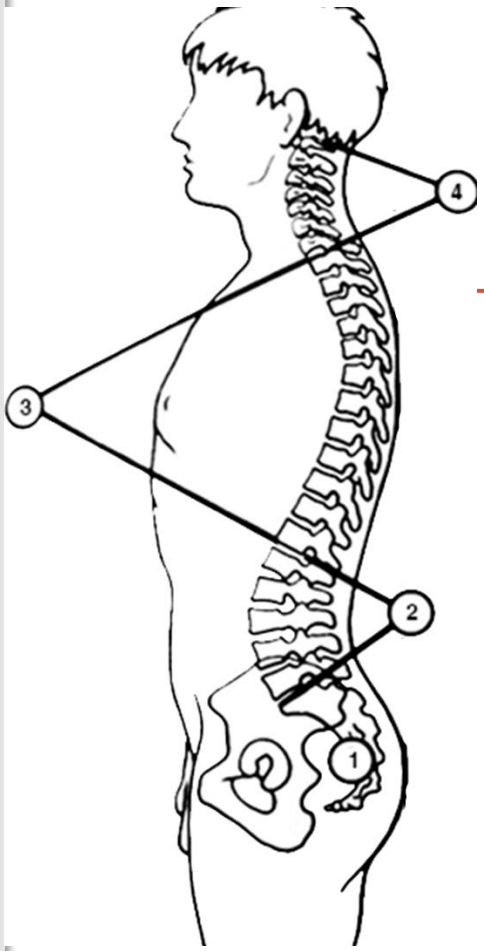
SEMINAR: SPINE SYNDROMES



34484 Pathology of the nervous system

Neurosurgery

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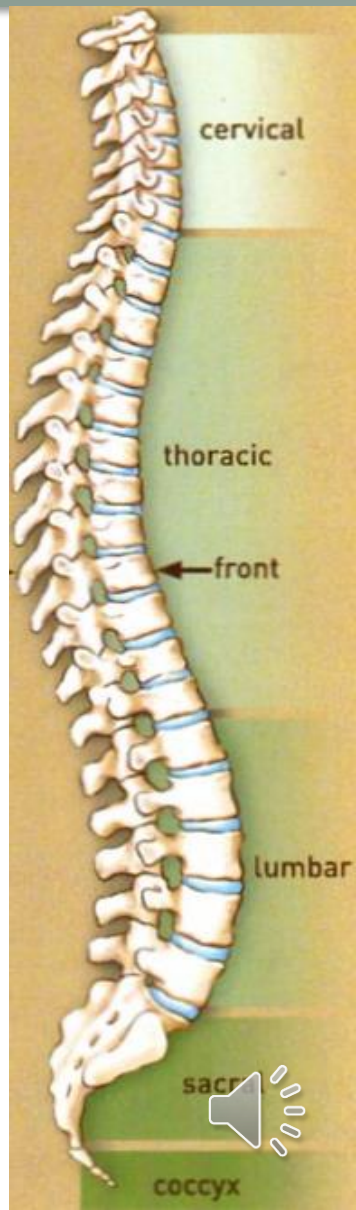
Spine syndromes

- Lumbar
  - Low back pain
    - Acute
    - Chronic
  - Lumbosciatica
  - Discogenic low back pain
  - Neurogenic claudication
  - Differential diagnosis low back pain
    - Sacro-iliac joint pain
    - Trochanteric bursitis
- Thoracic (spastic paraparesis)
- Cervical
  - Neck pain
    - Whiplash injury
  - Cervicobrachalgia
  - Cervical myelopathy
  - Differential diagnosis neck pain
    - Scapulohumeral periarthritis
    - Tennis elbow
    - Carpal tunnel

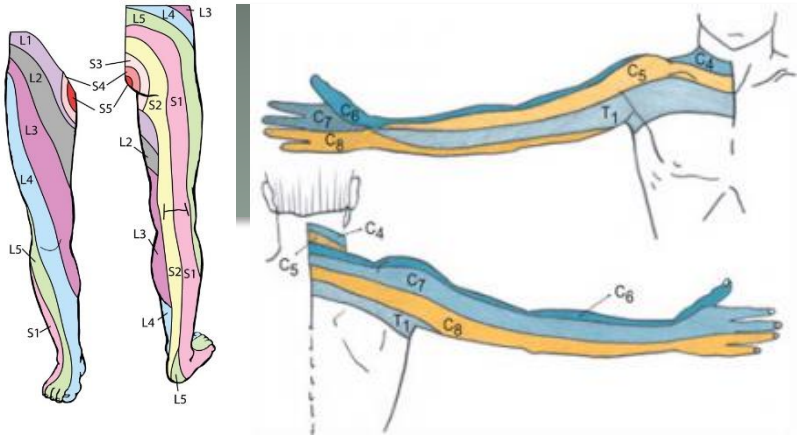


Other concepts to review

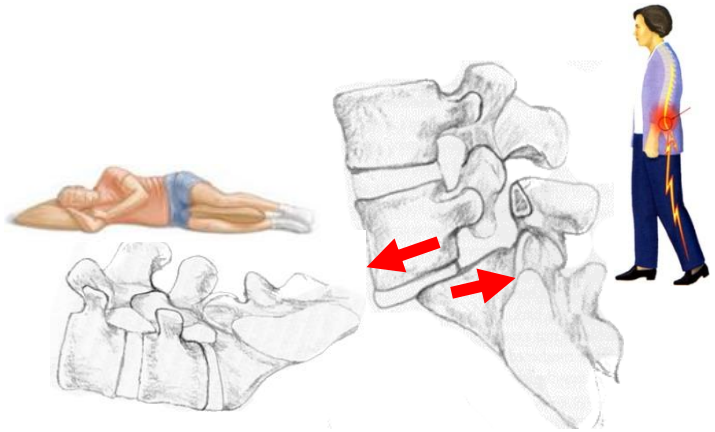
- Tumours spine & spinal cord
- Spinal cord trauma

Key concepts

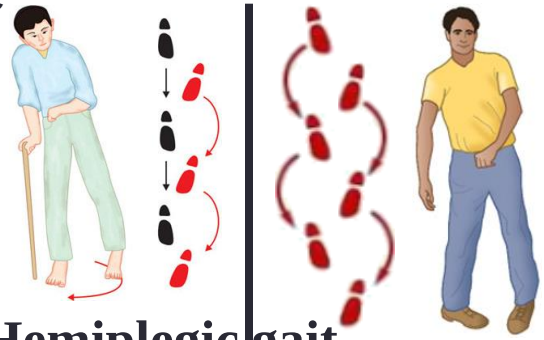
- **Radiculopathy** = nerve root
  - Pain, sensory disturbance, muscle weakness, hyporeflexia in the distribution of a nerve root
  - Cauda equina syndrome = several nerve roots affected in lumbosacral area
- **Mechanical dysfunction** = spine
  - Low back/neck pain improving on lying down and getting worse on sitting or standing up
  - Due to ligaments/ paraspinal musculature or facet joint injuries
- **Myelopathy** = spinal cord lesion
  - Can be cervical or thoracic not lumbar



Radiculopathy



Decubitus Standing



Spastic gait in myelopathy

Hemiplegic gait

Low back pain

- VERY common disorder
  - 15 % of sick leaves
  - ⇑ common cause disability >45 years
- ⇑ often NO specific diagnosis
  - Only associated with 1% radiculopathy and/or herniated disc
- Clinical evaluation = rule out serious pathology
  - If there isn't = conservative treatment four weeks:
    - NSAIDs, physiotherapy and moderate activity
    - 90% patients improve - but frequent recurrences

Low back pain

Radiculopathy

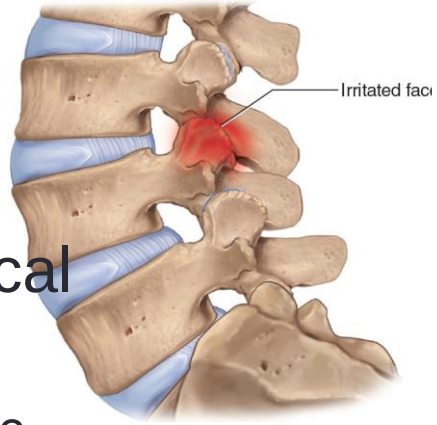
Acute low back pain

- If it lasts <45 days
- ↑↑ frequent
- Clinical features: severe low back pain that leaves the patient bent
- Treatment: take it easy + anti-inflammatory agents
- Initially occasional episodes ↑frequent until to lumbosciatica

Chronic low back pain

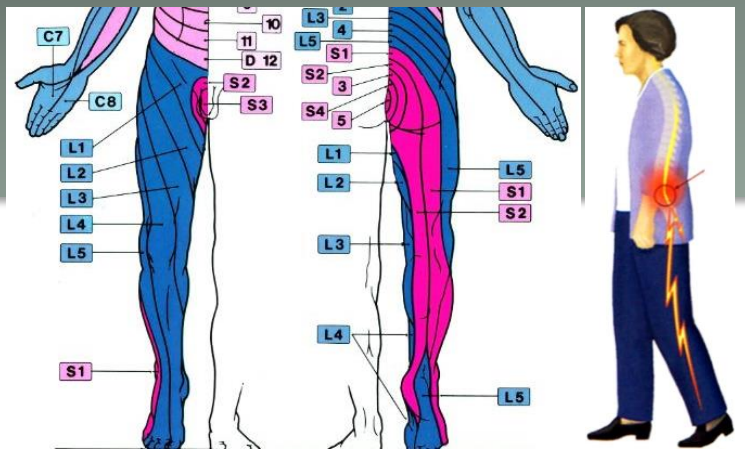
- If it lasts >30 days
- Etiology
  - <45 years: degenerative disc disease
    - Pain worsens on bending forward
  - >50 years: facet joint arthropathy
    - Pain worsens when extending the spine or standing up
- Treatment initially conservative (weight loss, physiotherapy, swimming, quit smoking) and surgical treatment for refractory cases
  - Degenerative disc disease = lumbar disc prosthesis
  - Facet arthropathy = facet joint denervation or rhizolysis ± lumbar arthrodesis

Discogenic pain



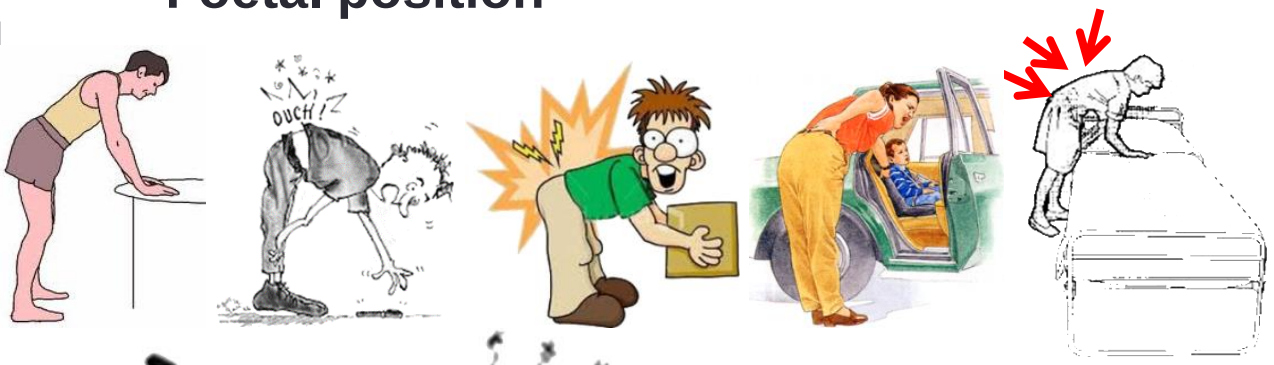
Facet joint pain

Lumbosciatica

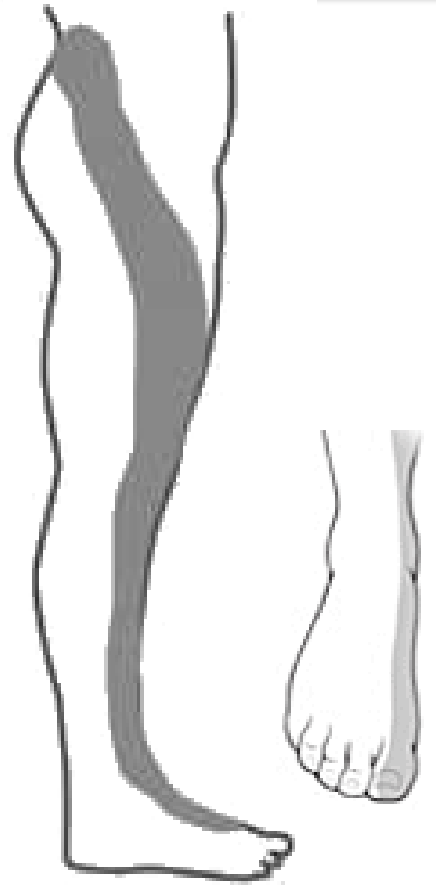


- Low back pain radiating to the lower limb distal to the knee
- Distribution according to affected nerve root
- Improvement in bed lying on the side (foetal position)
- Gets worse when leaning forward or lifting weights

Foetal position



Anamnesis: pain distribution



L_4

L_5

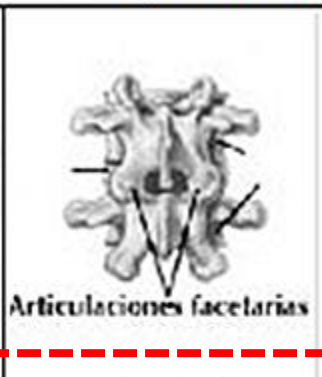
S_1

Differential diagnosis lumbosciatic pain

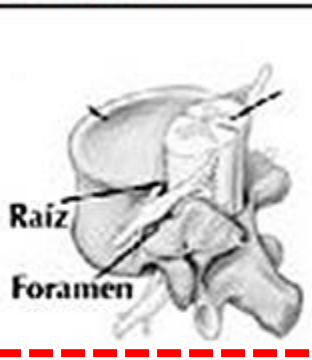
Tipos dolor lumbociático

Discogénico

Sacroiliaco



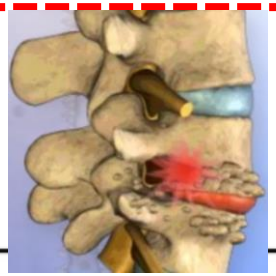
Facetario

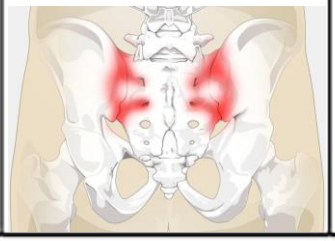


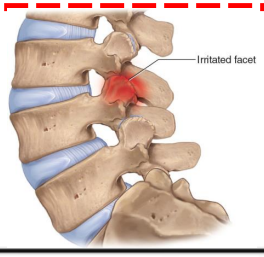
Radicular

Muscular

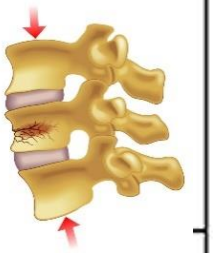
Ósea







1. Unilateral agudo
2. Unilateral crónico
3. Bilateral crónico (estenosis canal)



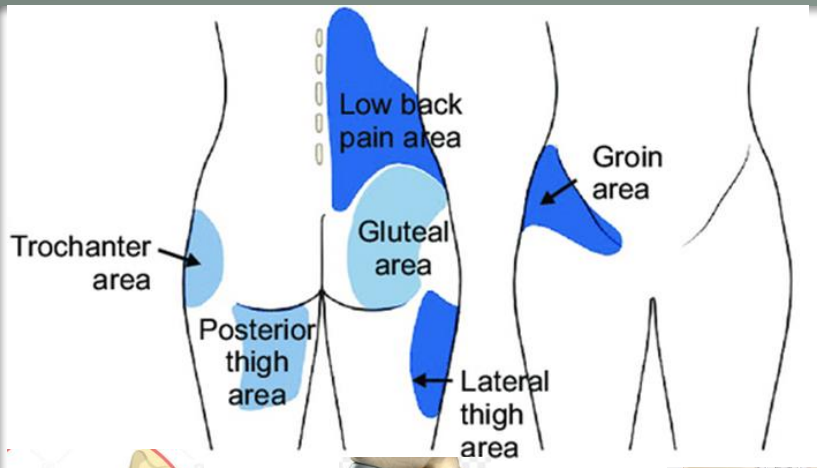
Procedimiento diagnóstico

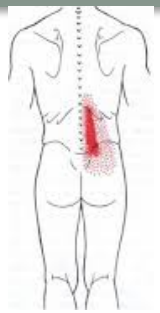
Discografía de provocación	Bloqueo de la articulación	Bloqueo del ramo medial del ramo posterior	Bloqueo radicular selectivo	Bloqueo muscular con anestésico local	MRI

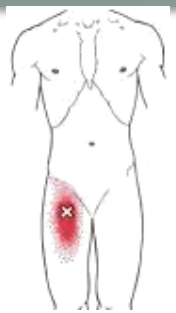
Tratamiento

Disc prosthesis	Sacroiliac joint arthrodesis	Rhizolysis	Nerve root decompression	Muscle relaxants	Vertebroplasty vs arthrodesis

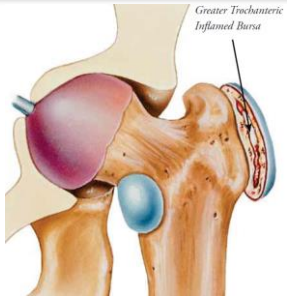
Differential diagnosis of lumbosciatic pain



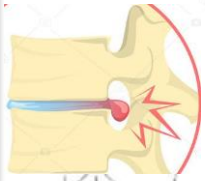


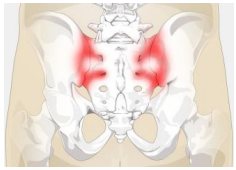


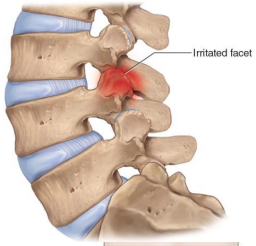
Muscular **Hip**

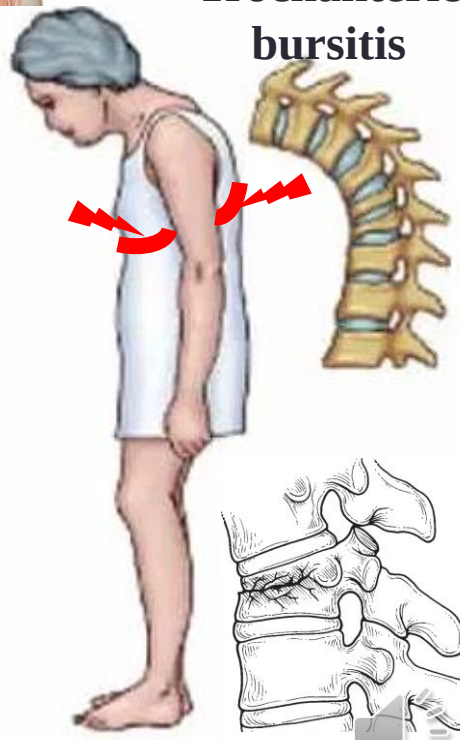


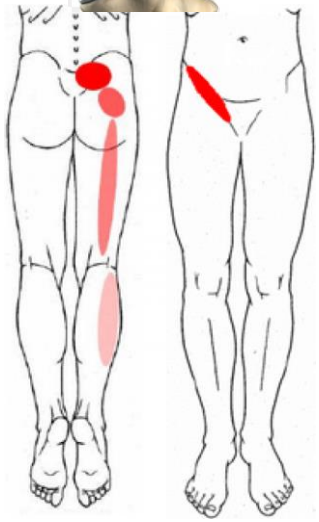
Trochanteric bursitis

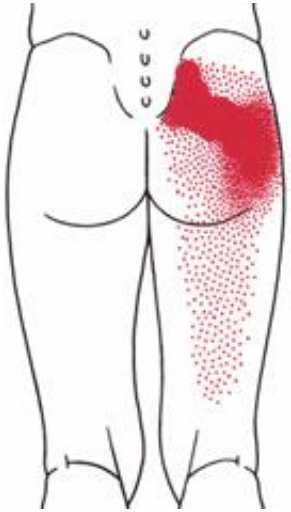


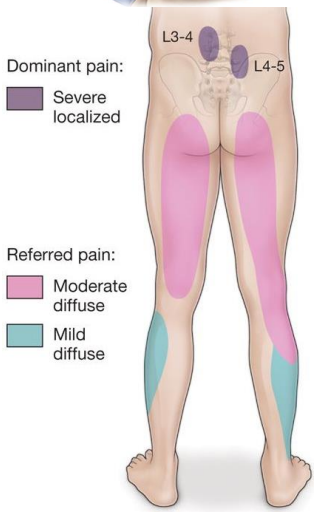










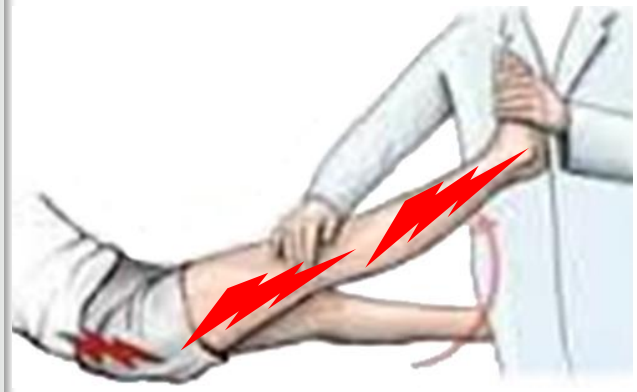


Radicular **Discogenic** **Sacroiliac joint** **Facet joint** **Osteoporotic fracture**

Physical examination

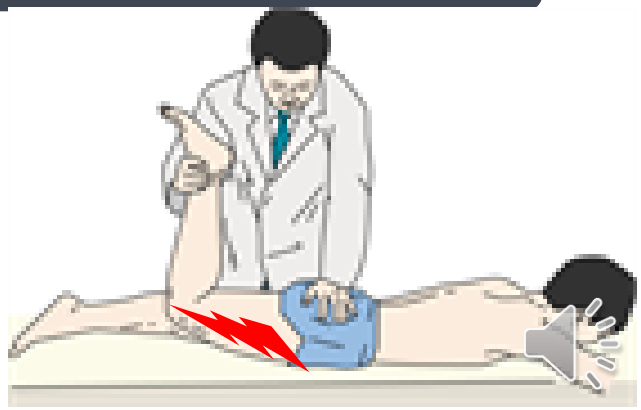
- Infection: fever, spinal pain, ↓ mobility, muscle spasm
- Neurological involvement
  - Radiculopathy
    - Foot & first toe dorsiflexion ↓ ⇒ disfunction L_5 nerve root >L_4
    - ↓ Ankle jerk ⇒ disfunction S_1 nerve root
    - ↓ Hypoesthesia foot ⇒ disfunction L_4, L_5 or S_1, depending on the affected area
      - L_5 nerve root = inner malleolus, S_1 nerve root = external malleolus
    - Nerve root elongation manoeuvres with pain ipsi/contralateral ⇒ nerve root damage

