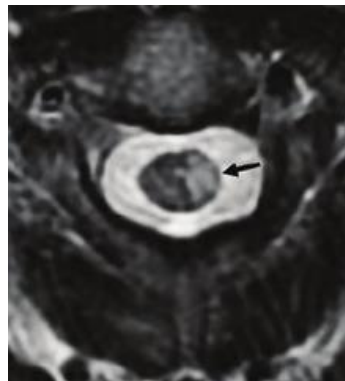




# 2. Spinal cord injuries

## • Spinal cord syndromes

- Central spinal cord syndrome
- Anterior spinal cord syndrome
- Brown-Séguard syndrome
  - *Spinal cord hemisection*
  - *Penetrating trauma, extramedullary injury (epidural hematoma, tumour) > radiation ...*
  - *Ipsilateral = motor loss + proprioception, vibration, discrimination*
  - *Contralateral = thermoalgesic loss*
  - *Diagnosis = MRI*
  - *Treatment only possible if compression exists*
  - *Prognosis → 90% ambulation, sphincter control*



# Treatment

- **Spinal immobilization (unstable)**

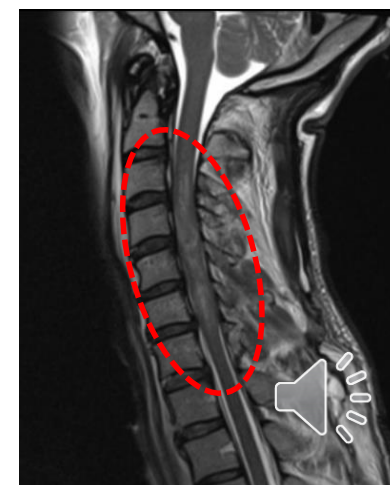
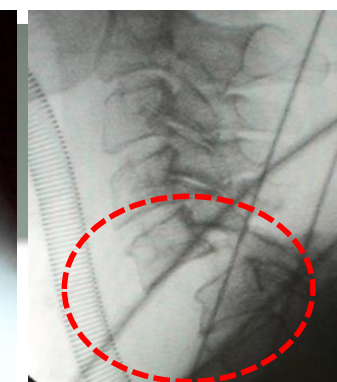
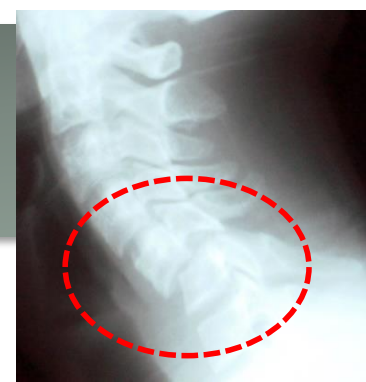
- Avoid any movement until lesions are defined
  - *Orthotics, traction, reduction?*
- In-block mobilization

- **Injury evaluation**

- Plain x-rays - flexion / extension?
- CT scan (3D) → Bone injury, hematoma
- MRI → Spinal cord injury, root ...

- **Avoid damage progression**

- Surgical stabilization of the spine
- Treatment of spinal cord damage
  - *High dose methylprednisolone?*
    - Today it is NOT recommended, but contraindicated due to its risk of myopathies