95 % patients do not require more tests after four weeks



⇐ Lasegue

Femoral stretch test ⇒

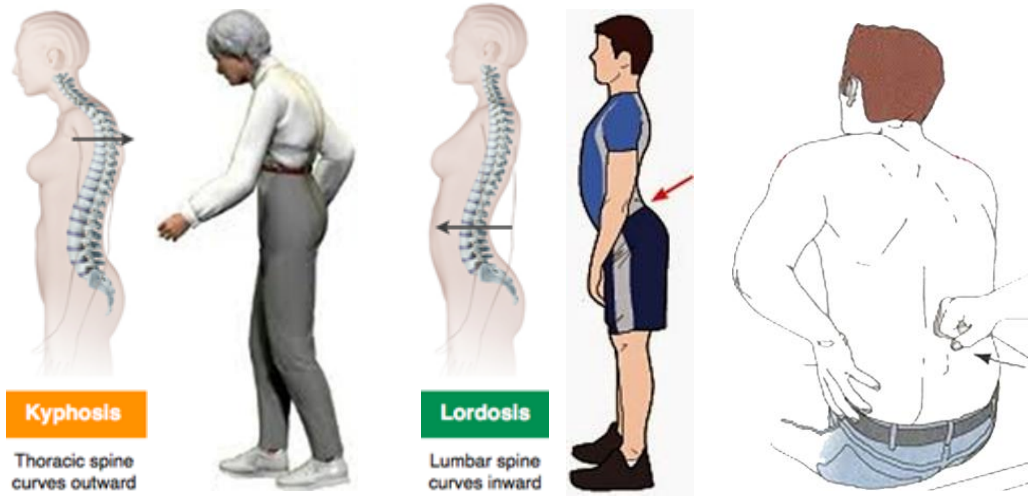


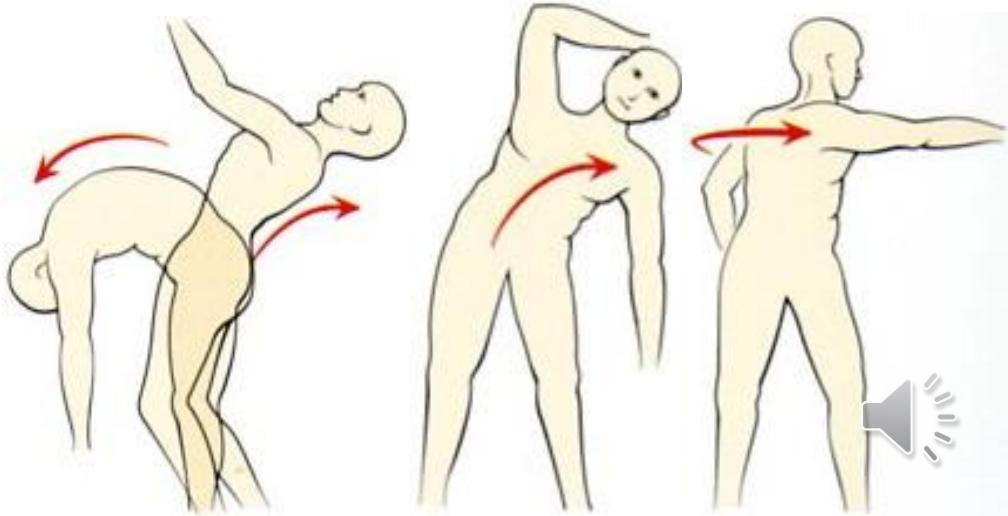
Complementary tests

- Neurophysiological studies (EMG, evoked potentials)
  - NOT needed IF clinically evident radiculopathy
  - NEEDED for differential diagnosis between myelopathy/myopathy/neuropathy
- Imaging
  - Bone scan IF suspected infection or tumour
  - Bone densitometry if suspicion of osteoporosis
  - MRI
    - If suspicion of injury that requires treatment or the clinical symptoms are persistent
    - If there are red flags
    - ❖ *May require sedation/anaesthesia to control the pain while the MRI exam is taking place*

Physical examination

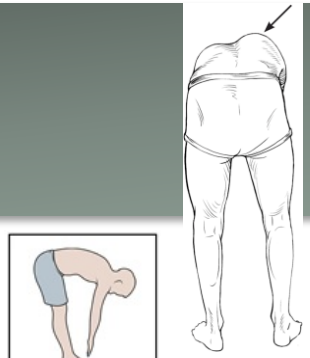
- Position shoulders + hips
- Spinal column stance coronal + sagittal planes
- Painful spots
  - Finger pression, tapping
- Mobility arches→ pain type
  - Pain in flexion ⇒ discogenic
  - Pain in extension ⇒ facet joints
  - Pain day + night ⇒ neuropathic

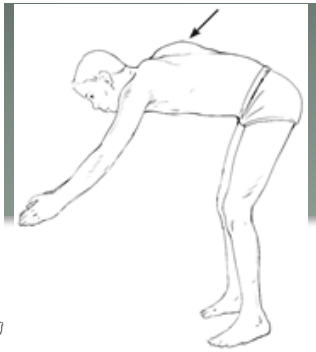


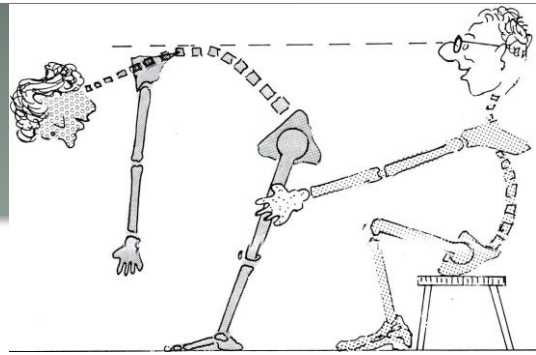


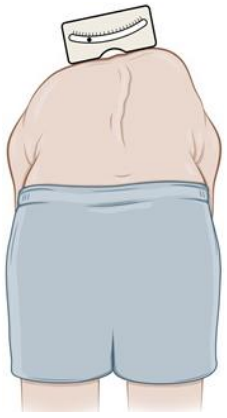
Physical examination

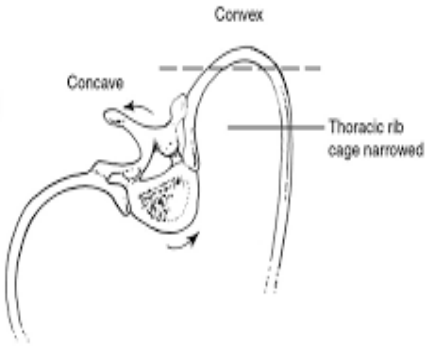
- Deformities
  - Symmetry, tone, muscle atrophy
- Stance & gait
  - Antalgic gait
  - Limp
    - Pain
    - Weakness
  - Gait paretic, antalgic, spastic
  - Gait on tip-toes & on heels



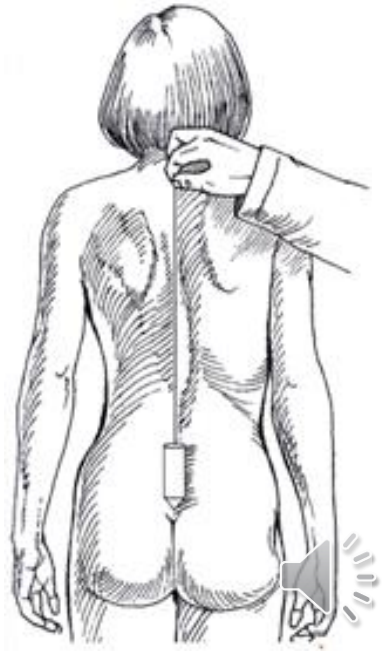




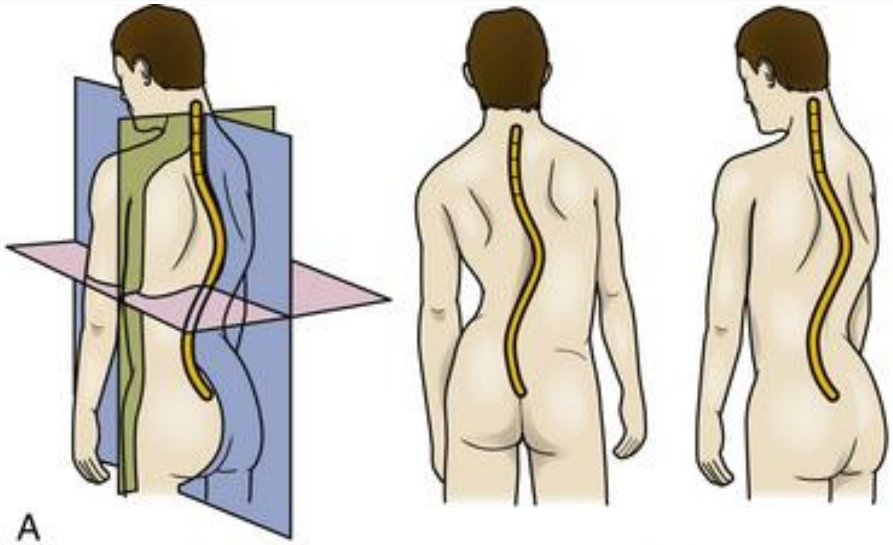


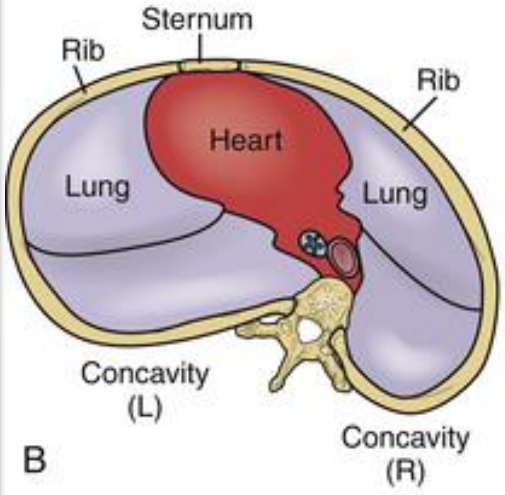


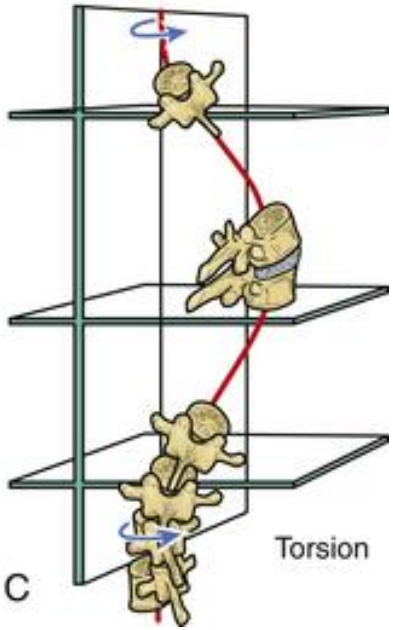
Normal **Scoliosis**

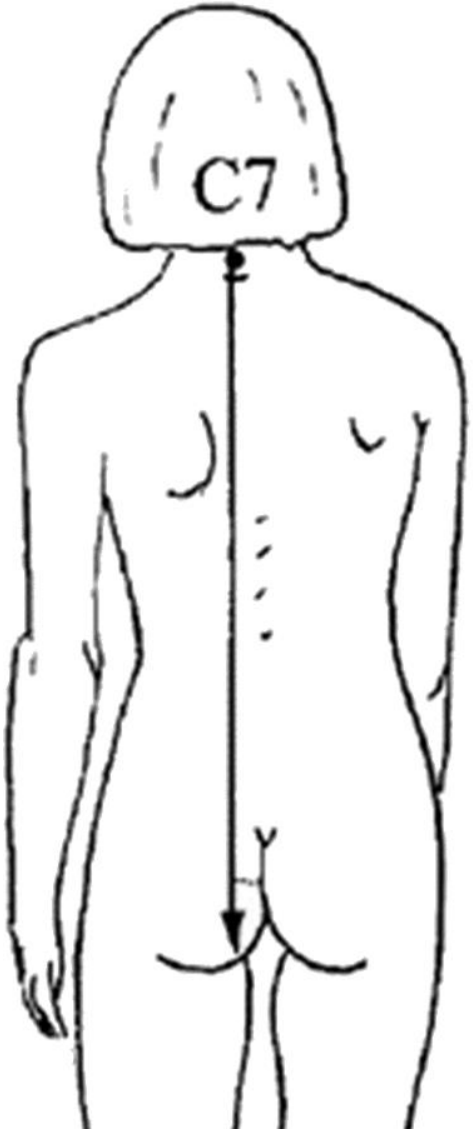


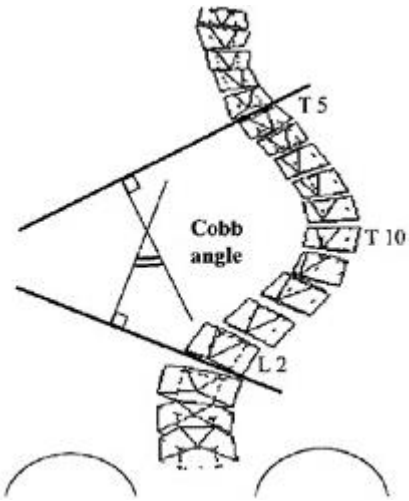
Spinal column deformity in scoliosis





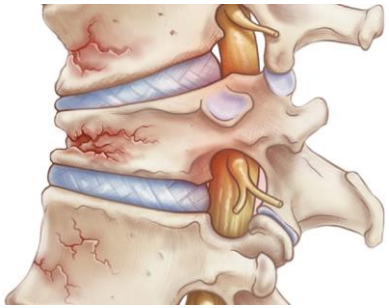


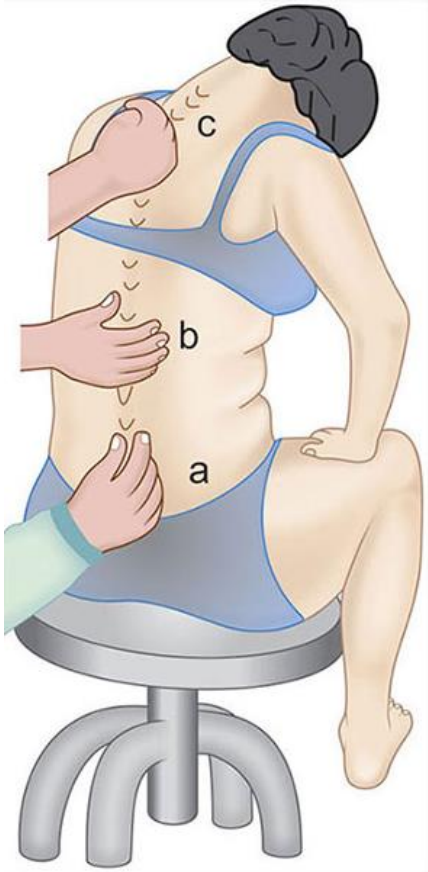


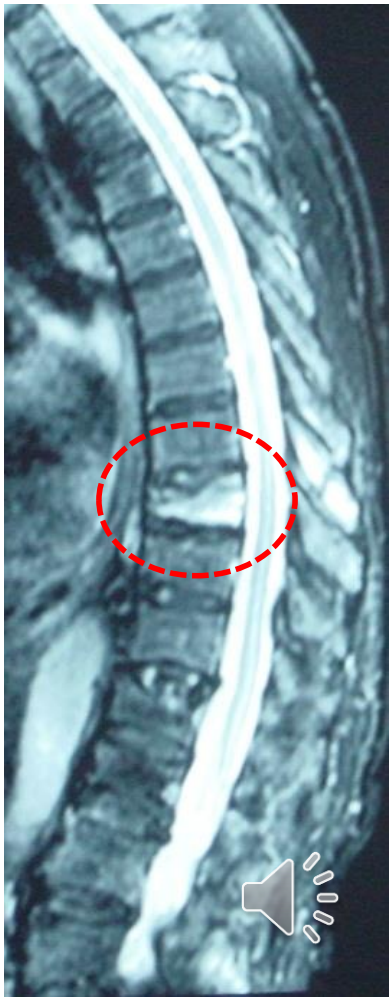


Tapping spinous processes: key sign = osteoporotic or metastatic fracture

Osteoporotic fracture

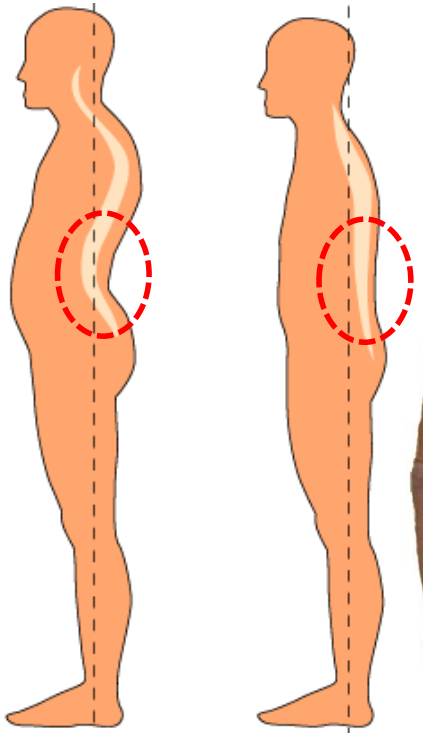






Spinal column deviation

← Lumbar scoliotic attitude

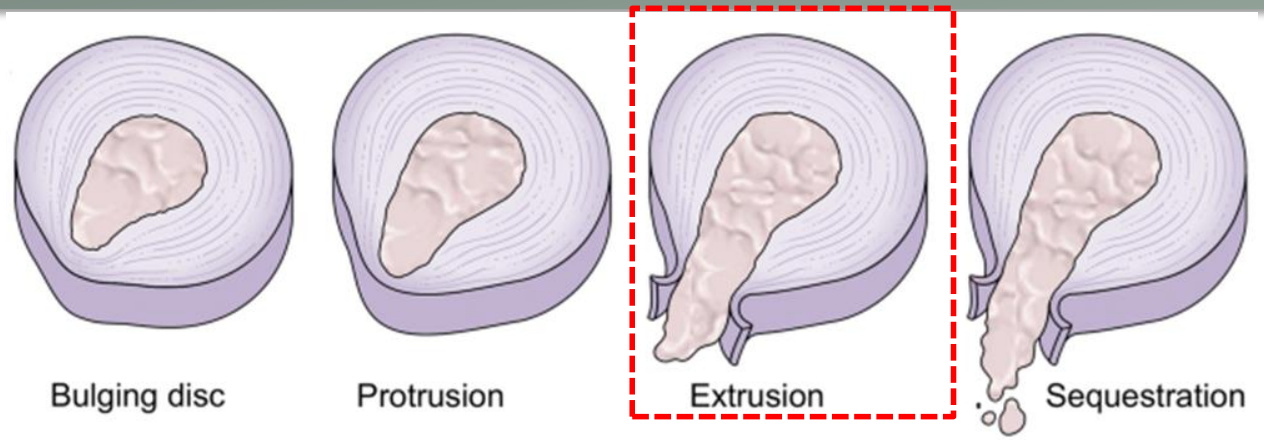


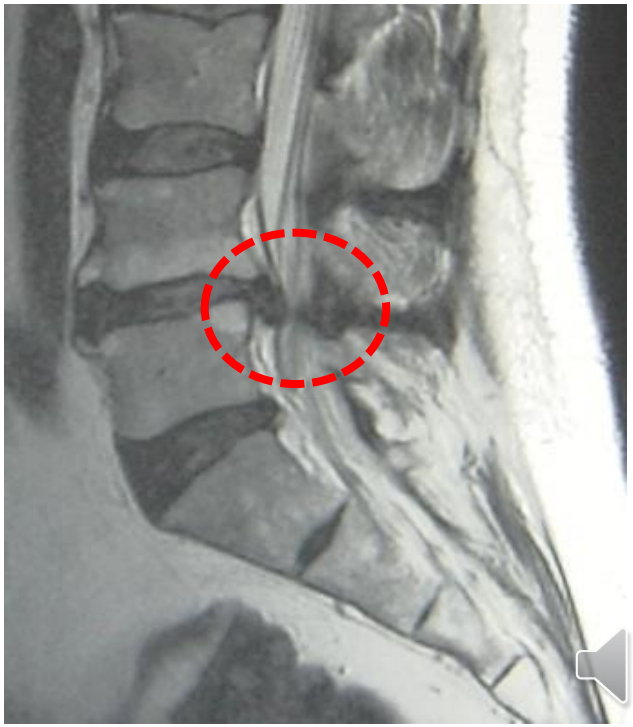
Normal

Lumbar standing

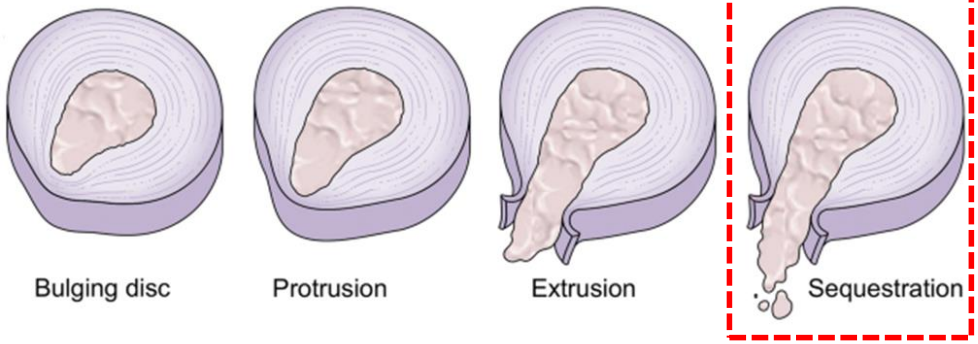
Lumbar standing →

Scoliotic attitude + lumbar standing + attitude in flexion of the left hip and knee (extruded herniation L_5-S_1 left side)

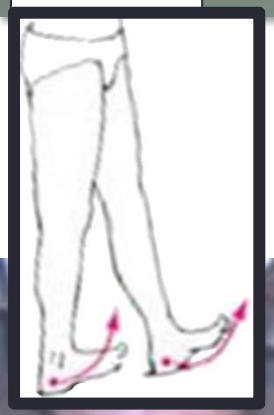




Lumbosciatica + scoliotic attitude + knee flexion in disc sequestration



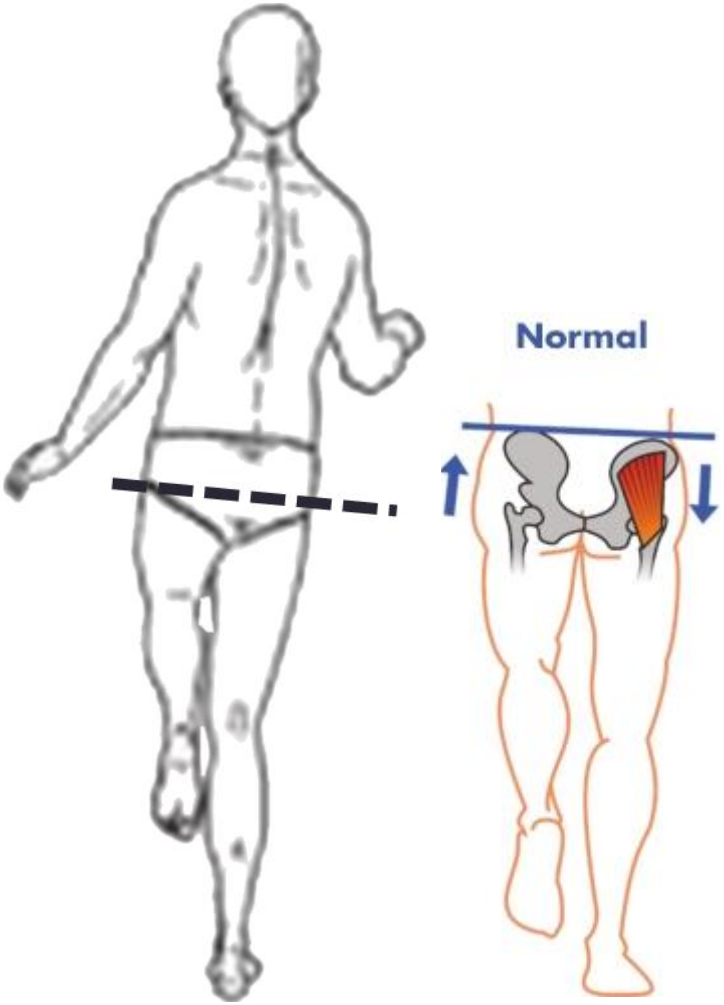
Normal, tiptoe, and heel gait



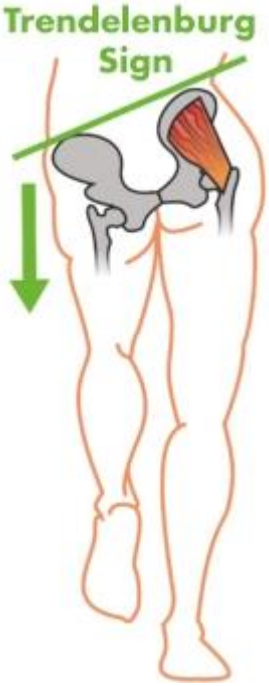
Heel gait:
Foot dorsiflexion (L_5 nerve root)

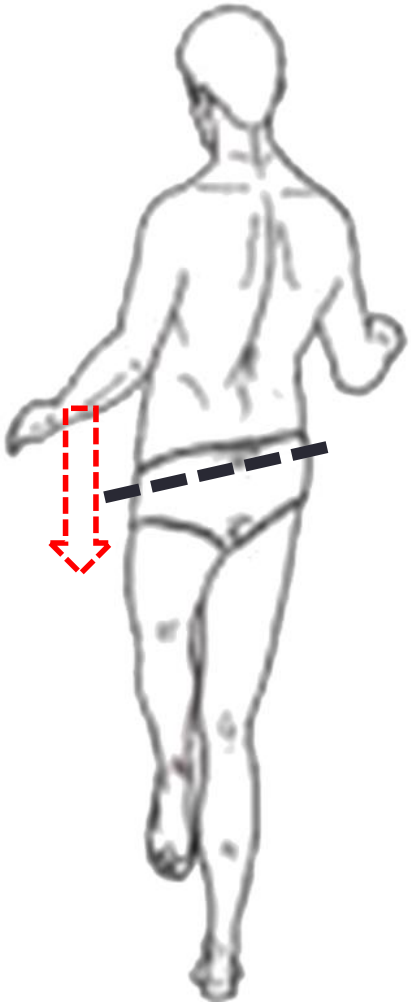
Tiptoe gait:
Foot plantar flexion (S_1 nerve root)

Trendelenburg-Duchenne sign



Normal

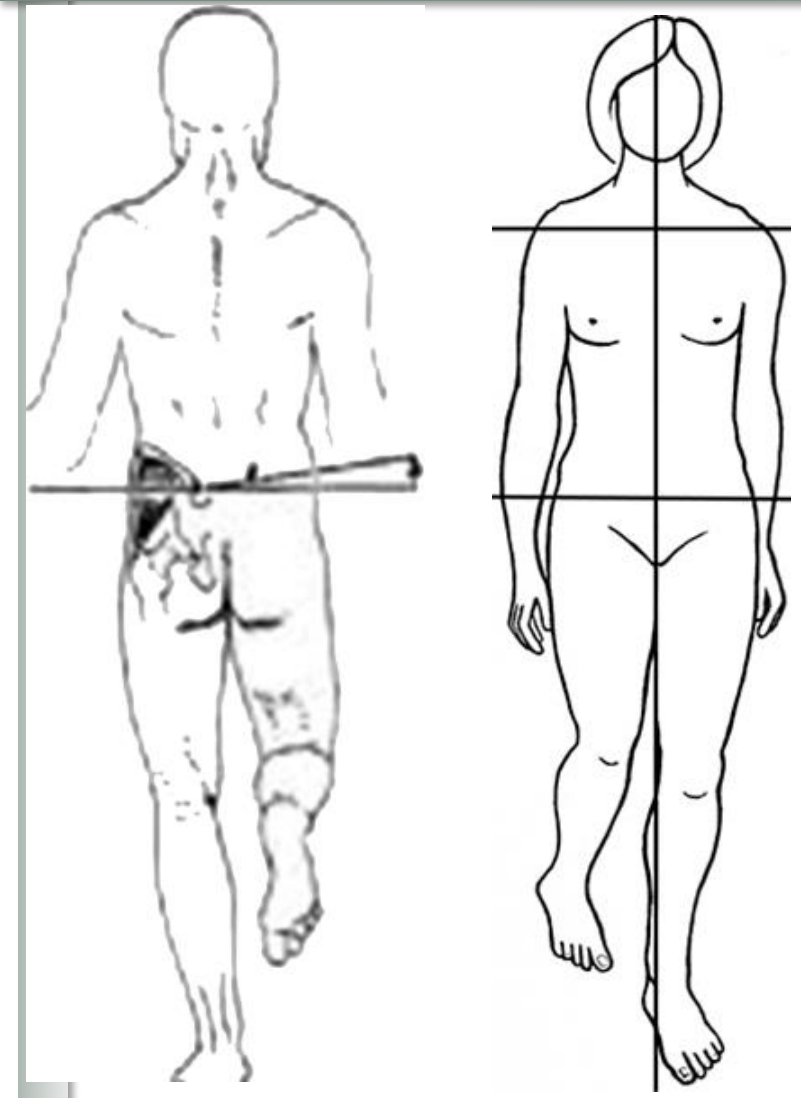




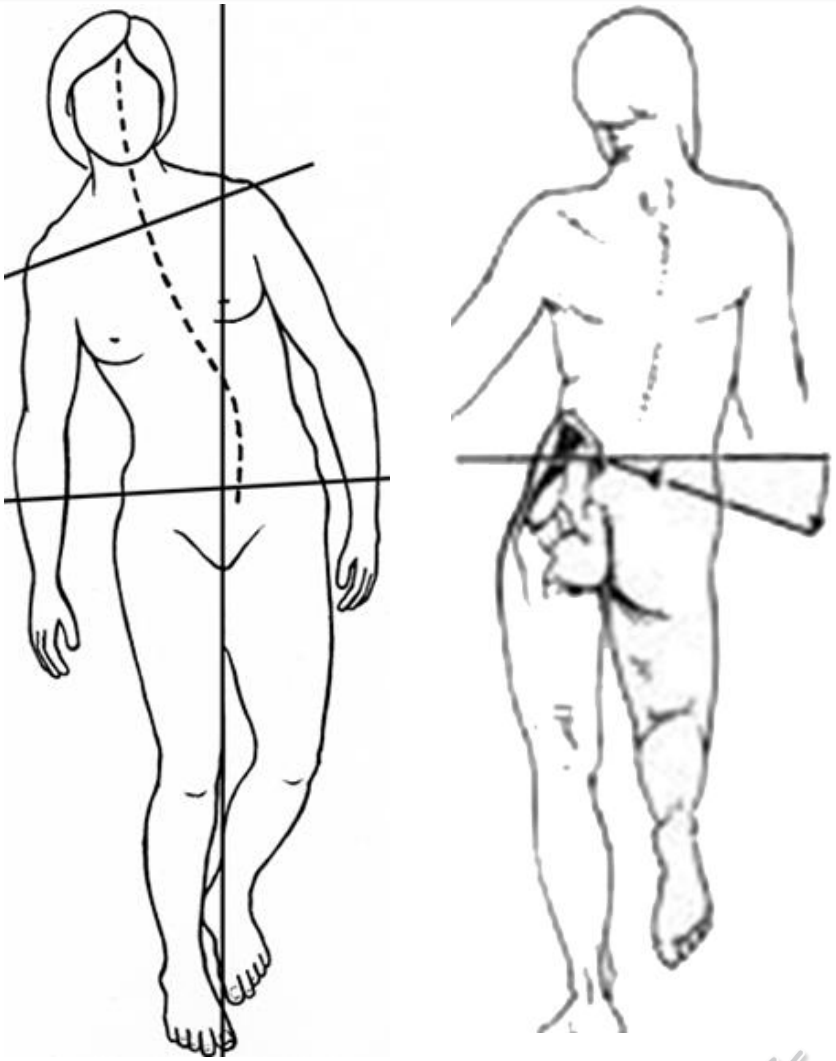
Gluteus medius muscle weakness (L_5 nerve root)

Steppage gait = L_5 nerve root injury

Trendelenburg gait: L_5 nerve root injury



Normal



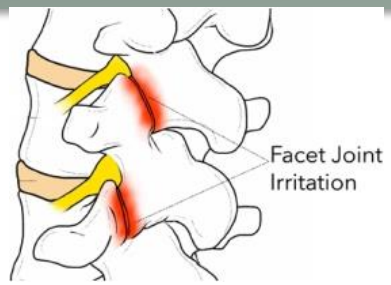
Trendelenburg gait

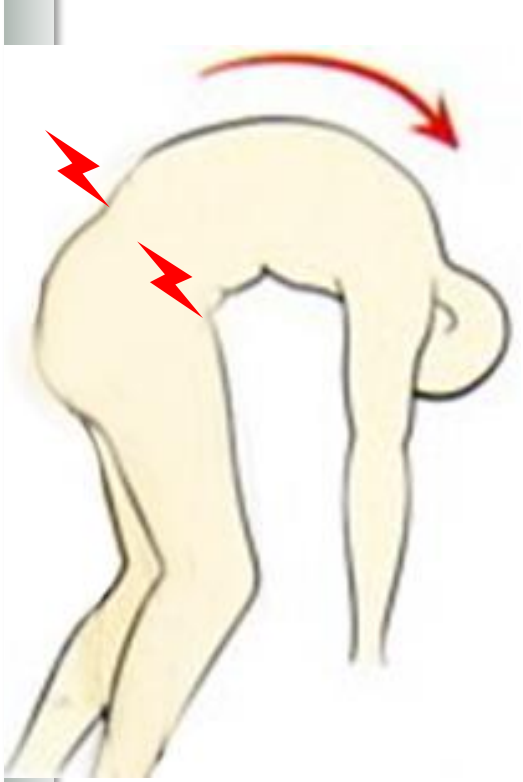
Trendelenburg gait: L_5 nerve root injury

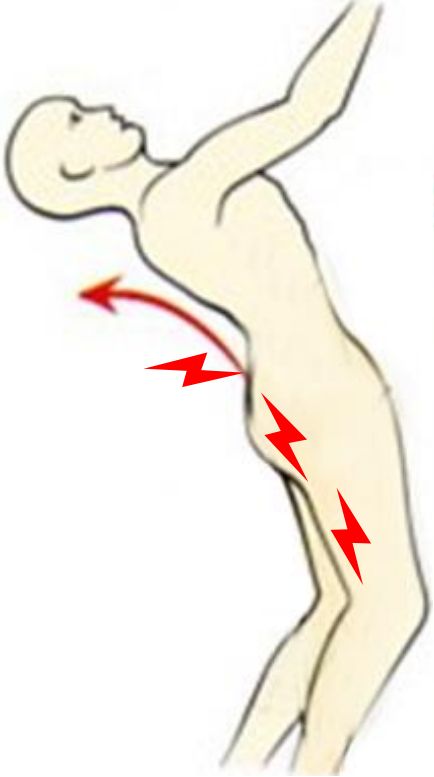
Normal

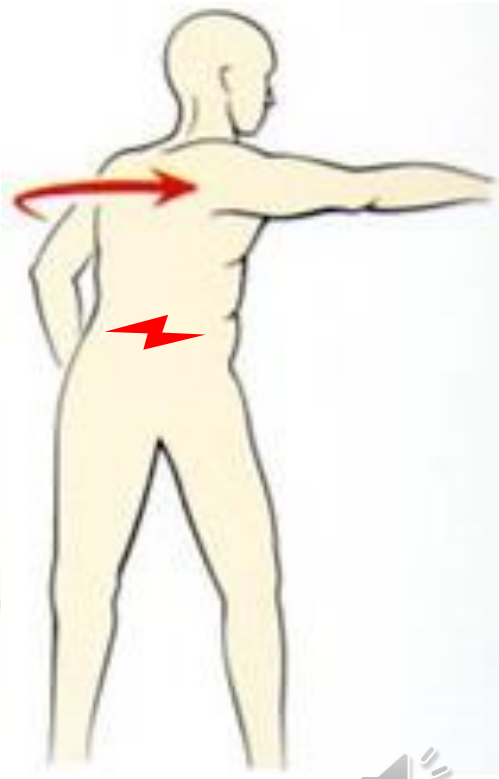
Trendelenburg gait

Lumbar spine mobilization: types of pain



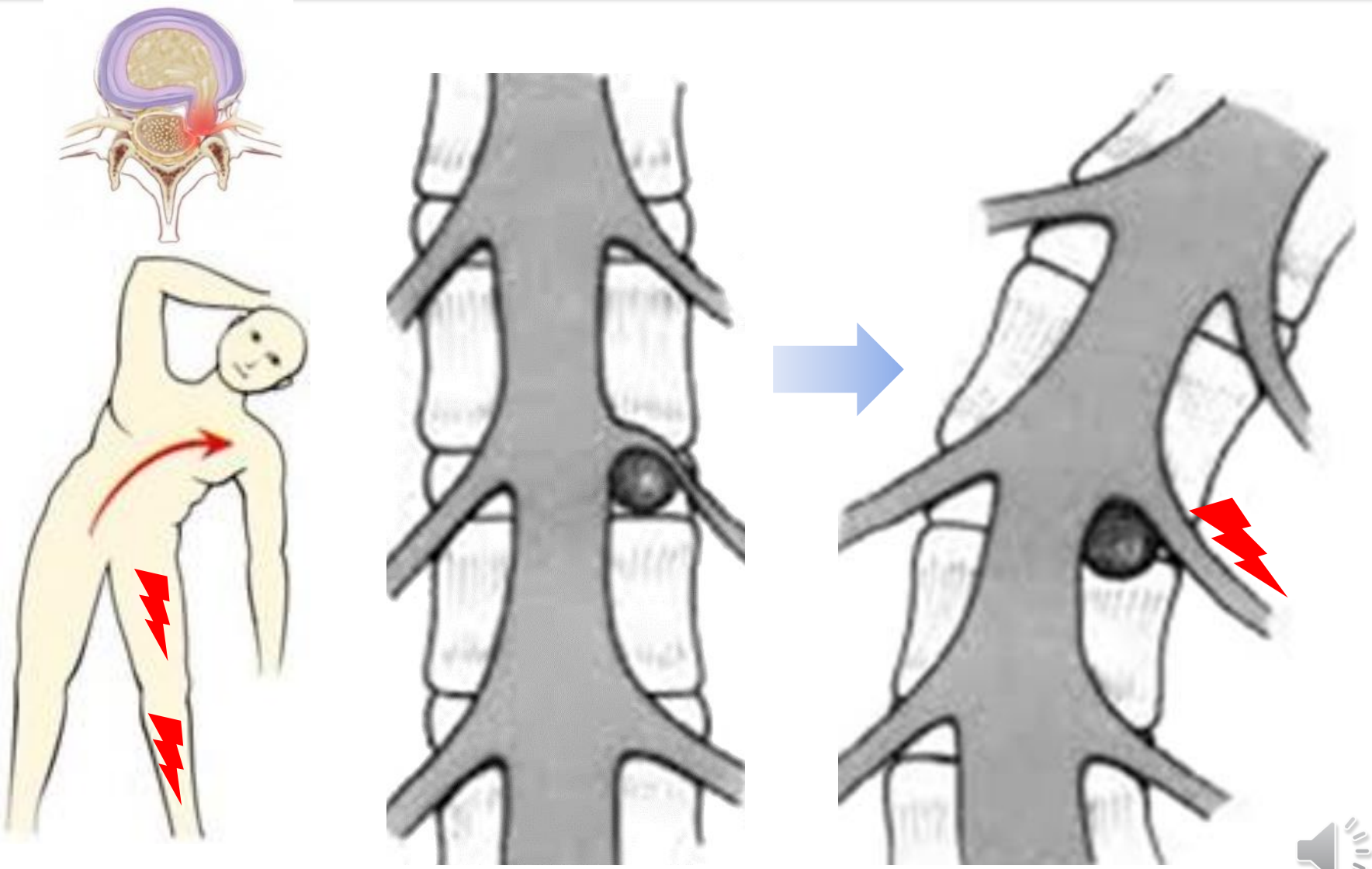






Discogenic **Nerve root distribution** **Facet joint origin**

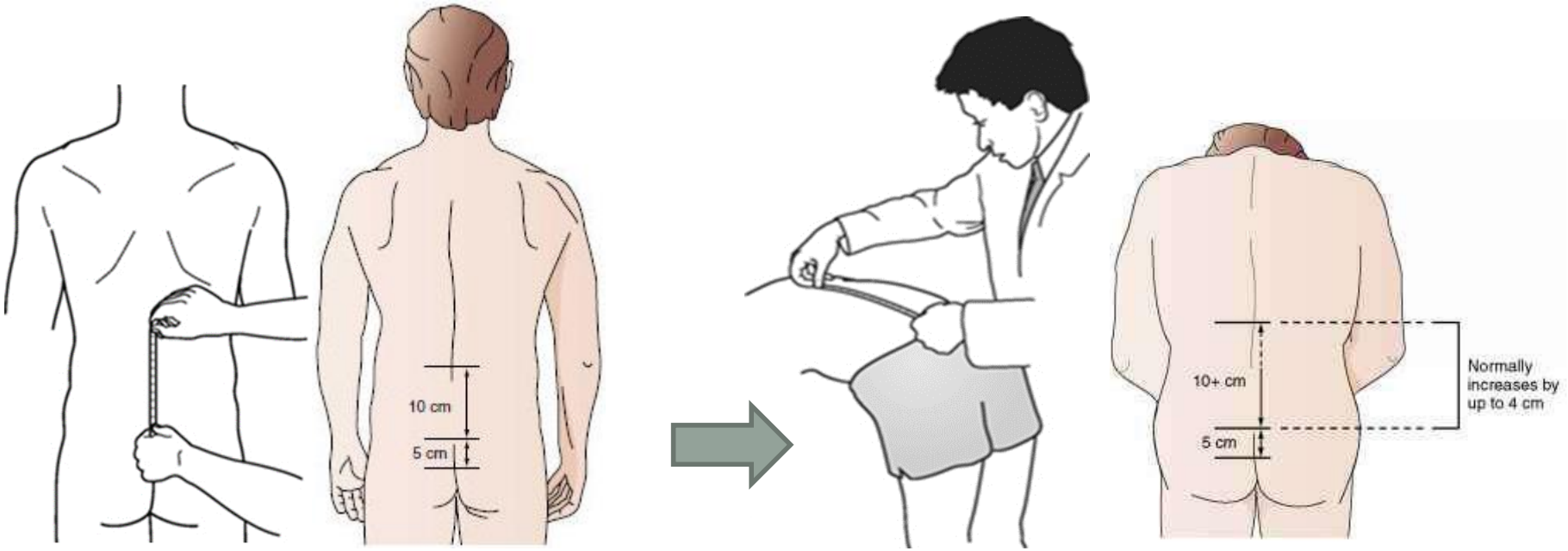
Lumbar spinal mobilisation = root compression impairment



Nerve root distribution

Schober test

- Measures the displacement of the lumbar spinous processes on flexing the spine forwards

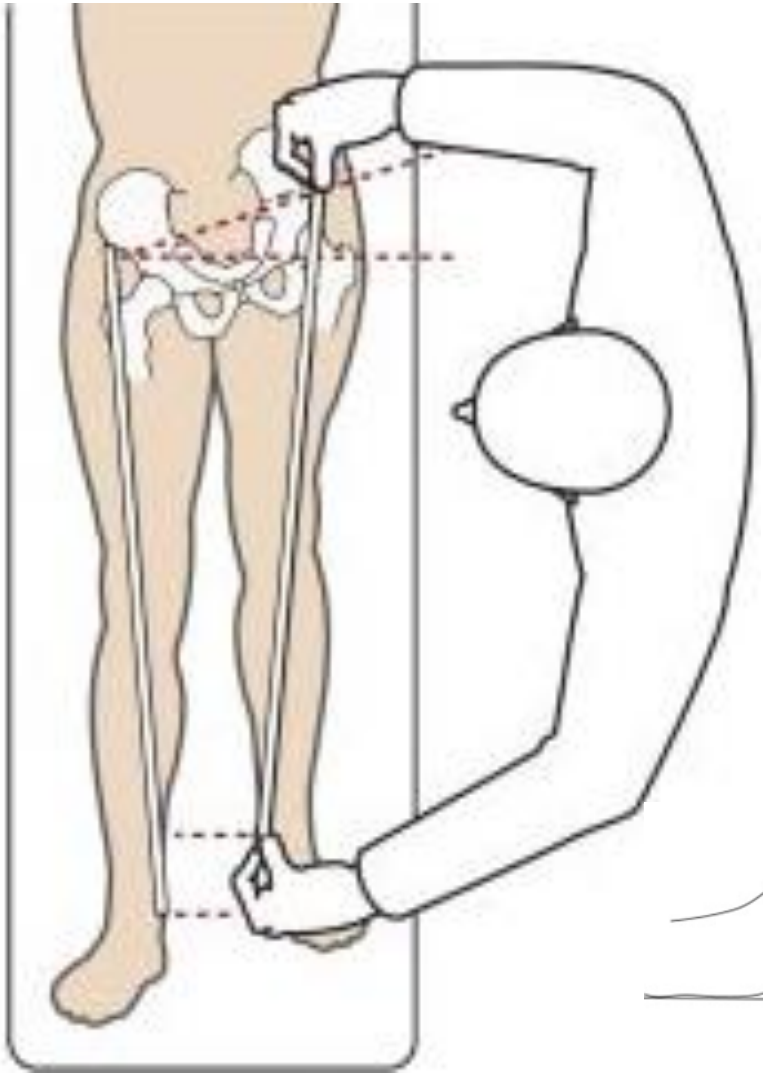


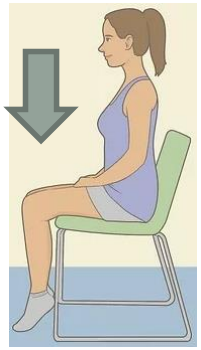
Stork standing test

- Typical of lumbar spondylolysis & spondylolisthesis
- With patient standing on one leg, lumbar hyperextension causes ipsilateral low back pain

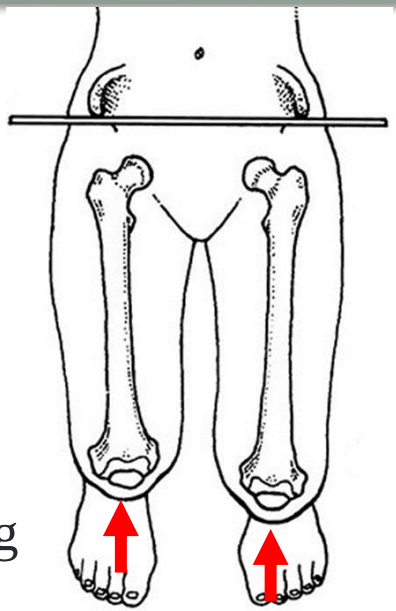
Lower limb dysmetria measurement: Galeazzi test