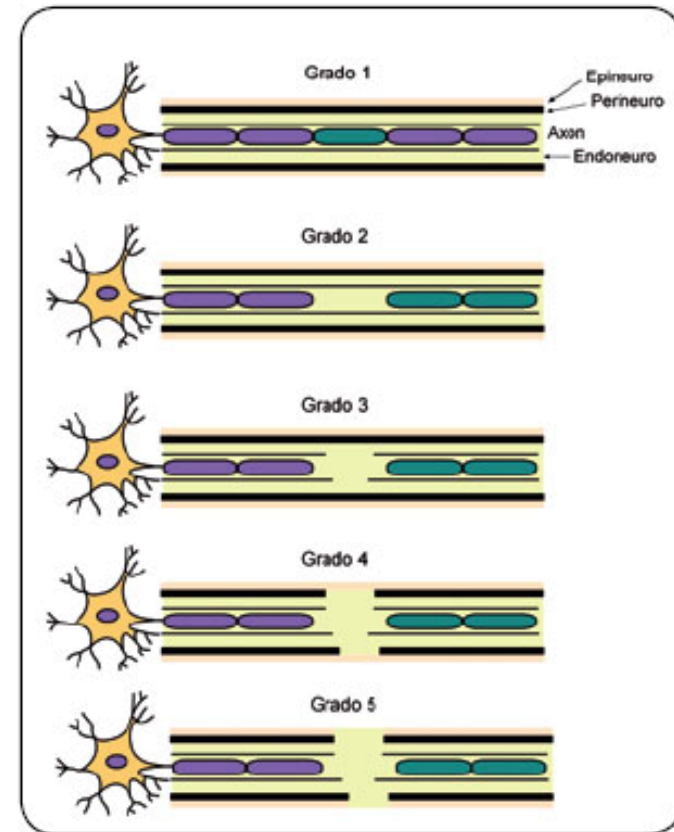
# PERIPHERAL NERVES

## • Types injuries

- Grade I- neurapraxia (without structural injury) to grade V-neurotmesis (axonal, endoneural, perineural, and epineural injury)

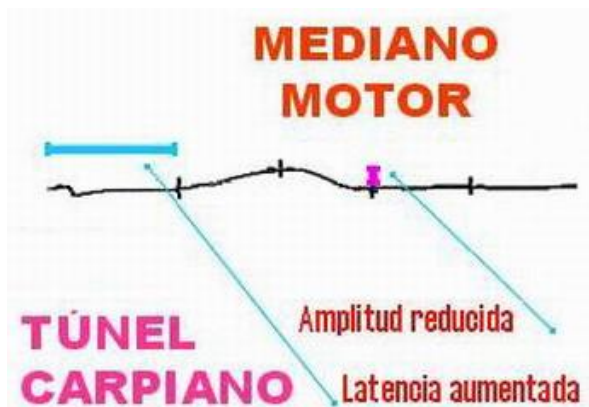
## • Etiology

- Entrapment
- Peripheral nerve passage through osteofibrous channels
- Carpal tunnel > cubital tunnel > peroneal nerve ...
- Traumatic injuries
  - *Crushing, stretching, sectioning, breaking, tearing*
- Nerve tumours (schwannoma) or structures around it (lipoma)

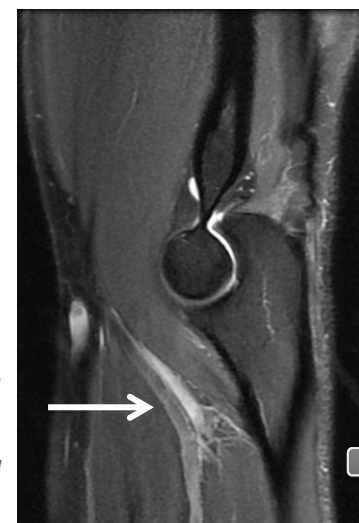


# Peripheral nerve injuries

- Clinical symptoms depending on damage and nerve distribution
  - Pain without nerve compression or entrapment
  - Sensation loss and muscle loss of strength and atrophy
- Diagnosis
  - Clinical symptoms + neurological examination (provocation manoeuvres)
  - EMG → locate point and severity of damage
  - MRI → anatomical details and cause



*Coronal MRI T1.  
 Lipoma that causes  
 carpal tunnel syndrome*

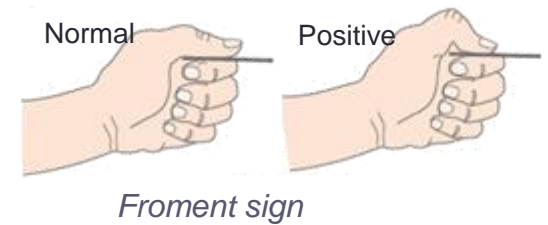
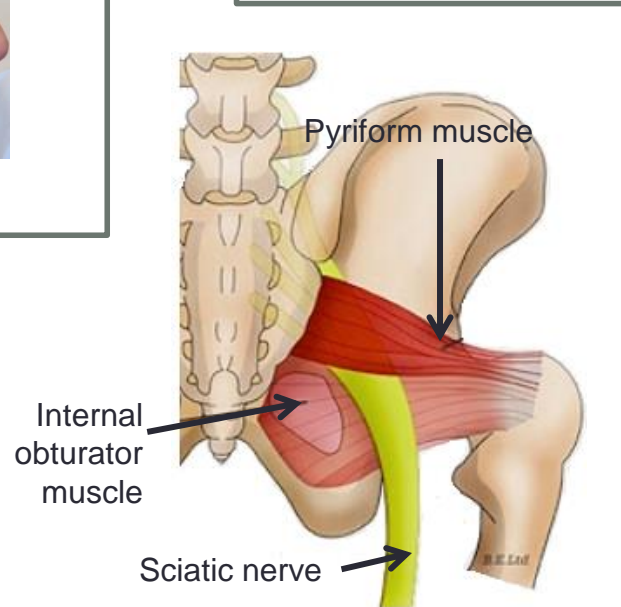
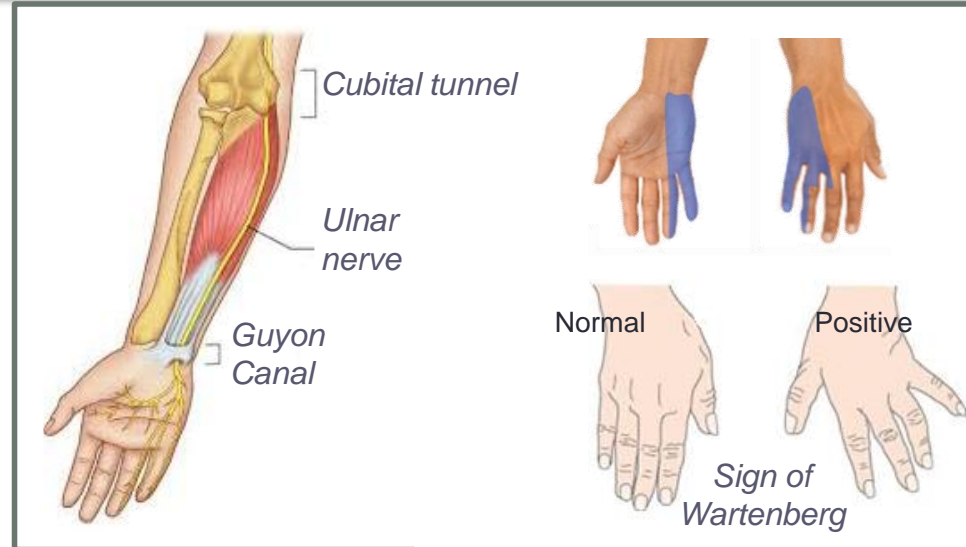
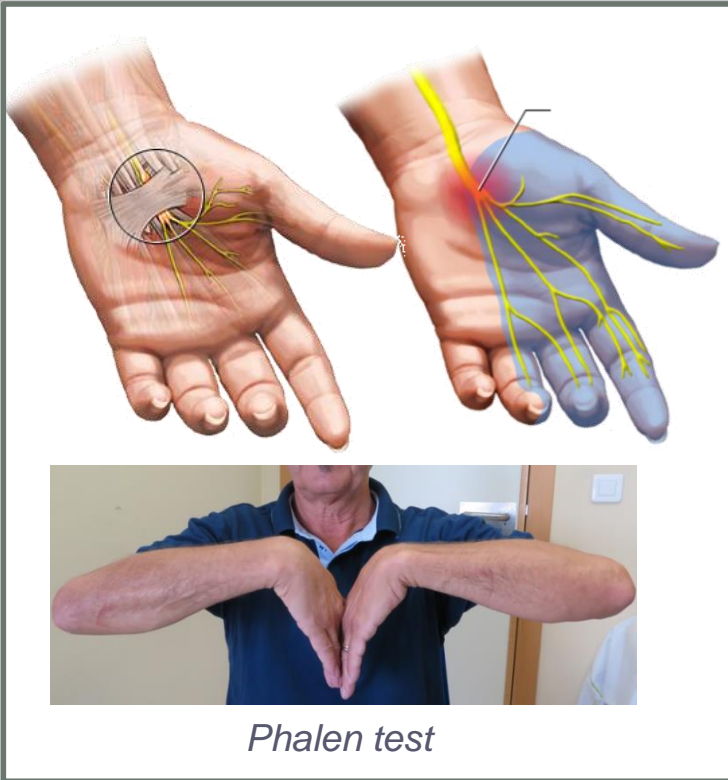