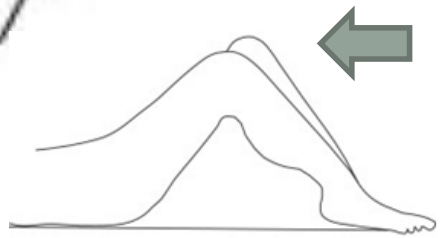
- Normal up to 2cm difference

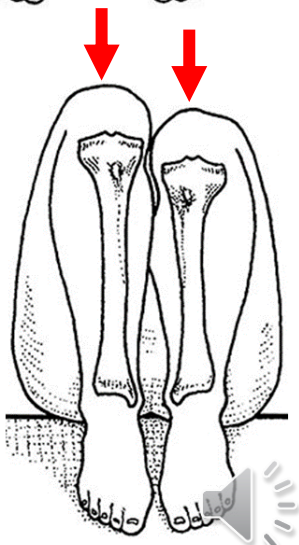




Sitting



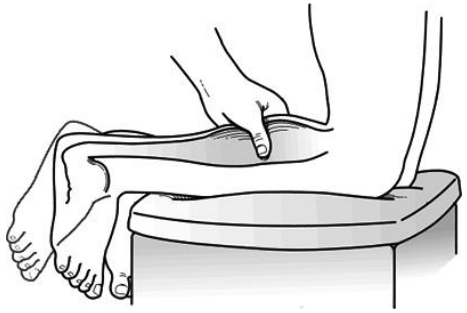




Lying

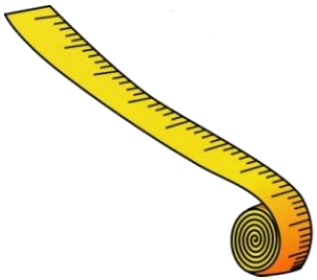
Neurological examination: motor

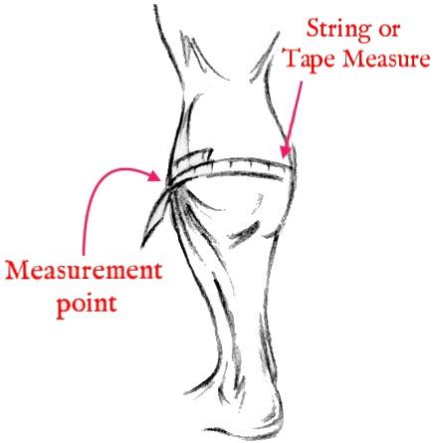
- Bilateral, symmetrical, and comparative
- Appearance, tone, strength
- Trophism
  - Measure thigh + calf perimeter (15 cm above and below the kneecap)
  - Arm, forearm, & hand muscle tone (hand intrinsic musculature)
- Muscle strength (0-5/5)
  - Muscle groups
  - Flexion/extension



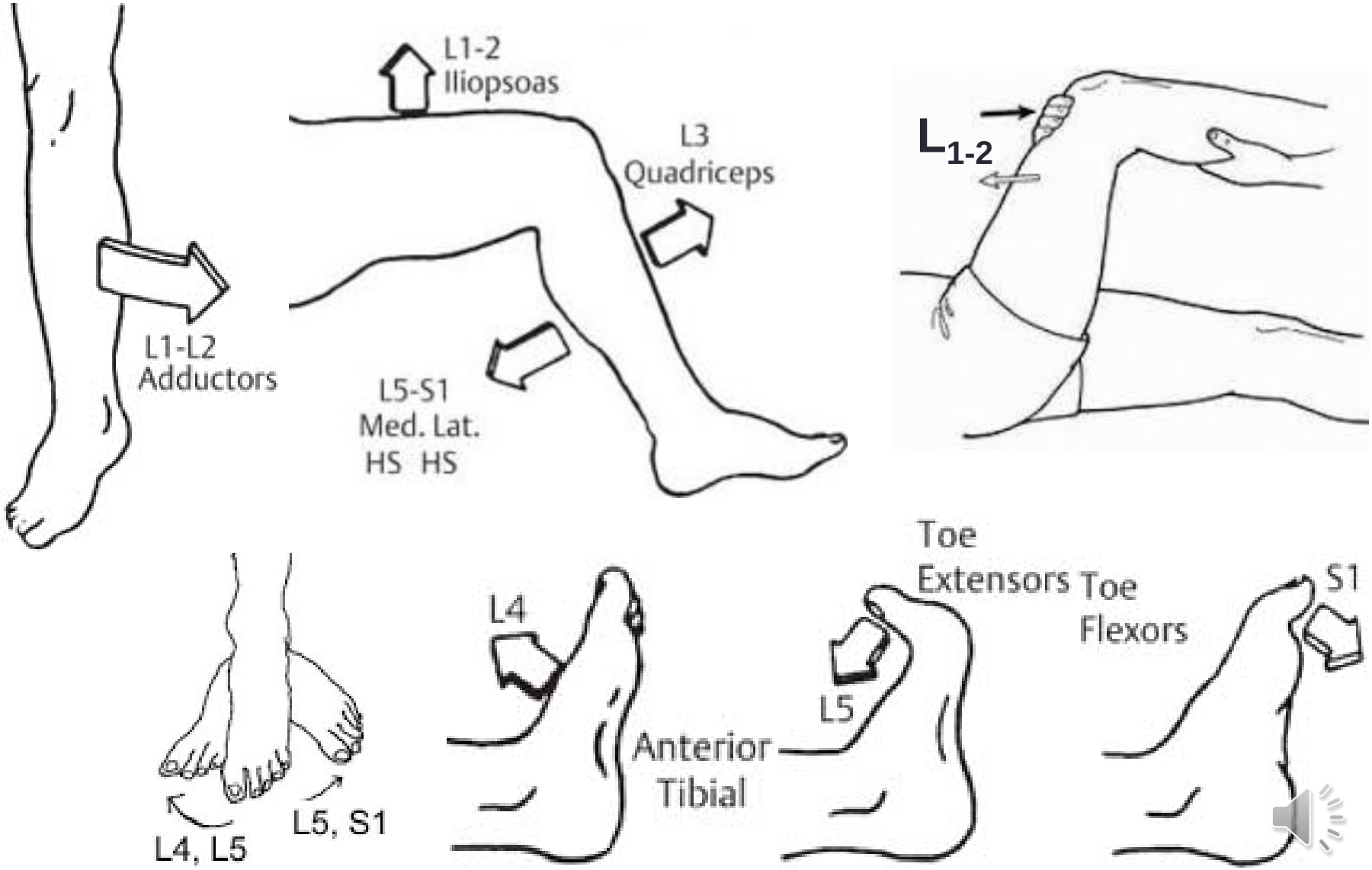
Measurement perimeter thigh and calf

- Differences normal up to 2cm for thigh and 1cm for calf





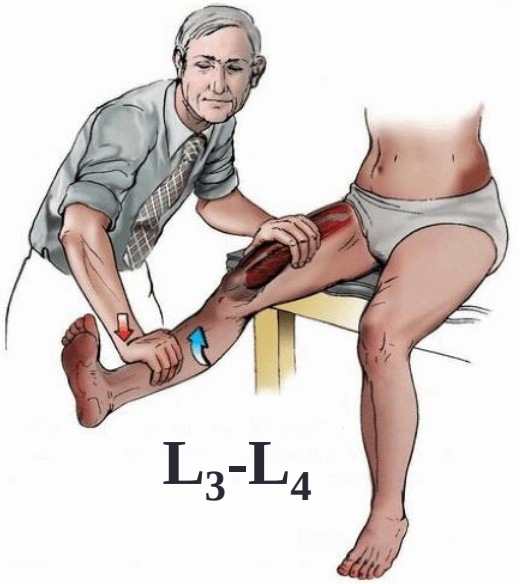
Motor neurological examination



Motor neurological examination

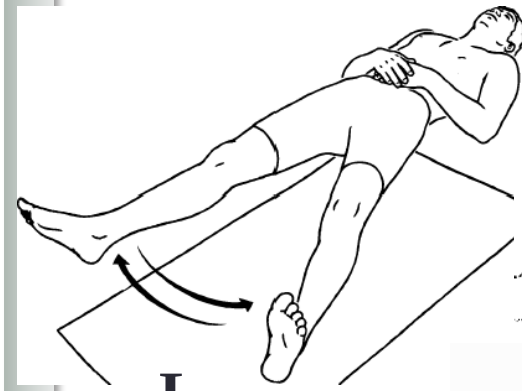
L_1-L_2

L_2-L_3

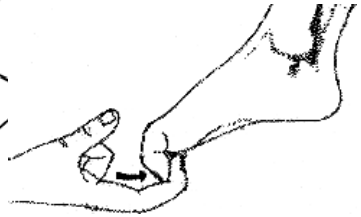


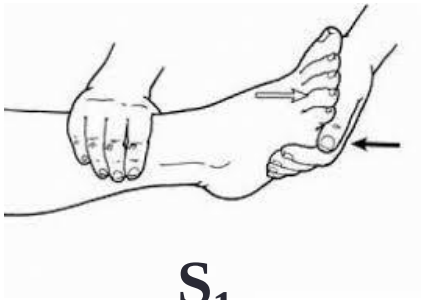
L_3-L_4

L_5

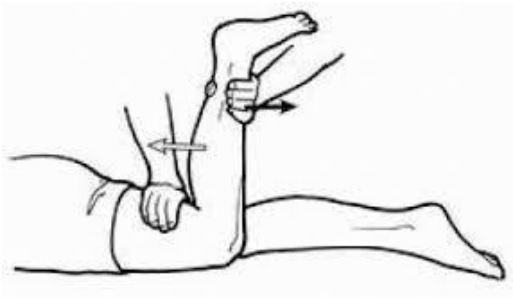


L_5





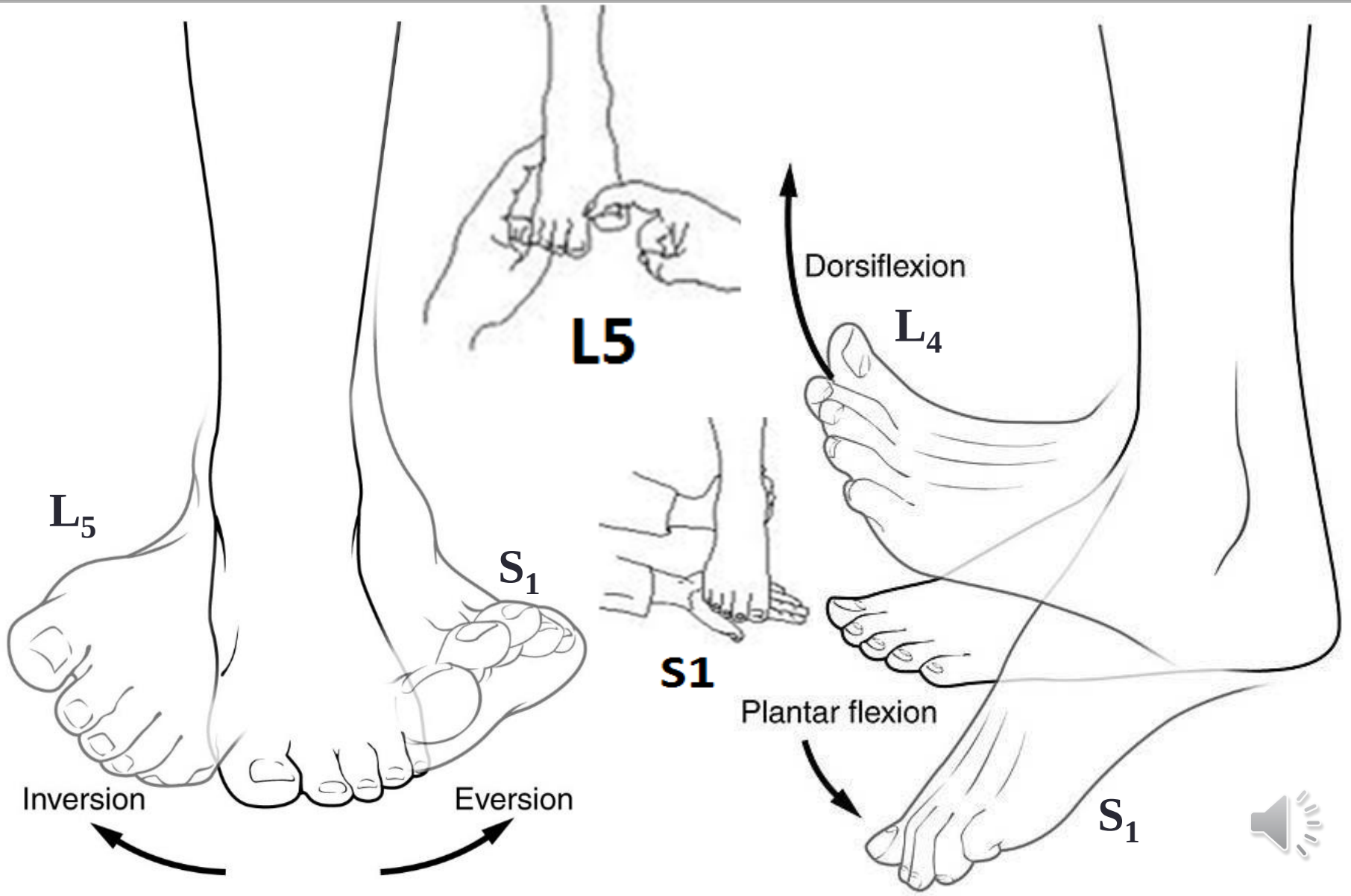
S_1



S_1-S_2

S_2-S_3

Motor neurological examination foot



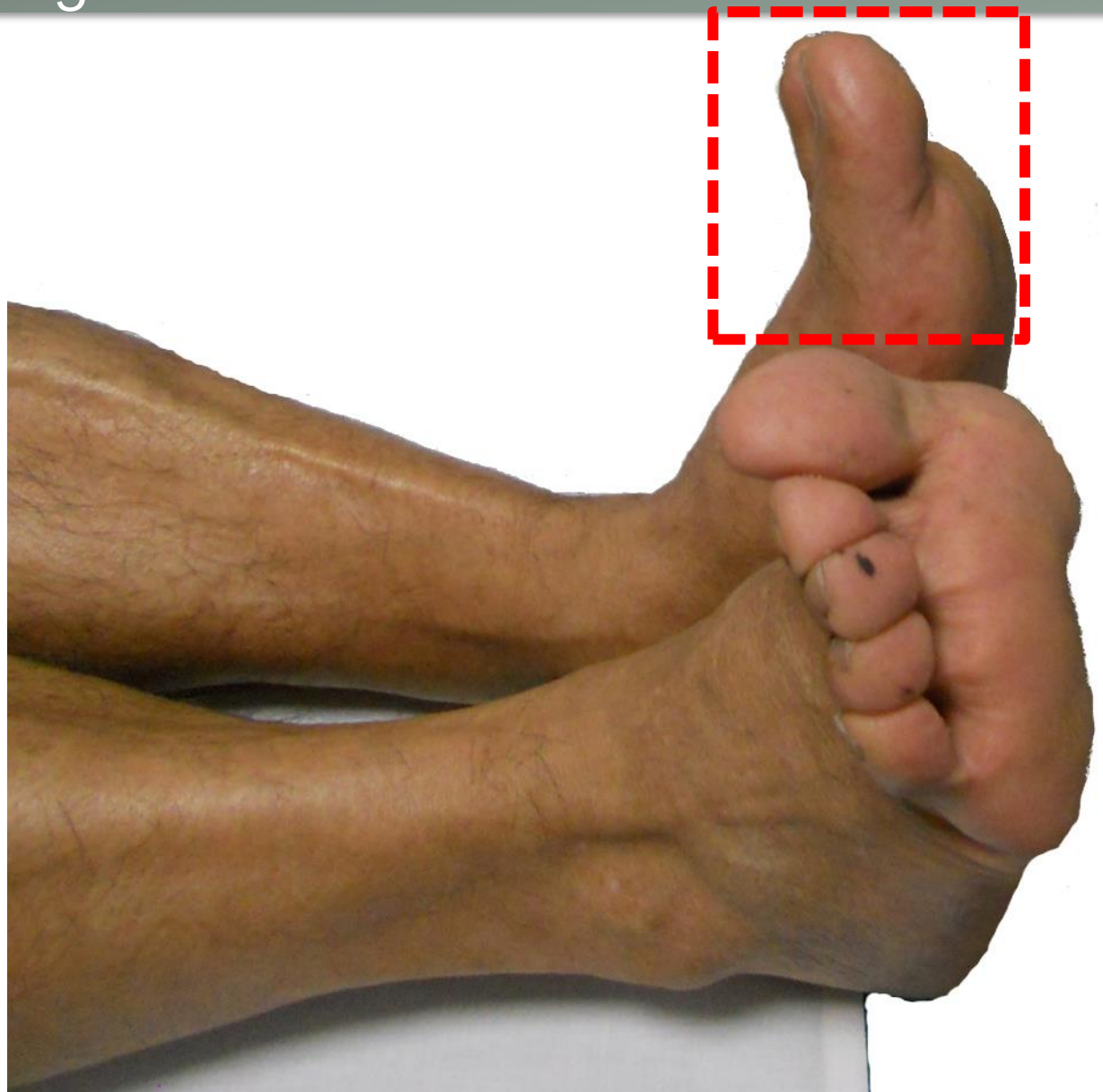
Motor neurological examination foot

L_4: foot dorsiflexion

L_5: first toe dorsiflexion

S_1: foot plantar flexion

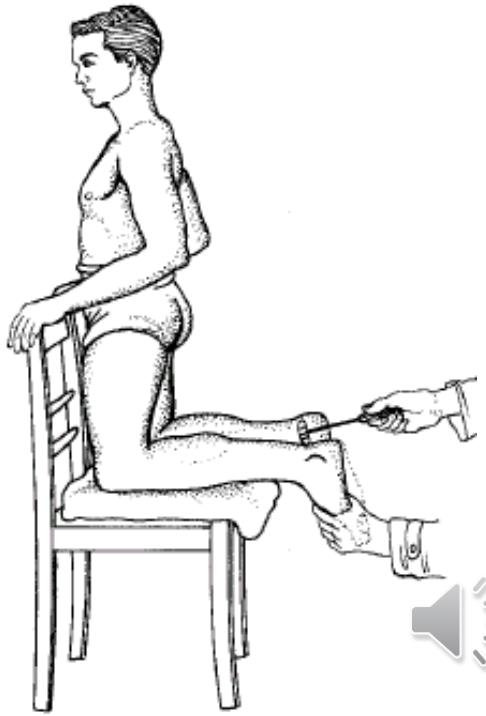
Loss of foot dorsiflexion = disc herniation L_4-L_5



Neurological examination: osteotendinous reflexes

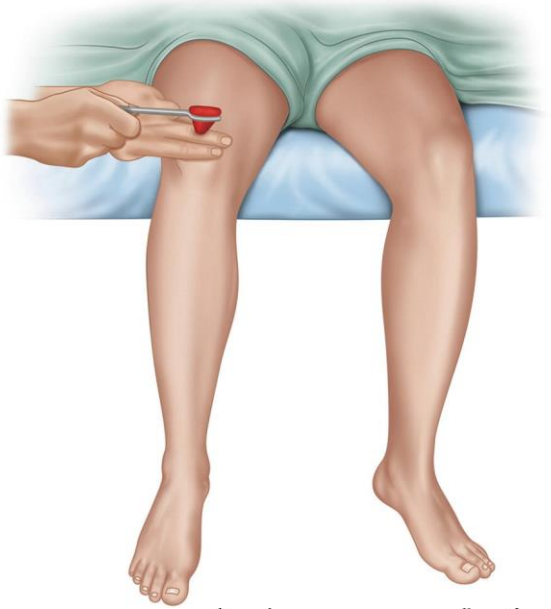
- Bilateral, symmetrical and comparative
- Reinforcement: Jendrassik manoeuvre

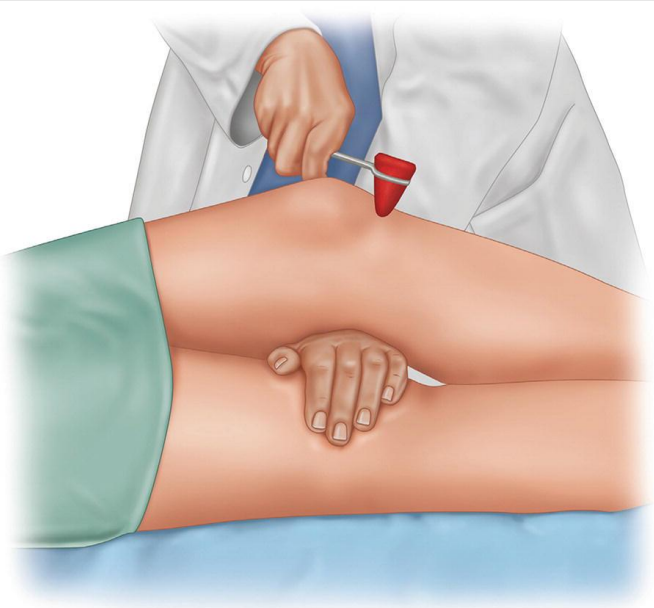
5+ = sustained clonus
4+ = unsustained clonus
3+ = brisk without reflexogenic area increase
2+ = normal
1+ = hypokinetic
0.5 = present only with reinforcement
0 = no response at all

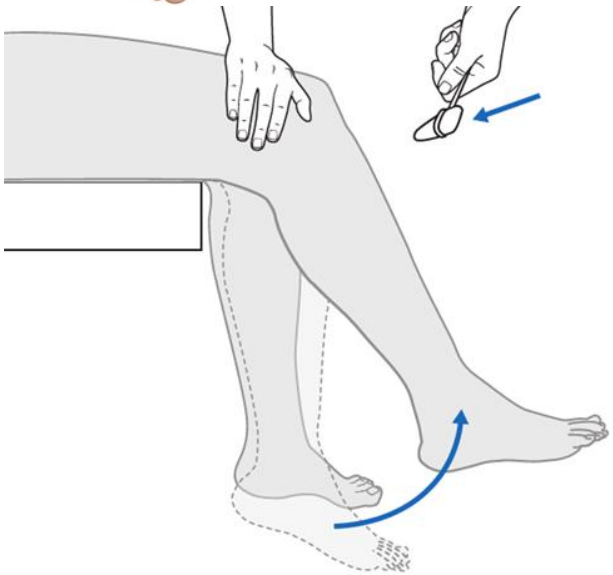


Jendrassik maneuver

Patellar reflex or knee jerk = $L_4 > L_3$

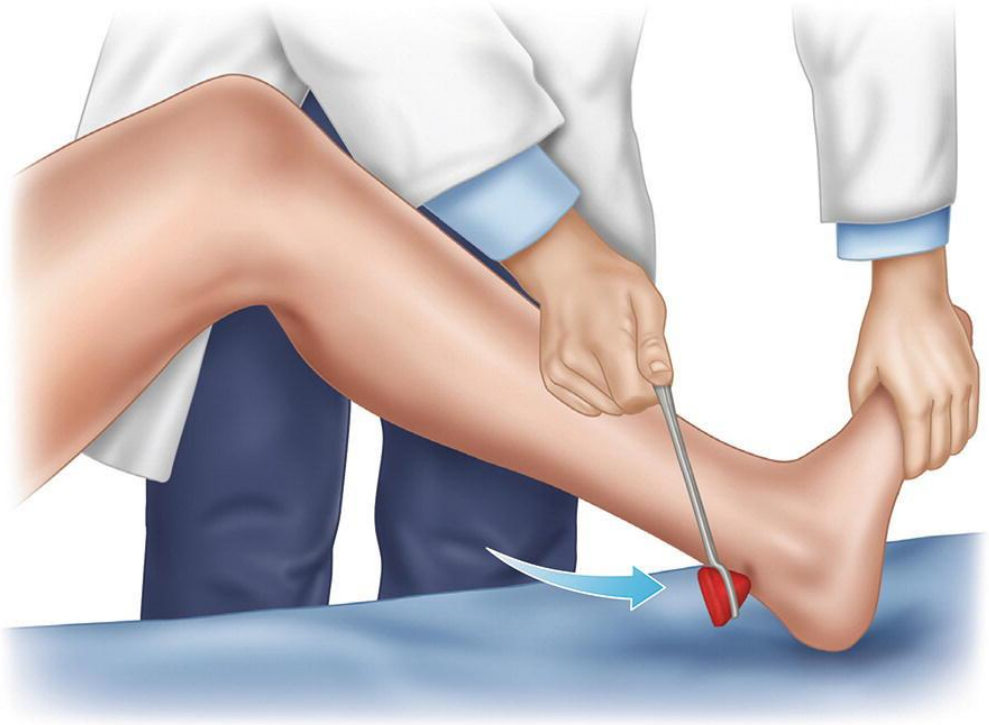






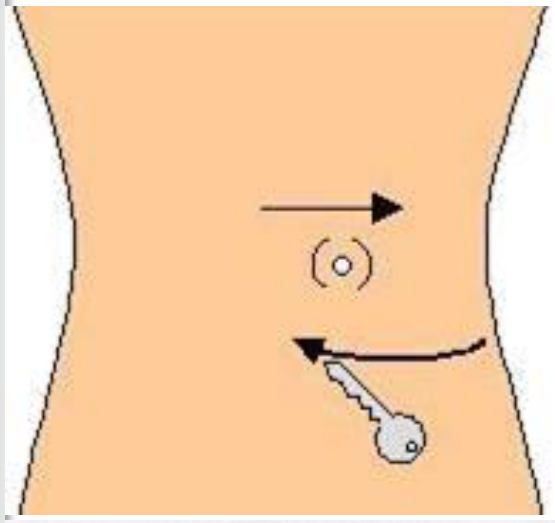
Semitendinosus muscle reflex = L_5

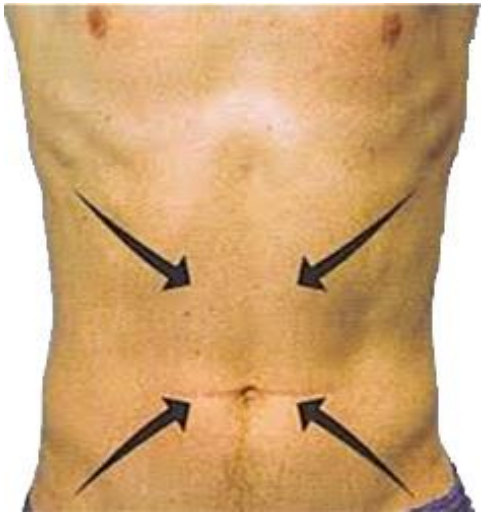
Achilles reflex or knee jerk = S_1

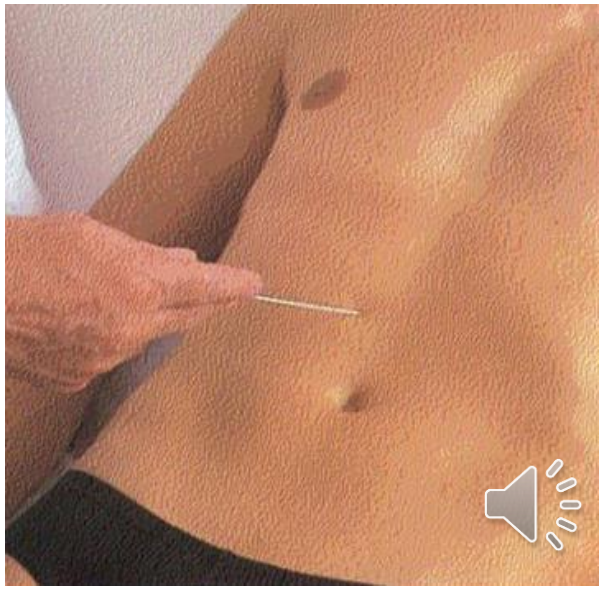


Hamstring reflex = $S_1 + S_2$

Abdominal cutaneous reflexes: superior (T_6-T_7), median (T_8-T_9), inferior (T_{10}-T_{12}). Absent in corticospinal tract injury



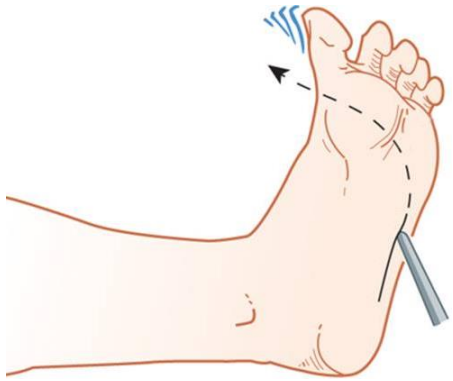




Normal plantar reflex = flexion

Plantar reflex EXTENSION = Babinski sign (superior motor neuron injury)

Normal

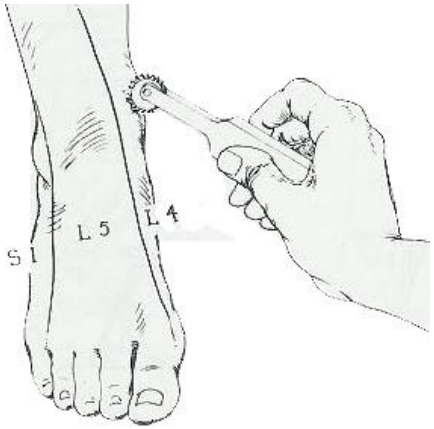


Babinski

https://www.youtube.com/watch?v=2_4POkGeZvQ

Neurological examination: sensation

- Bilateral, symmetrical, and comparative
- Pain
  - Pins (blunt)
  - Wartenberg wheel
- Superficial touch
  - Paintbrush, cotton
- Position
- Vibration



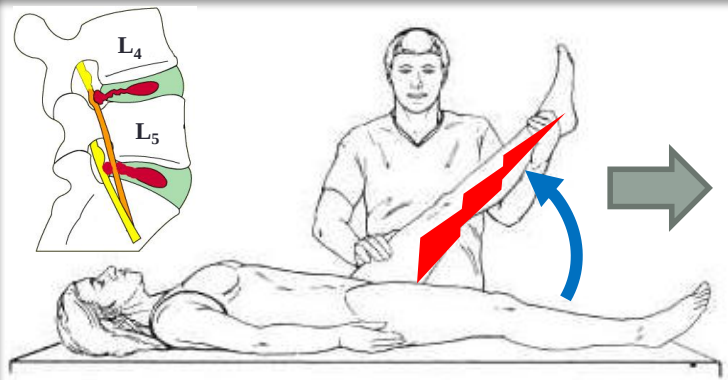
Wartenberg wheel

Buck hammer

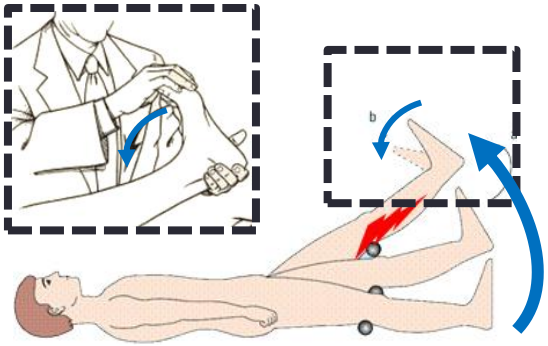
Clinical examination

- Nerve root elongation manoeuvres
  - Lasegue (< 60º)
  - Bragard
  - Knee extension
  - Counter-lateral Lasegue (Fajersztajn sign)
  - Femoral stretch test

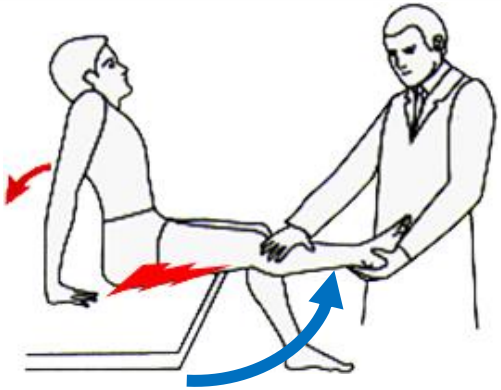
Nerve root elongation manoeuvres



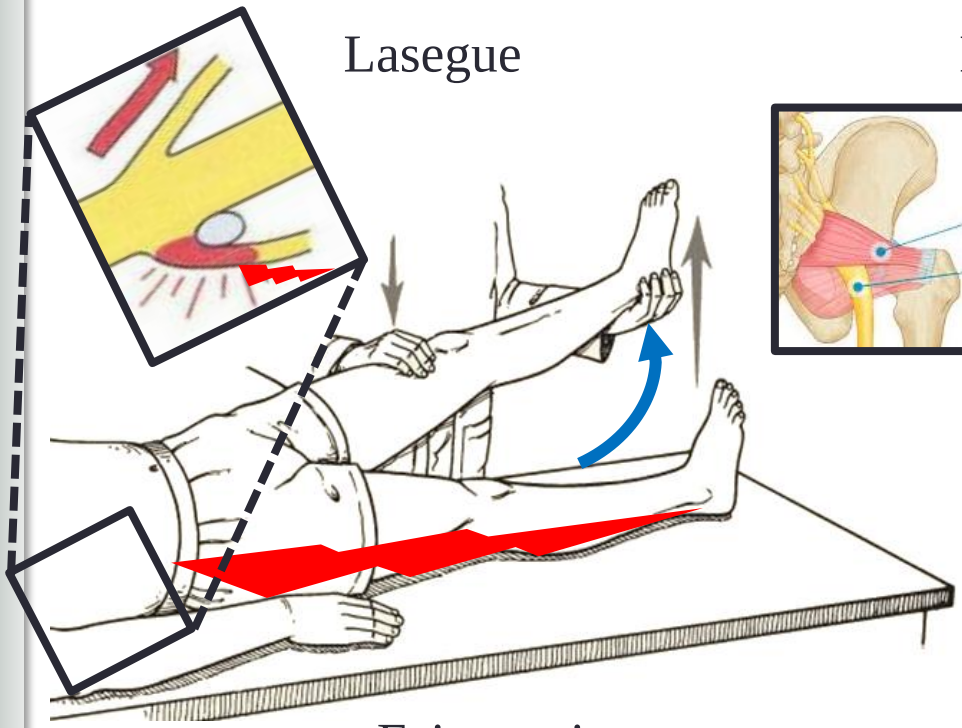
Lasegue



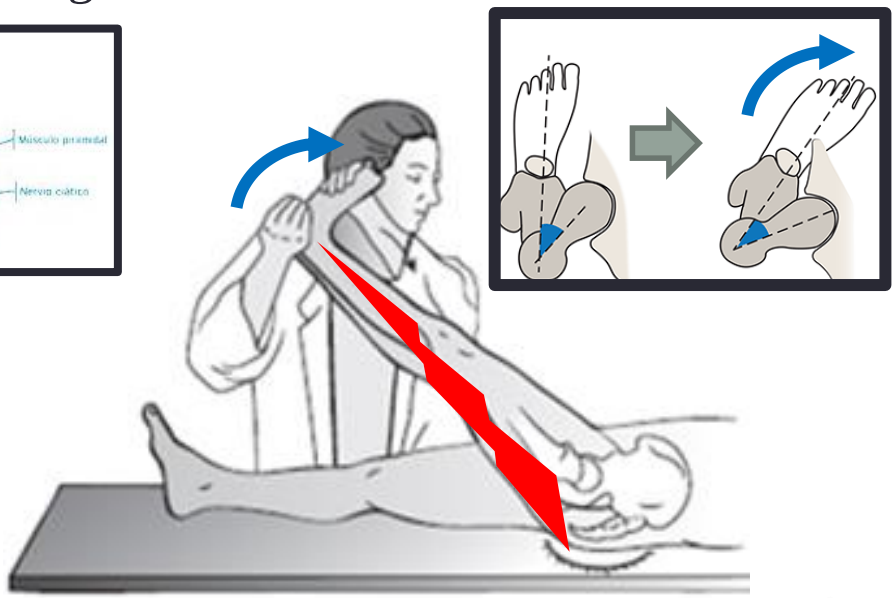
Bragard



Knee extension test



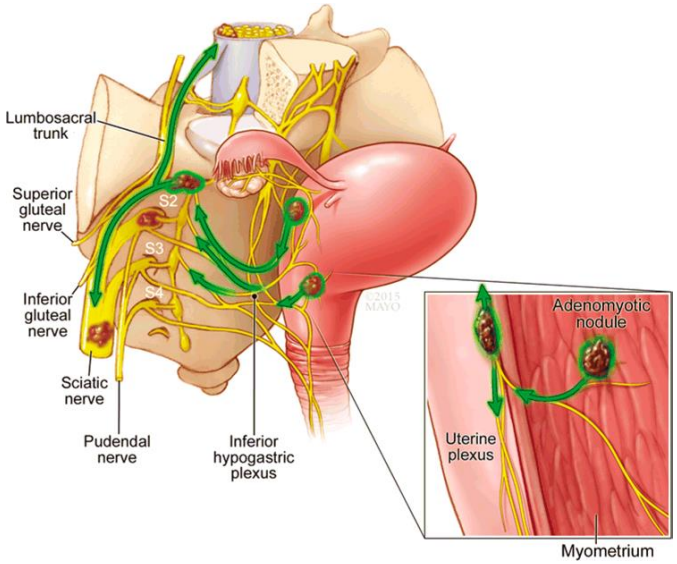
Fajersztajn

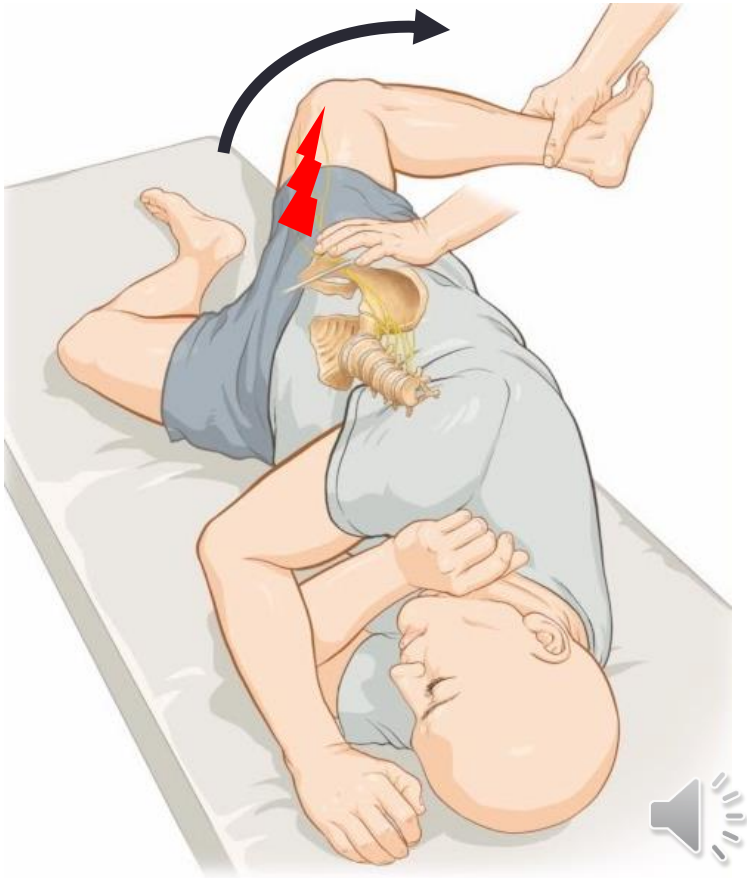


Pyramidal pelvis muscle syndrome

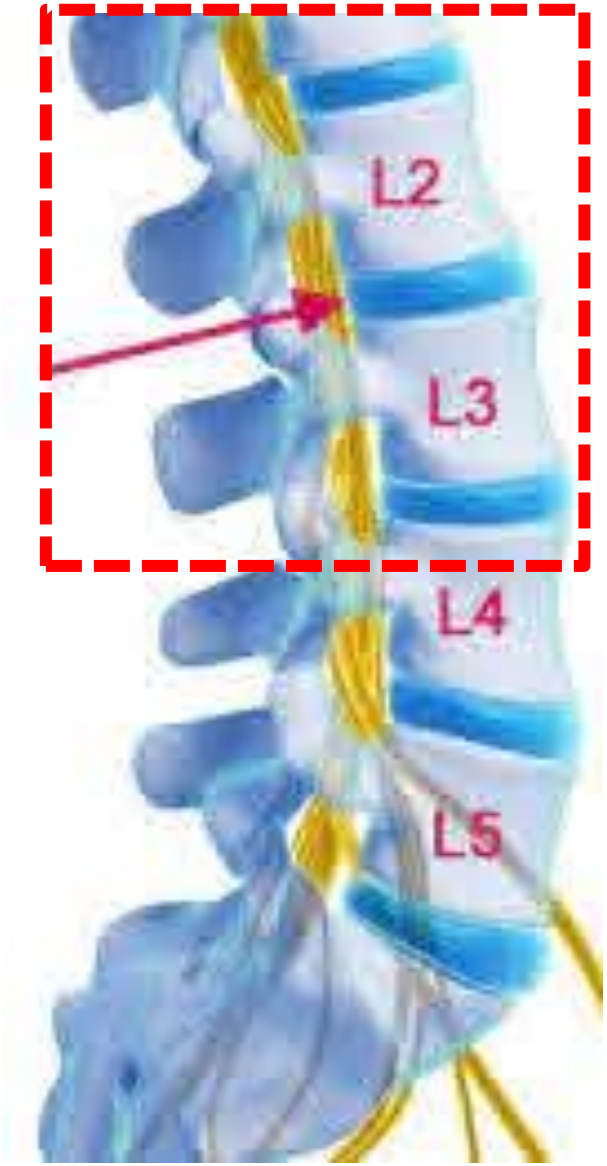
Psoas test

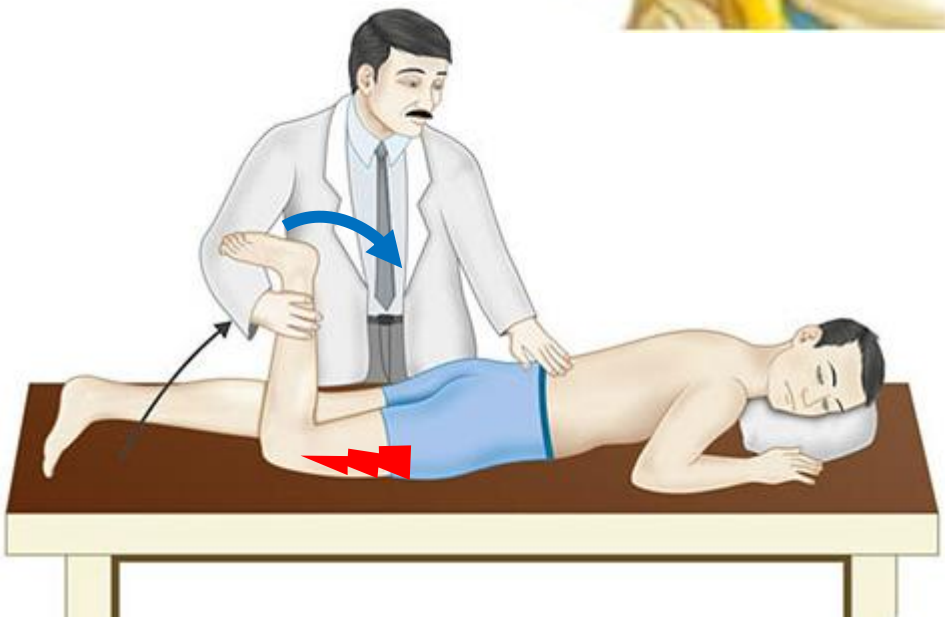
- Rules out retroperitoneum lesions that affect the lumbosacral plexus
  - Ovarian tumour, endometriosis, …