*RM sagittal PD fatsat.  
 Ulnar tunnel narrowing  
 and increased nerve  
 signal*





# Peripheral nerve injuries

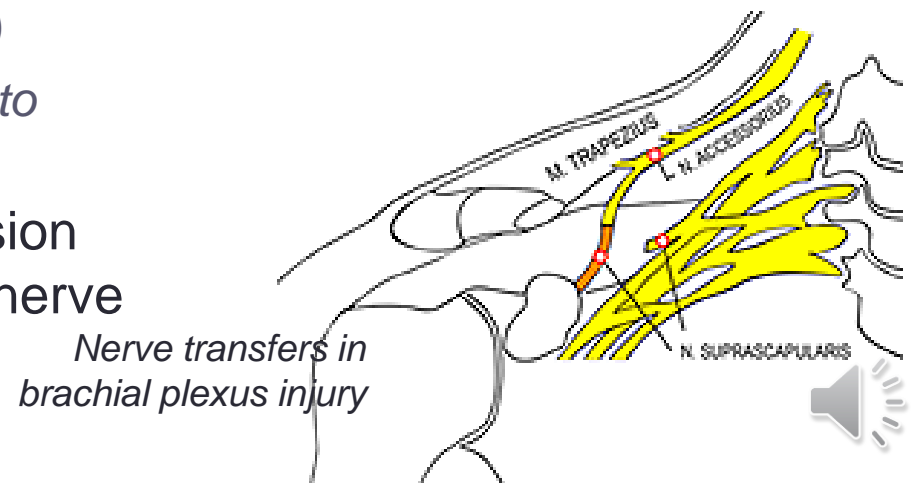
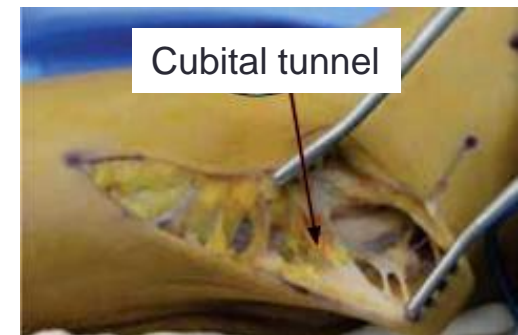


# Peripheral nerve injuries

## • Treatment

- Entrapment → decompression
- Traumatic injury → repair ± nerve transfers
  - *Regeneration 1 mm / day if the connective tubes that guide axons in their growth remain intact*
  - *Large distances = the muscle will be atrophic by the time the growing axons reach them (the better the result the more distal the lesion)*
  - *With  $\geq 20\%$  axons it is possible to recover the muscle function*
- Tumours → microsurgical excision while trying not to damage the nerve

Scar after carpal tunnel decompression



# SUMMARY KEY CONCEPTS

## TOPIC 22

- Lumbar spine
  - Low back pain and sciatica, acute and chronic. Conservative treatment
  - Lumbar disc herniation: MRI findings must be consistent with clinical symptoms and neurological findings
  - Lumbar canal stenosis: neurogenic claudication, treatment surgical
  - Thoracic spine: rare disc herniation, treatment surgical
- Cervical spine
  - Cervicalgia: conservative treatment
  - Cervical disc herniation: less frequent than lumbar, surgery treatment
  - Cervical spinal canal stenosis: cervical myelopathy, early diagnosis and treatment
- Spinal cord tumours: mostly benign
- Spinal cord injuries: spinal cord + bone injury
- Peripheral nerves: entrapment



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# QUESTIONS?



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