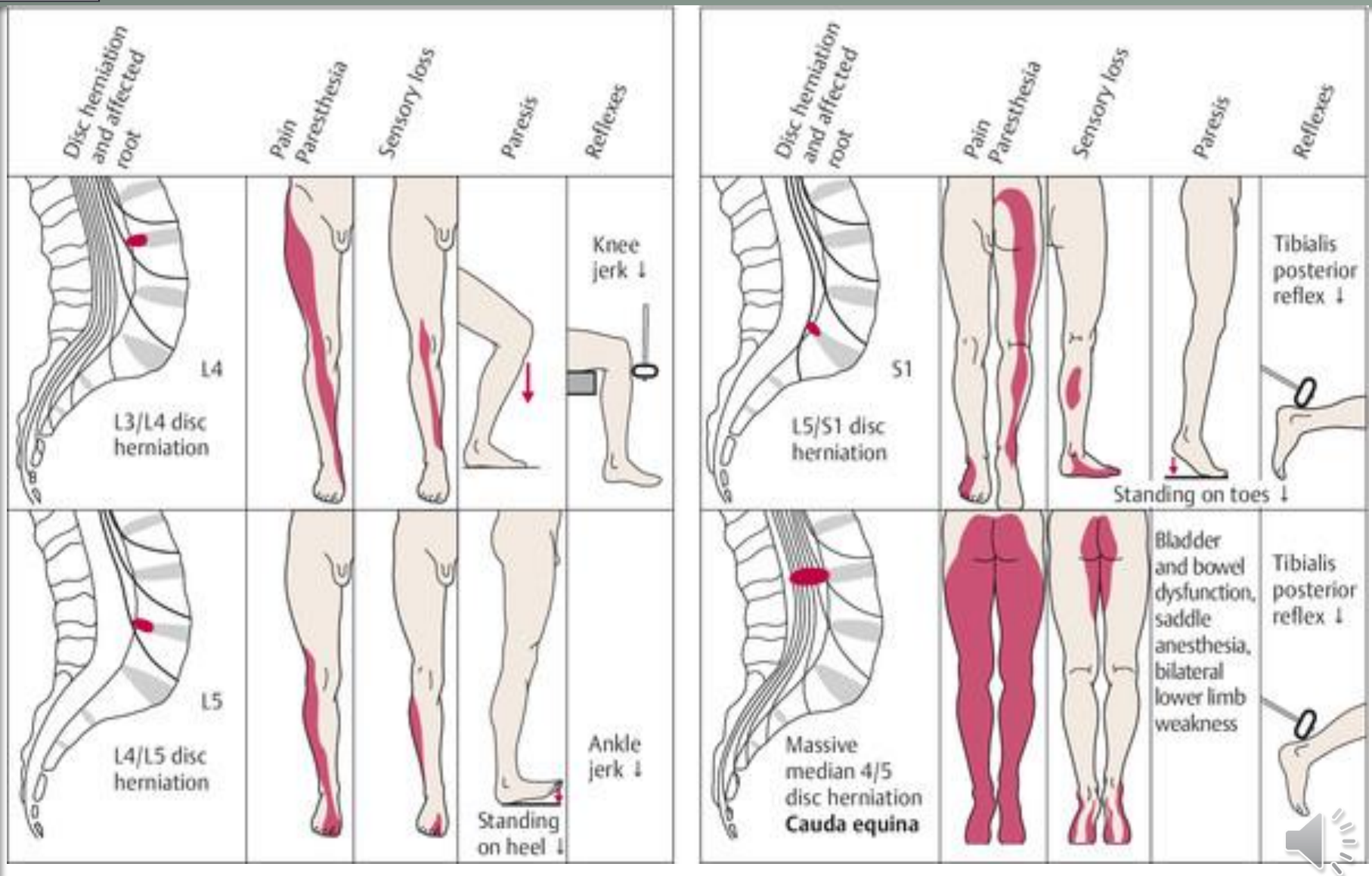


Femoral stretch test





Summary neurological examination lumbar disc herniation

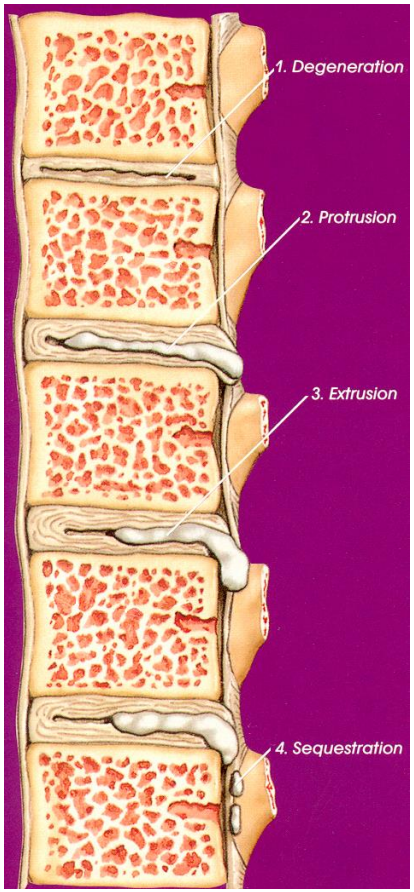


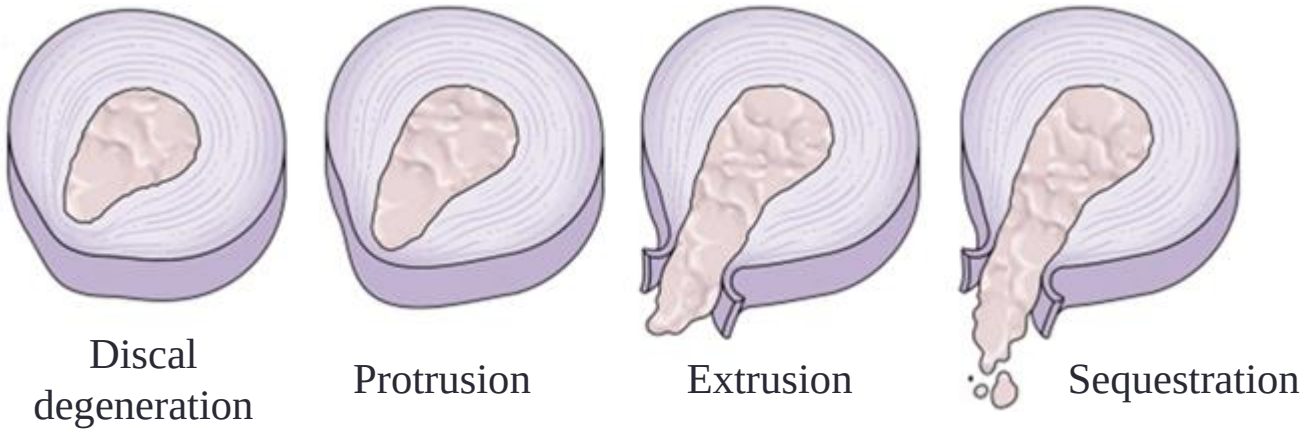
Diagnosis: lumbar disc herniation

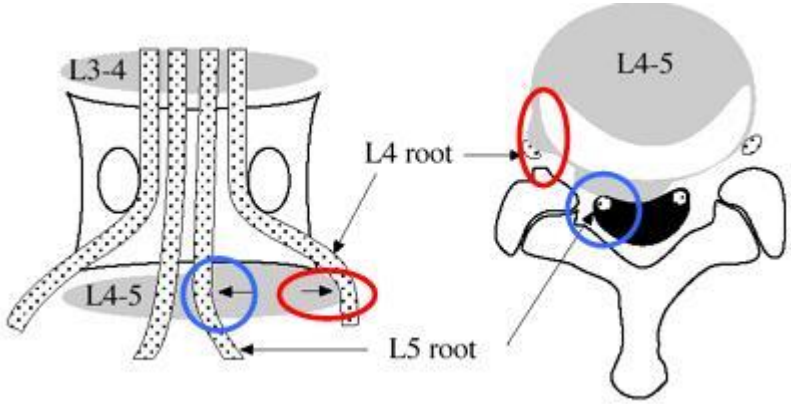
- Diagnostic imaging: MRI
  - Clinical features + neurological examination + MRI image must correlate
    - Differential diagnosis
      - Spinal canal stenosis
      - Tumour…
  - Beware of making diagnosis ONLY with the image because of asymptomatic patients:
    - 24% show a herniated disc on MRI (36 % in >60 years)
    - 4% show spinal canal stenosis on MRI (22 % in >60 years)
- Other:
  - CT and CT myelography

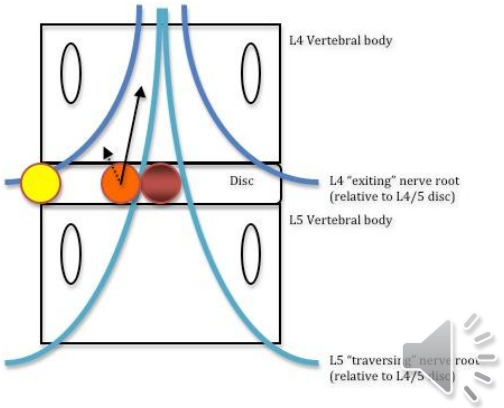
Types of lumbar disc herniations

- Type: disc degeneration, protrusion, extrusion, and disc sequestration
- Location: central, paramedial, foraminal



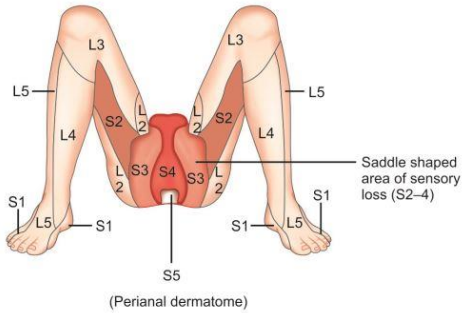




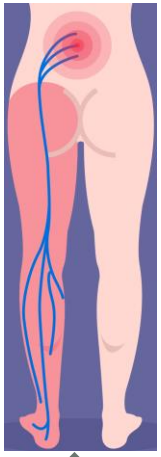


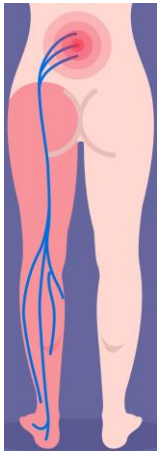
Types of lumbar disc herniations

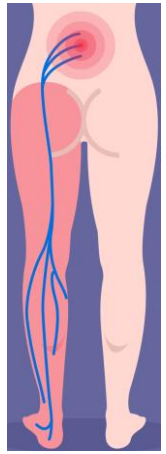
Bilateral lumbosciatica

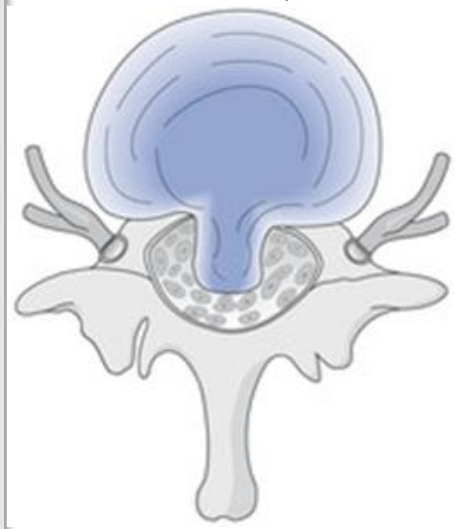


Cauda equina syndrome

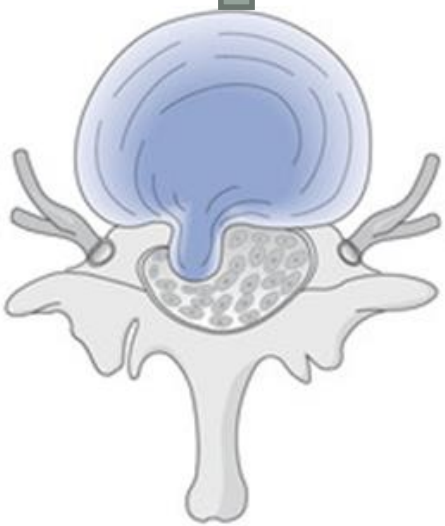




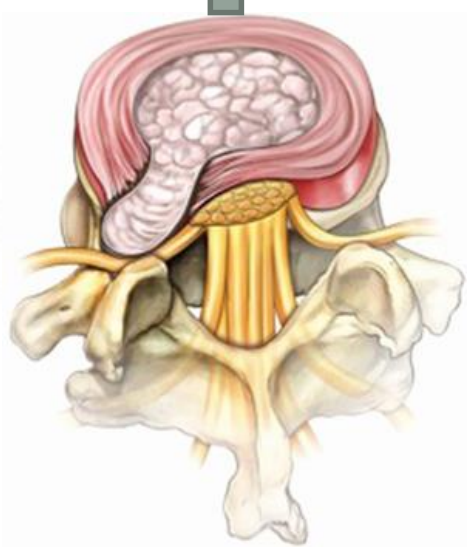




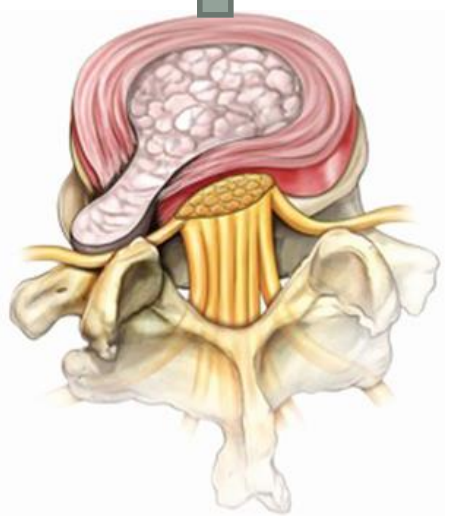
Central



Paramedian

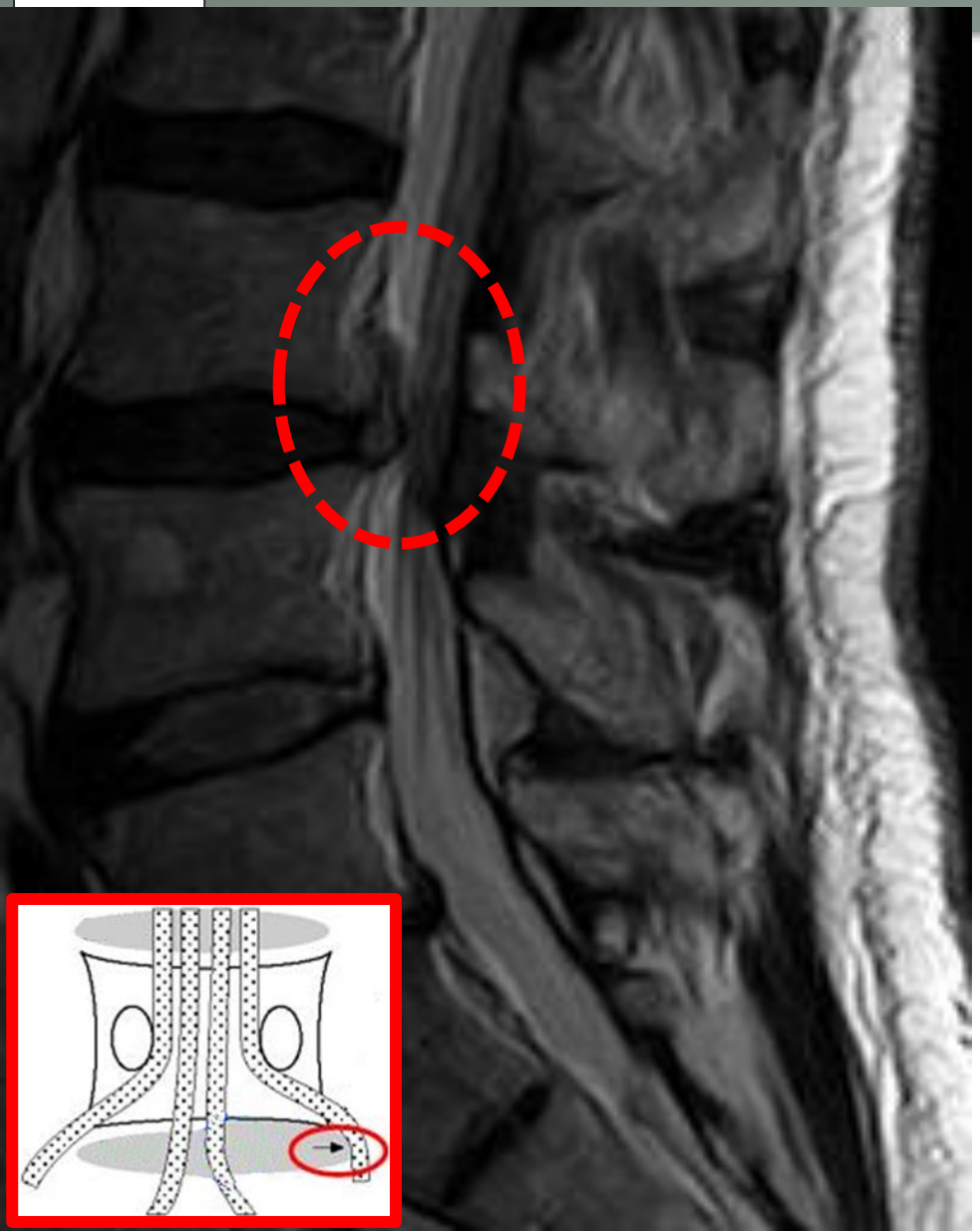


Foraminal



Extraforaminal

Migrated herniated disc L_3-L_4



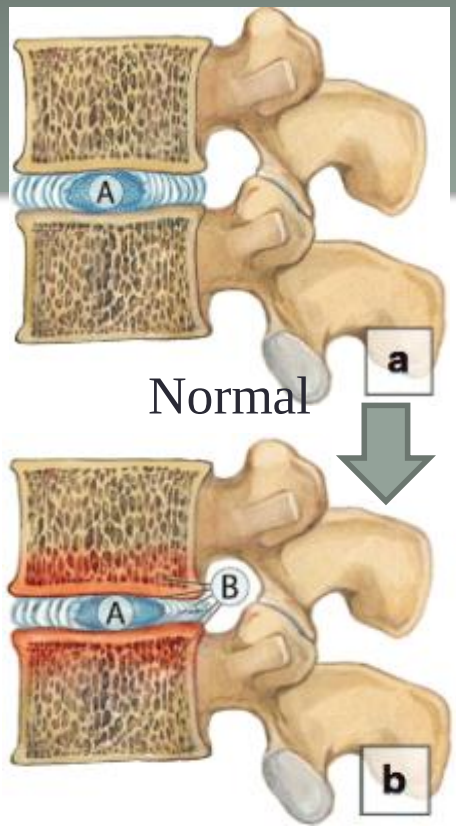
Lumbar disc herniation treatment

- **Conservative**
  - NSAIDs, physiotherapy, lumbar girdle, and bed rest
- **Surgical treatment: clinical symptoms that**
  - <1 month but very severe pain
  - >1 month with no improvement but correlation of clinical examination & neuro-imaging findings mandatory
- **Surgical procedure according to clinical symptoms & neuroimaging findings**
  - Nucleotomy
  - Disc radiofrequency
  - Intradiscal ozone therapy
  - Lumbar microdiscectomy
  - Microdiscectomy + nucleus pulposus replacement
  - Discectomy + arthrodesis
  - Lumbar disc prosthesis

Disc degeneration

- Nomenclature
  - **Degenerate disk** → Possible nerve root pain due to inflammatory changes
  - **Empty disk** = gas inside the disc space (age↑)

- **Degenerative disc disease**
  - Age 30 – 50 years ↑♂, usually lumbar disc
  - Related to degenerative disc changes
  - Disc degeneration → ↓ disc height → favours injuries
    - ↓Proteoglycans
    - Dehydration, mucoid degeneration, reabsorption
    - Rupture of anulus & of normal anatomical structures (ligaments)
  - May be accompanied by degenerative changes in facet (zygapophyseal) joints

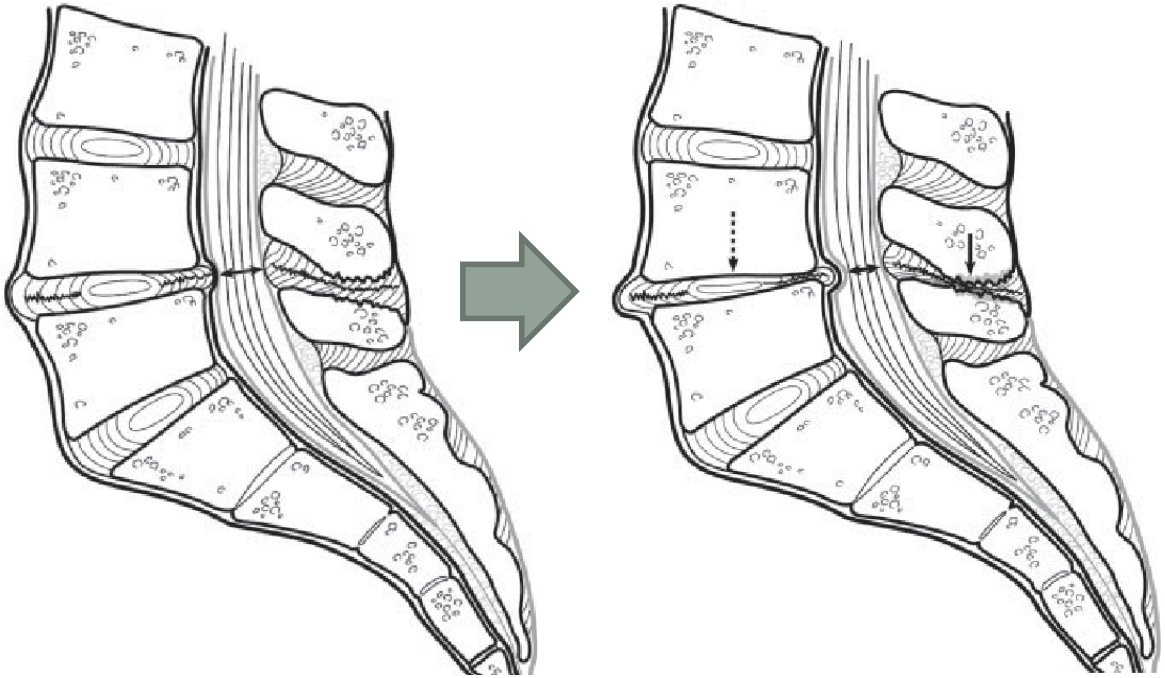


Discogenic low back pain

- Leaning forward
- Sitting
- Getting in & out of car
- Lifting weights

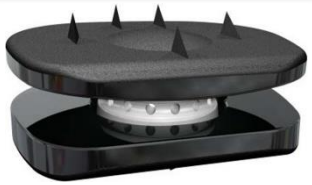
Disc degeneration

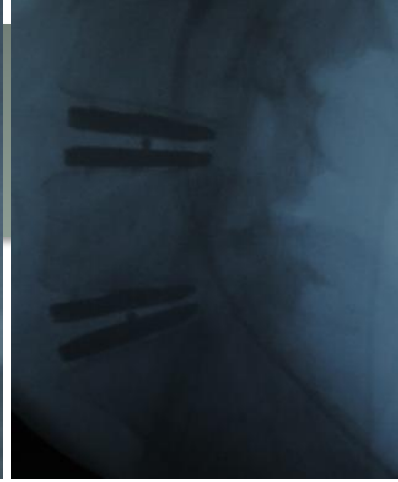
- Diagnosis
  - MRI
    - Disc degeneration: disc collapse + cartilaginous plaque degeneration (through which the disc is nourished)



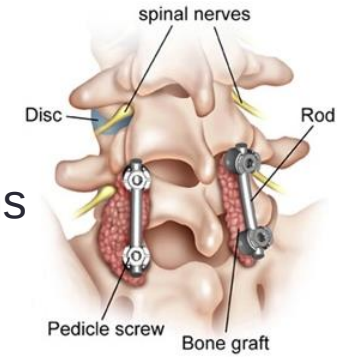
Degenerative disc disease

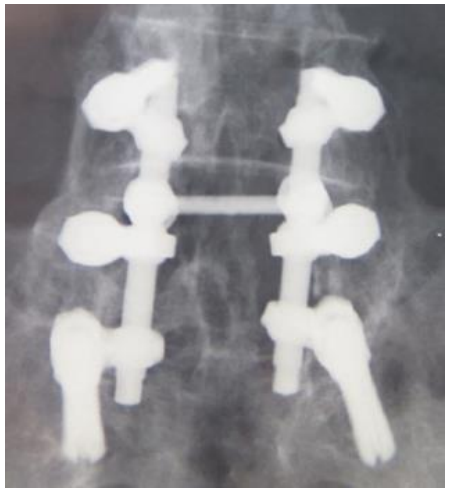
- **Treatment**
  - **Conservative**
    - Inflammation and pain control (corticosteroids, ozone therapy, heat/cold...)
    - Physiotherapy
  - **Surgical**
    - If maintained > 6 months
      - < 45 years → Disc prosthesis
      - > 45 years → arthrodesis

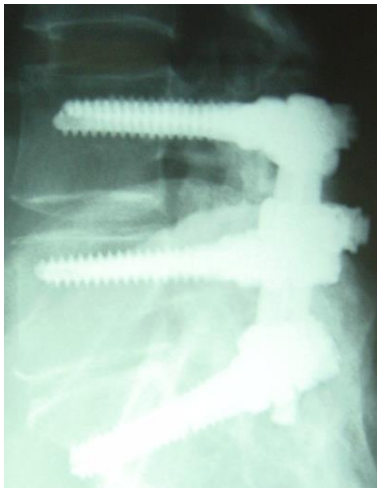




Disc prosthesis





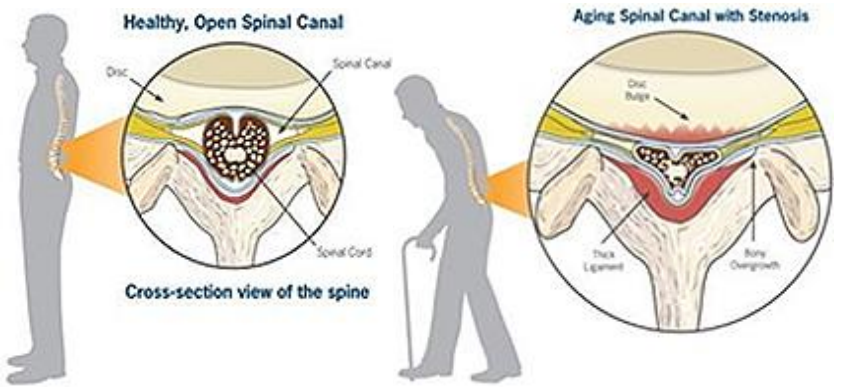


Arthrodesis

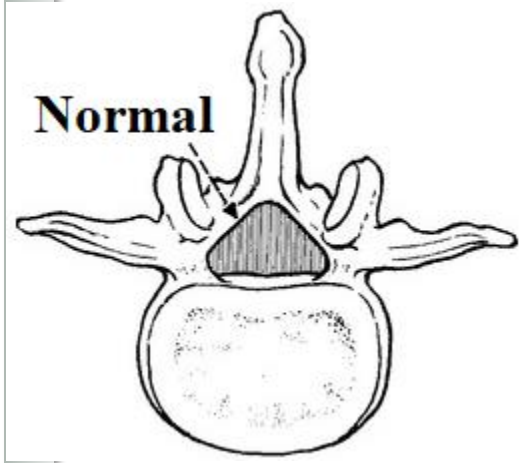
At the cervical level:
cervicalgia, with similar diagnosis and treatments to the lumbar area

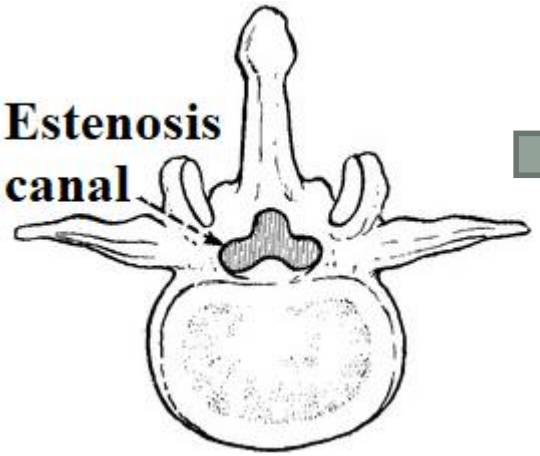
Spinal canal stenosis

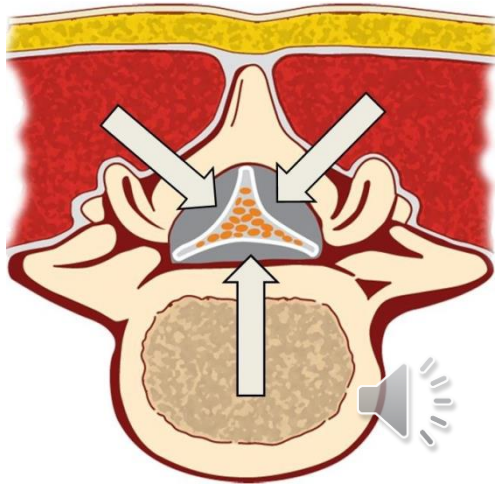
- Definition: reduction of the spinal canal section
- Affected areas
  - Lumbar
  - Cervical
  - Thoracic
  - Lumbar + cervical



NORMAL **CANAL STENOSIS**

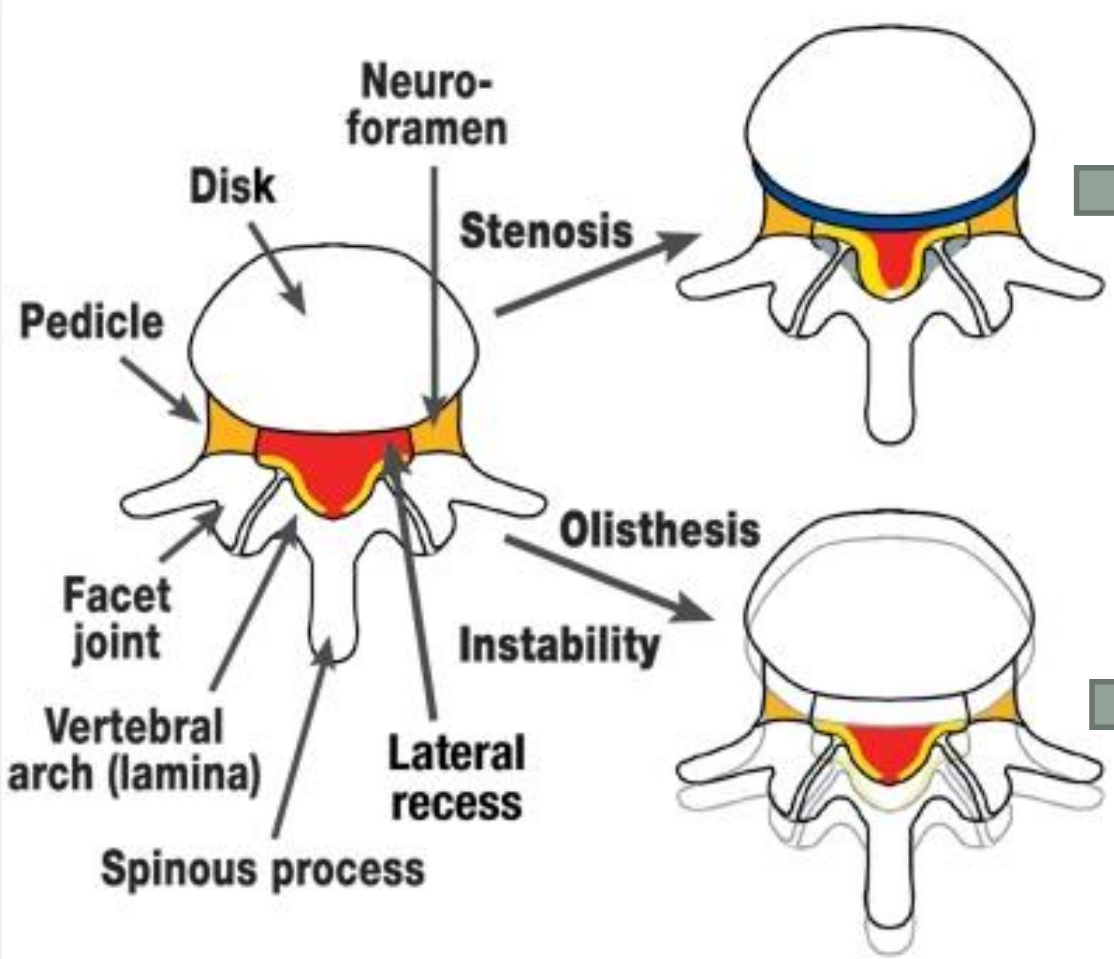


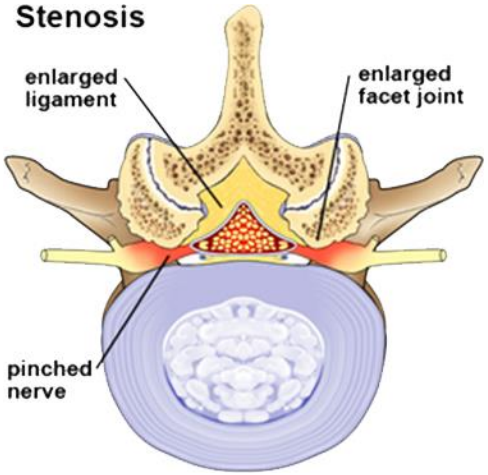


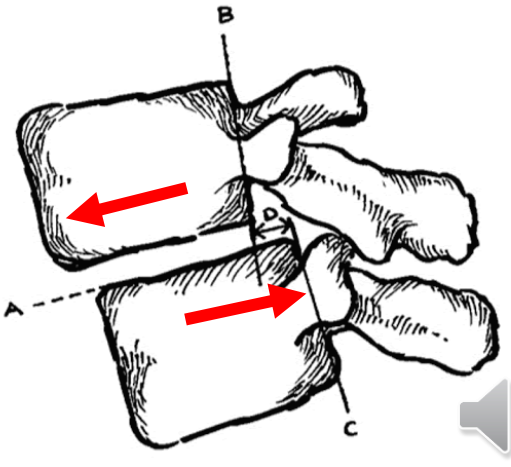


Spinal canal stenosis: causes

- Facet joint + yellow ligament hypertrophy
- Olisthesis (displacement of one vertebra over another)

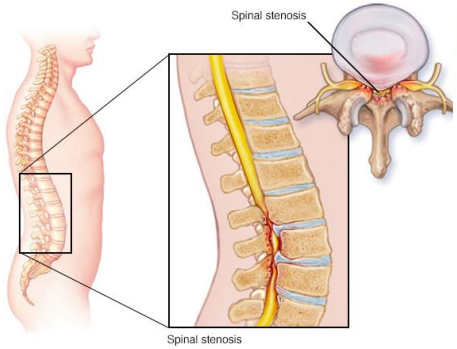


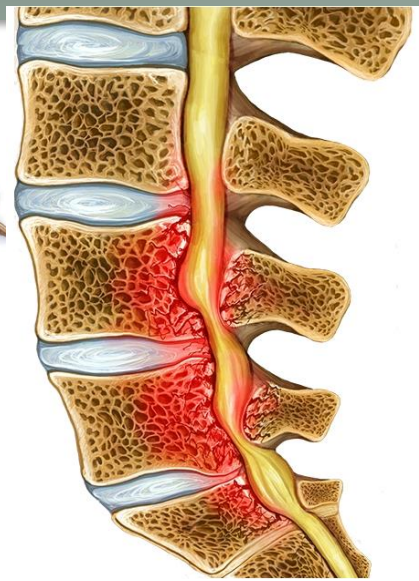


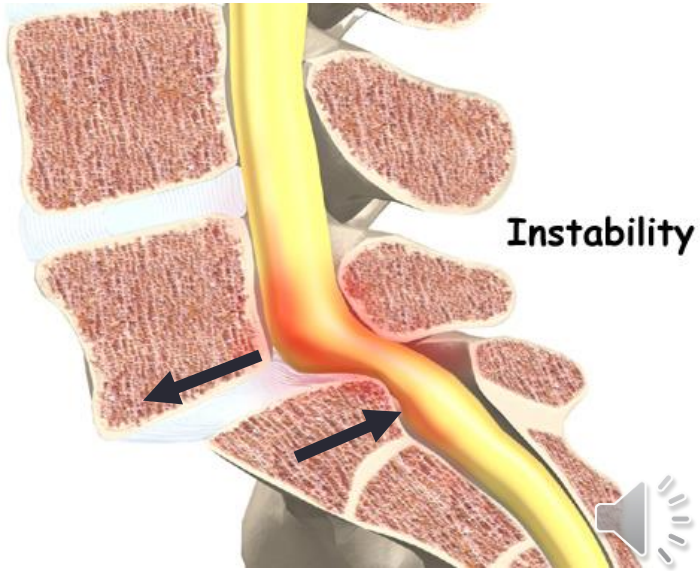


Lumbar spinal canal stenosis

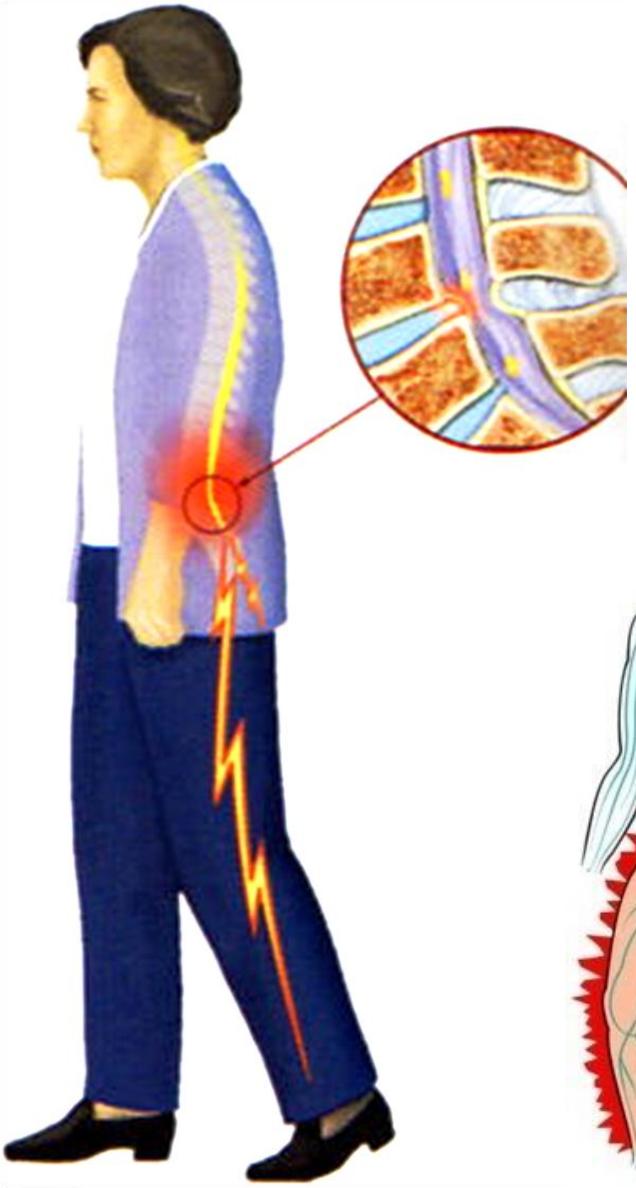
- Etiology
  - Facet joint & yellow ligament hypertrophy ± disc protrusion, olisthesis
  - May be congenital
  - L_4-L_5 > L_3-L_4 > L_2-L_3 > L_5-S_1
- Differential diagnosis with vascular claudication
  - Spinal canal stenosis = patient needs to sit to notice symptom improvement
  - Vascular = patient notices improvement when standing still
- It is usually stable, except:
  - Olisthesis, degenerative scoliosis (multisegmented)

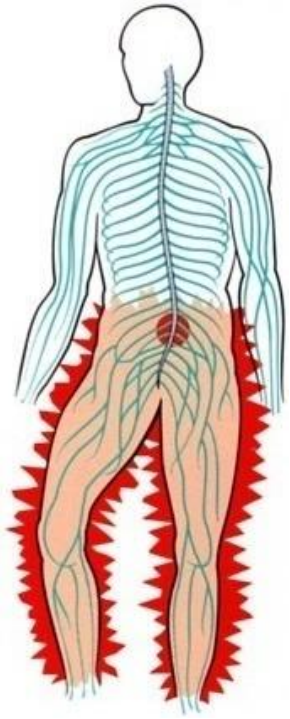




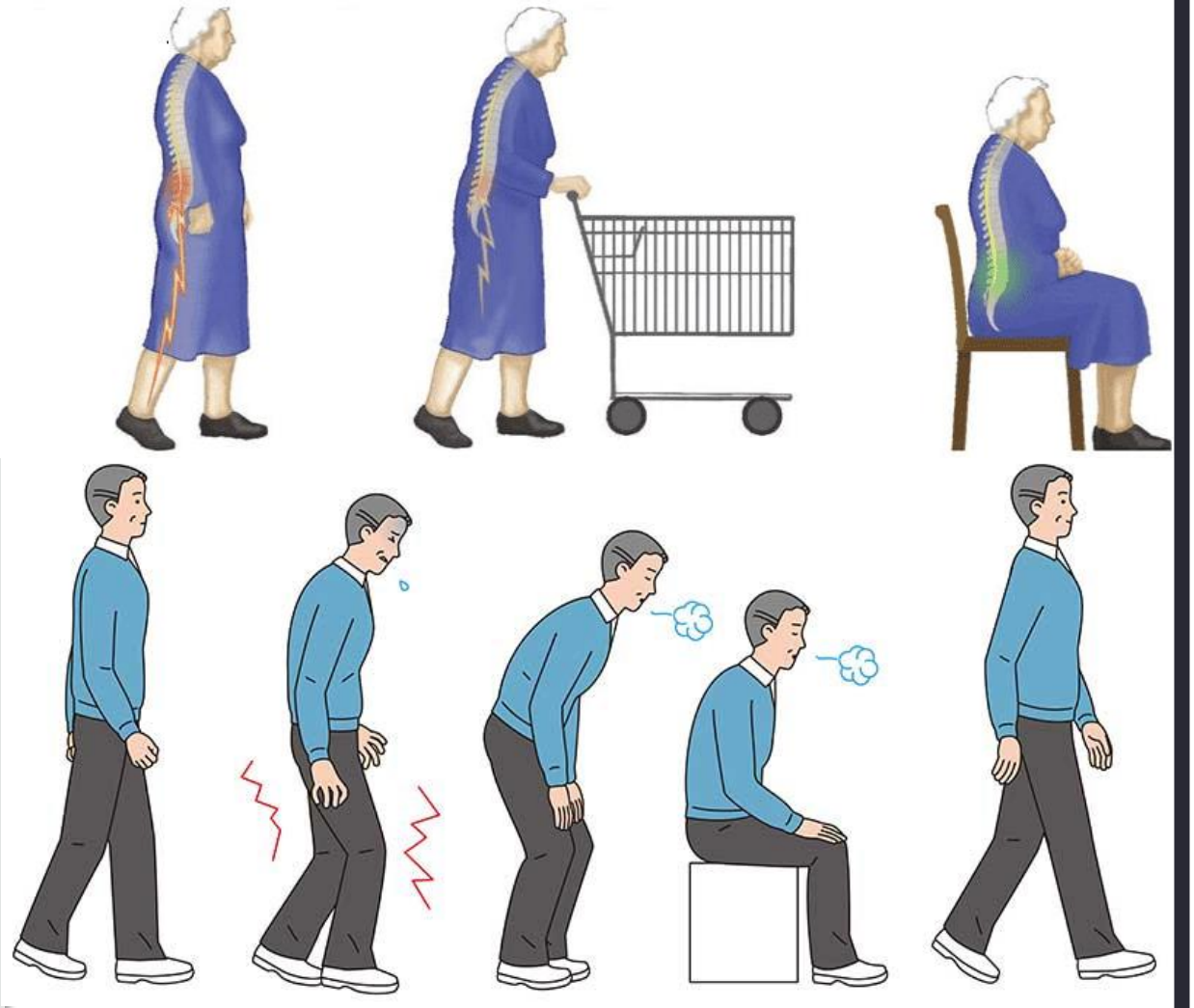


CLINICAL FEATURES = on walking pain and / or claudication relieved by leaning forward and sitting

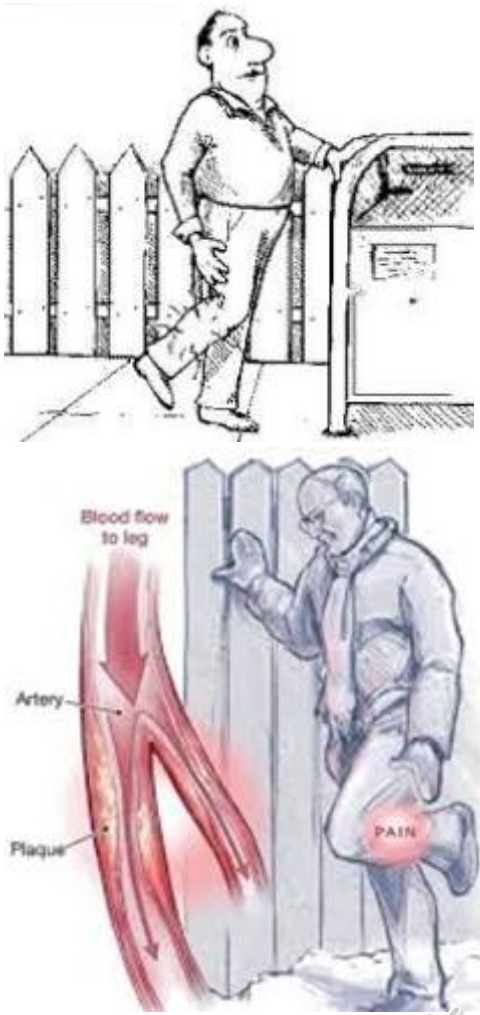




Lumbar canal stenosis: differential diagnosis



Neurogenic claudication



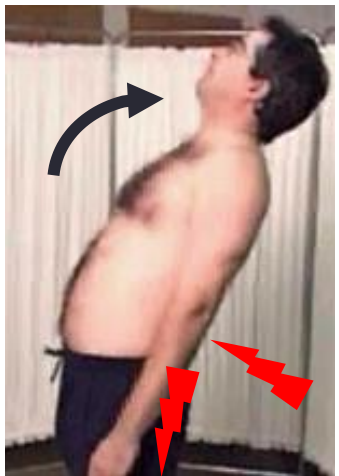
Vascular claudication

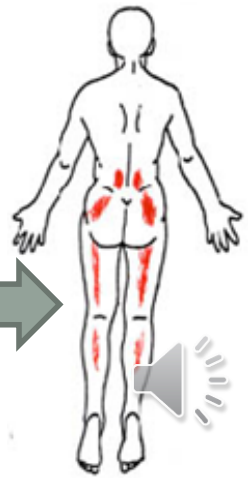
Spinal canal stenosis: clinical features

Finger joint osteoarthritis

Lumbar canal stenosis

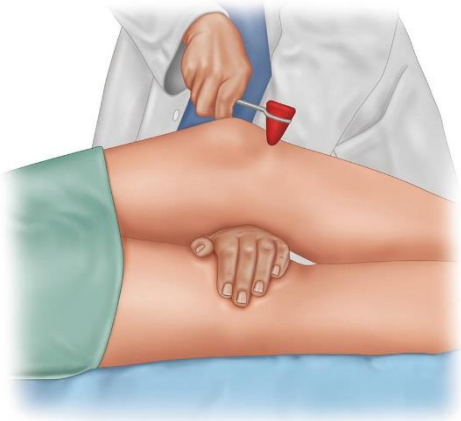
- Physical examination
  - Position: spinal flexion
  - Low back pain increases with spinal extension
  - Neurological examination
    - Normal in 18% patients
    - ↓ Patellar & Achilles reflexes
    - POSSIBLE coincidence with cervical spinal canal stenosis!

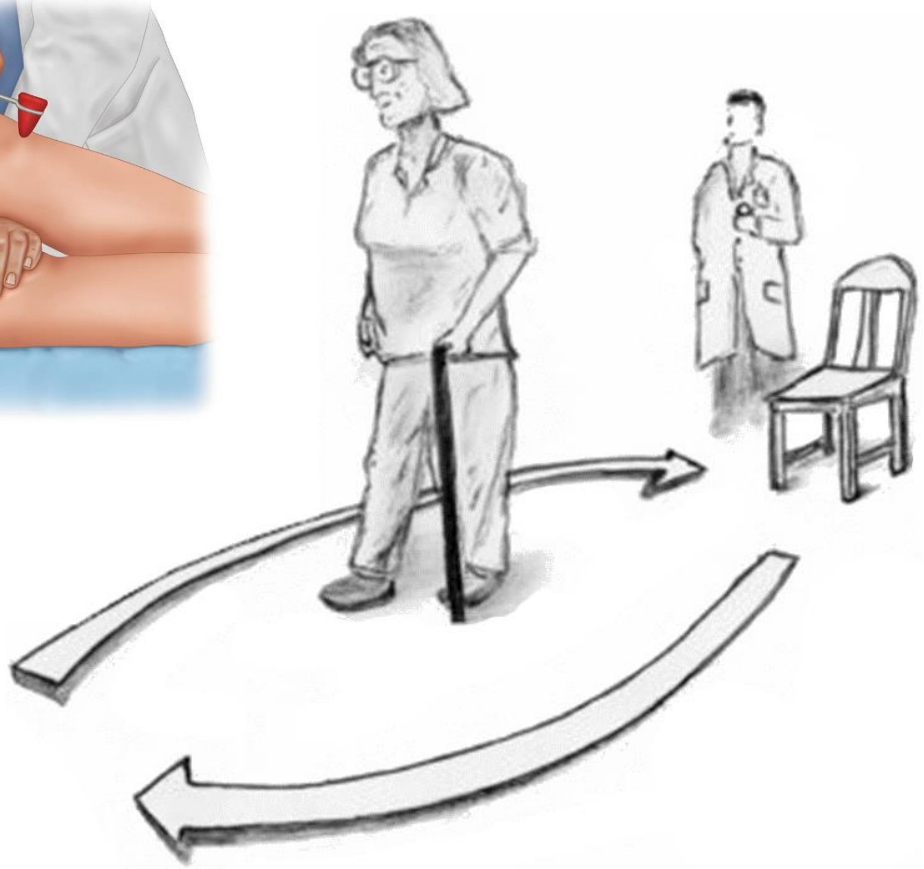


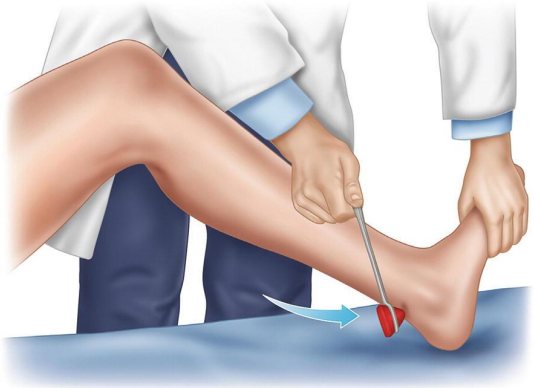


Lumbar canal stenosis: neurogenic claudication

- Repeat osteotendinous reflex examination after patient walks 50-100 meters= often reflexes are then absent

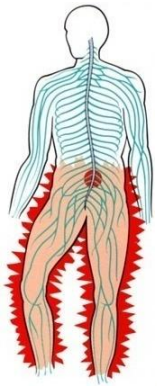


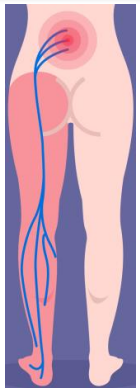


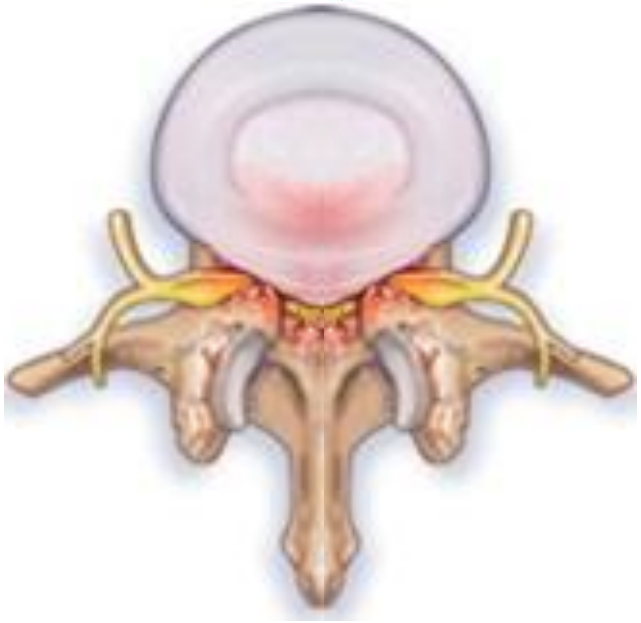


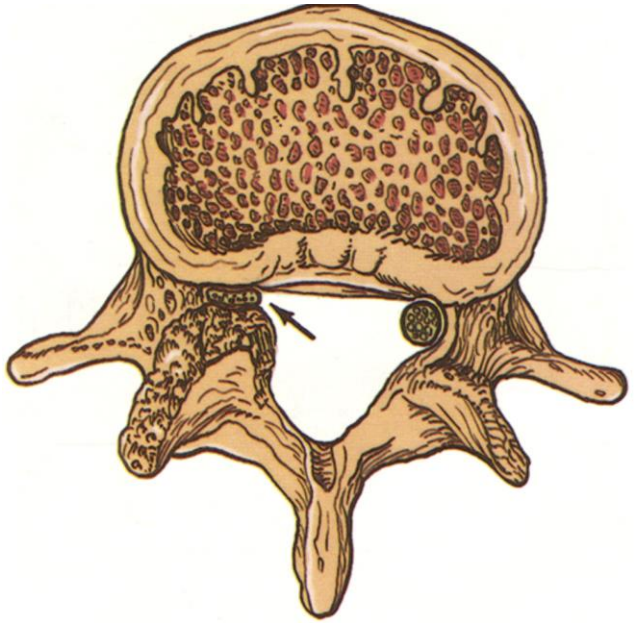
Types of lumbar spinal canal stenosis

- Central
- Lateral recess









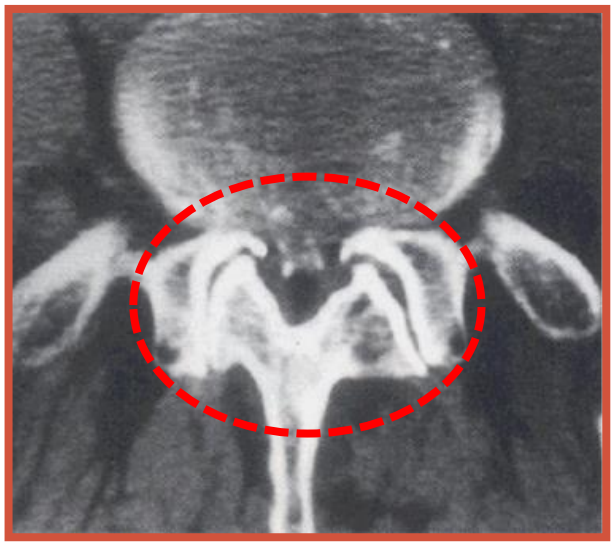
Central

Lateral recess

Lumbar canal stenosis: complementary tests

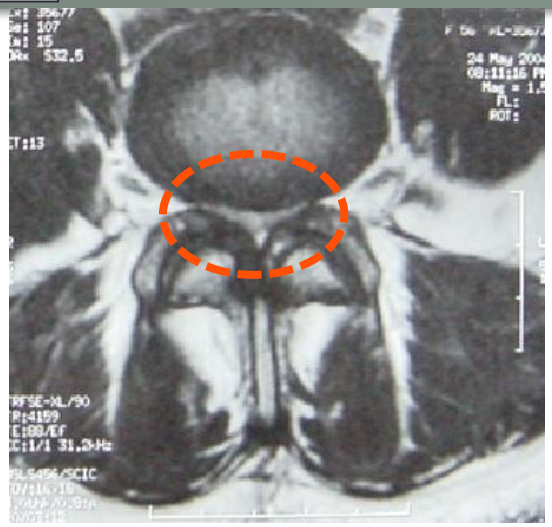
- Diagnostic evaluation
  - Plain x-ray → olisthesis
  - CT → clover leaf spinal canal, ligament + facet joint hypertrophy /olisthesis
  - MRI
    - Involvement of neural structures
    - Facet joint cysts
    - Surgical planning

Olisthesis

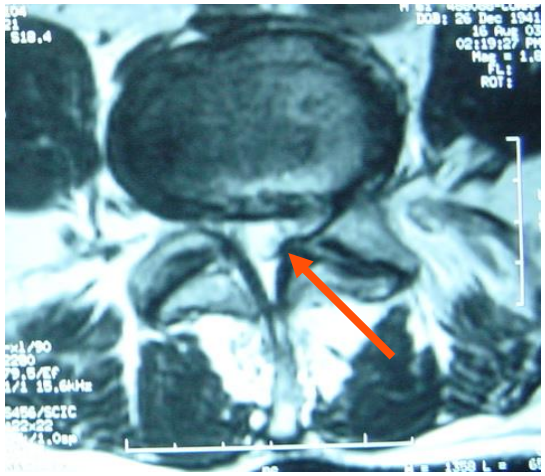


33% asymptomatic patients 50-70 years show canal stenosis on MRI, WITHOUT any clinical symptoms!!

MRI lumbar spinal canal stenosis



Pure canal stenosis



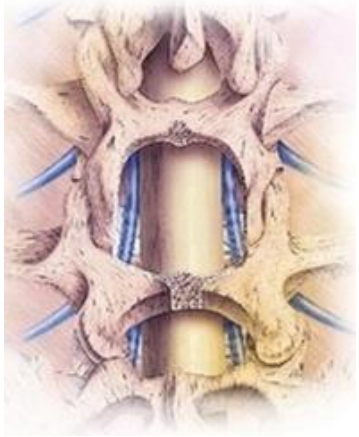
Canal stenosis + facet cyst

Canal stenosis + herniated disc

Lumbar spinal canal stenosis: treatment

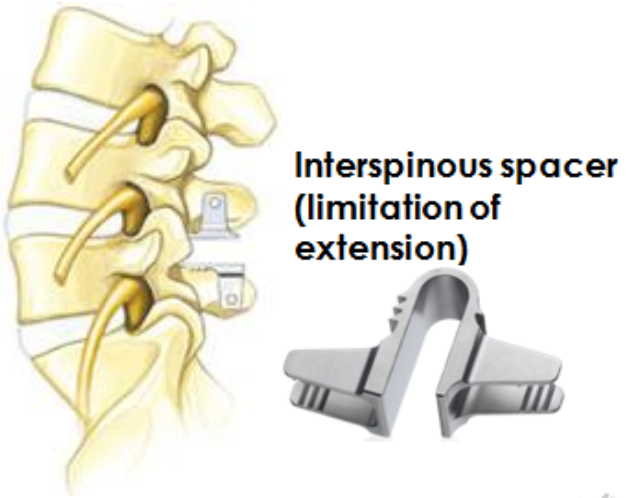
- **Conservative treatment**
- **Surgery**
  - Direct decompression
    - Simple microsurgical decompression
    - Open laminectomy ± spinal fusion
  - Indirect decompression
    - Interspinous spacer

Conservative treatment



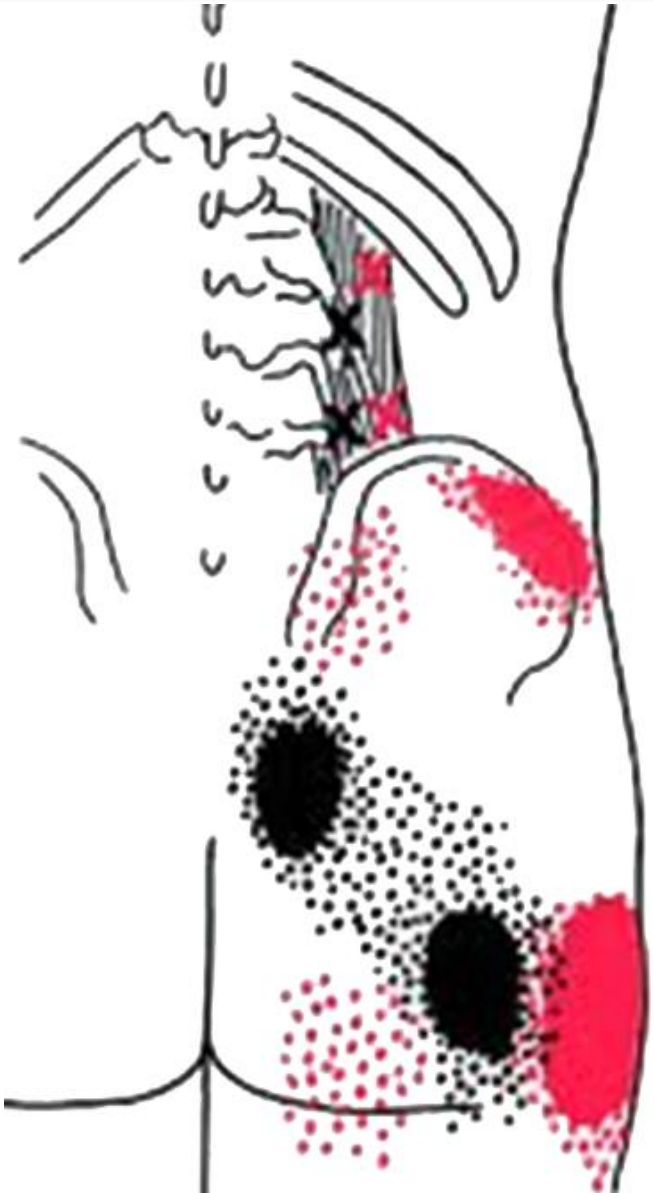
Simple decompression

Decompression + arthrodesis

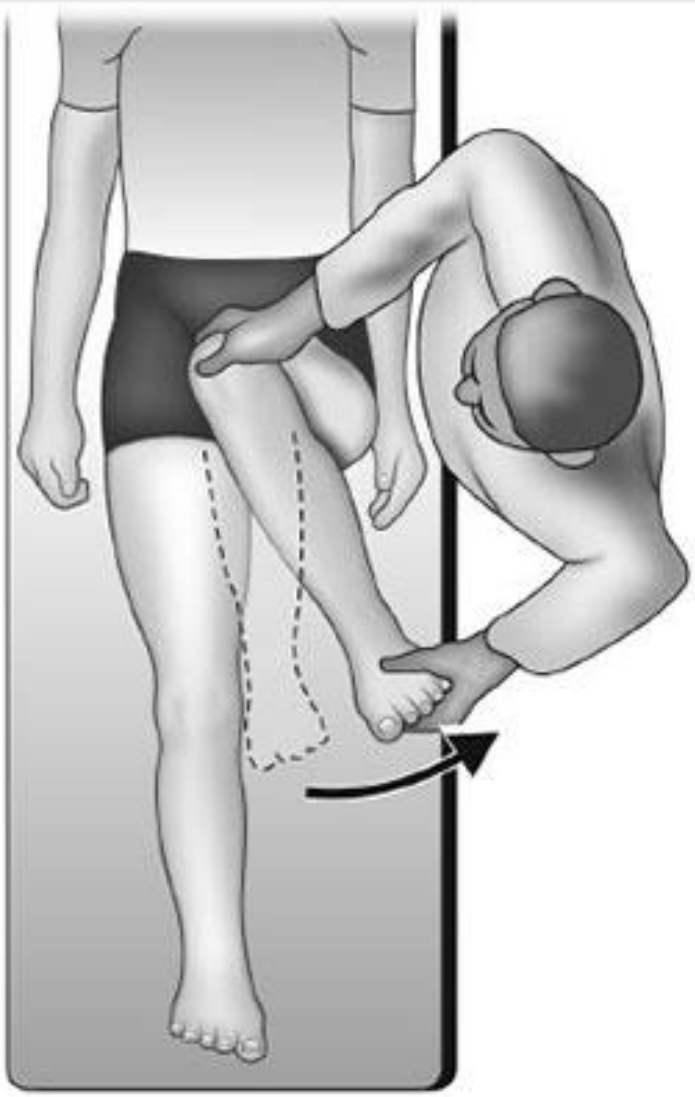


Indirect decompression: interspinous "U"

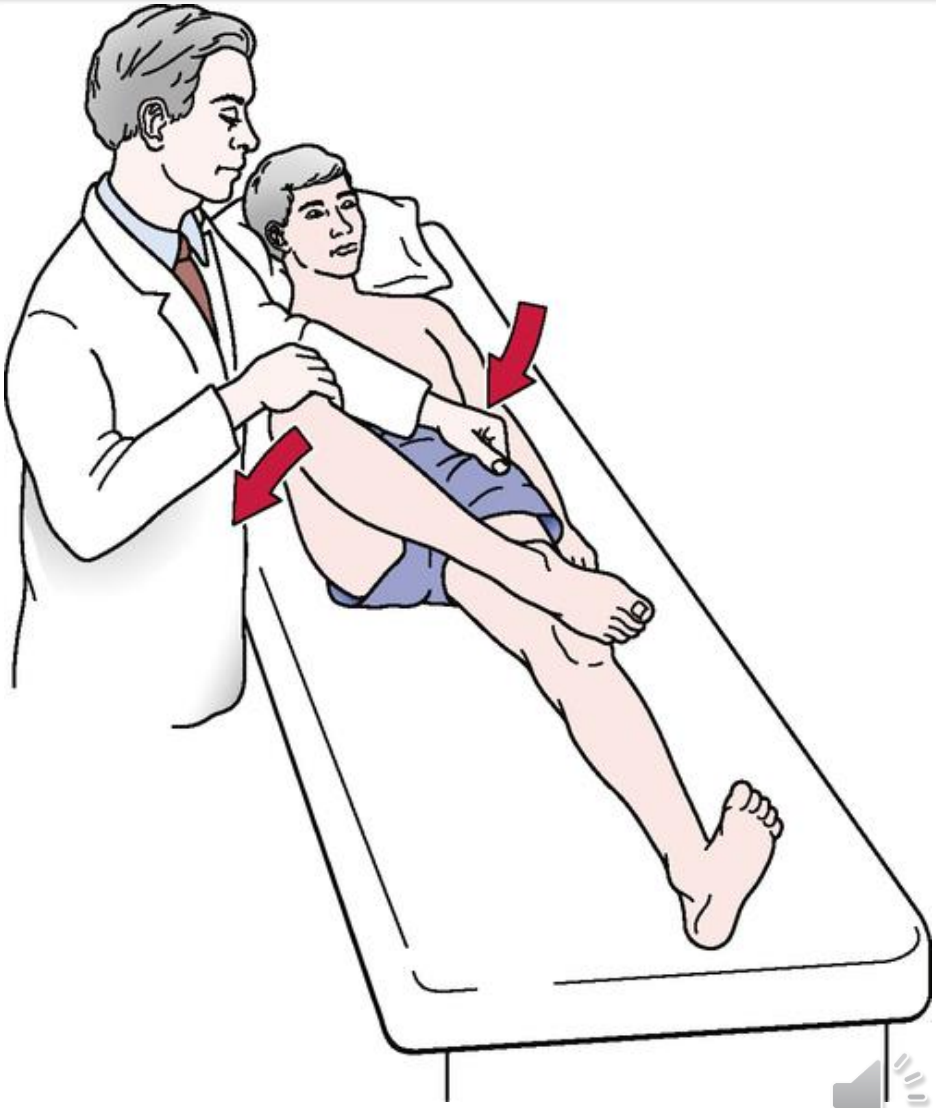
OTHER CAUSES of lumbosacral pain



Hip mobilisation



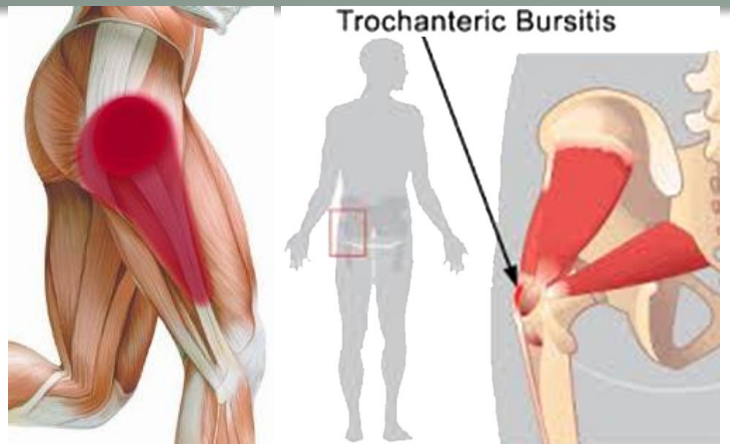
Internal rotation

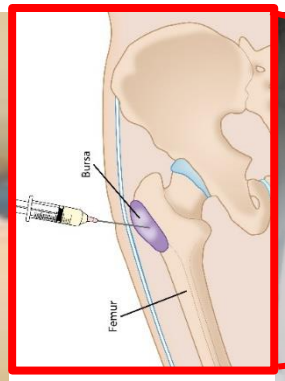


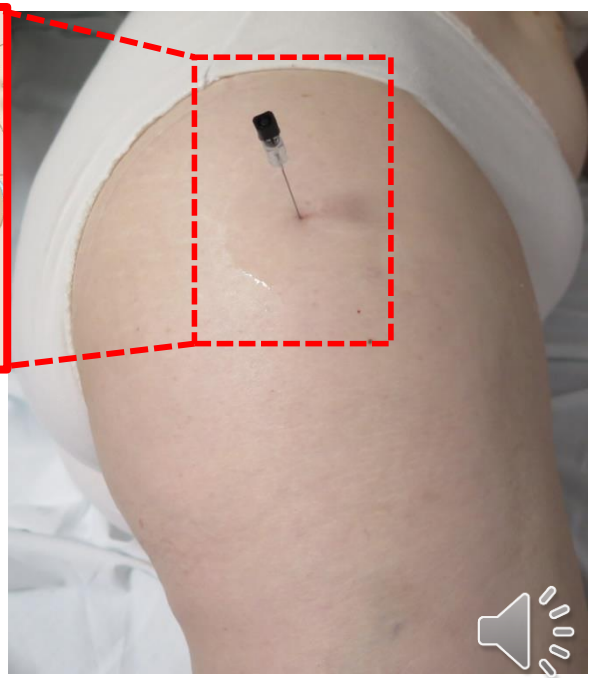
External rotation

Trochanteric bursitis

- Greater trochanter level pain
  - Increases with pressure in the painful area and with activity
- Very common in women
- Treatment: infiltration

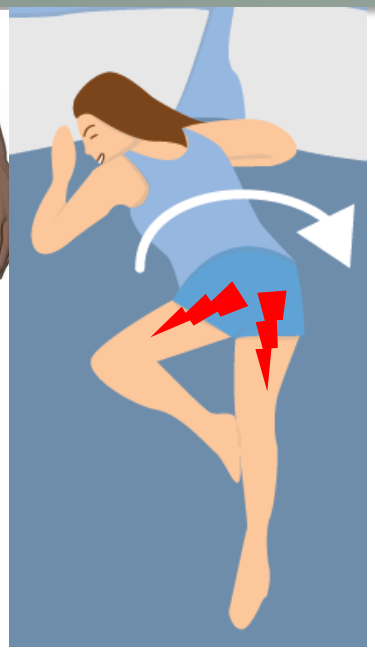






Pain in the sacroiliac joint

- It is confused with "low back pain", but:
  - Low back pain (buttock > legs)
  - Pain ↑ when rolling over in bed, sitting, jumping on one leg, climbing stairs, taking long steps, carrying weight
  - Clinical examination: pain in the sacroiliac joint (Fortin sign)
- Image: plain rx, MRI = ∅

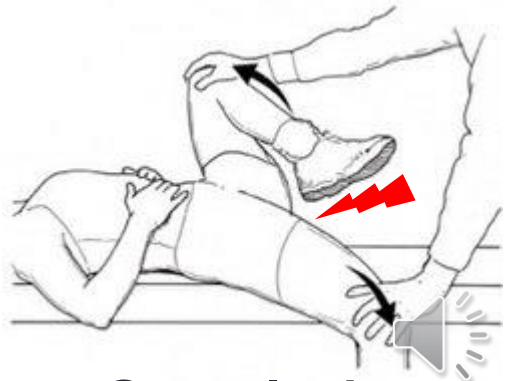


Pain when rolling over in bed

Pain on sitting

Pain when washing dishes

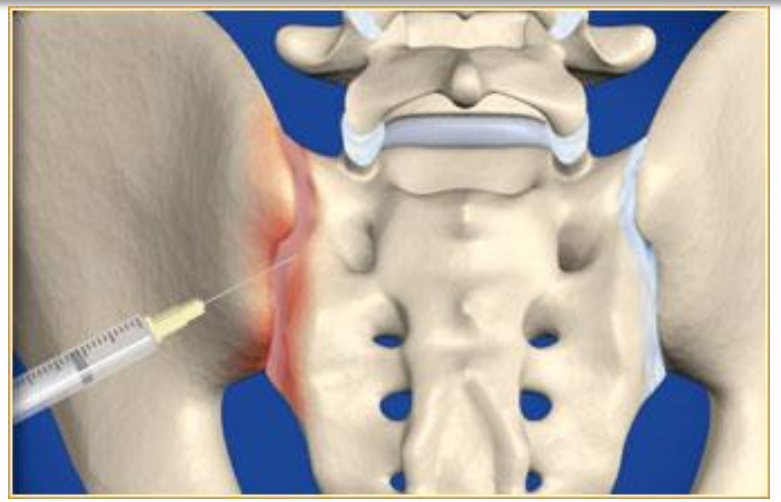
Fortin sign



Gaenslen's test

Sacroiliac joint pain treatment

- Conservative
  - Indometacin
  - “Hip girdle”
- Infiltration
- Surgery: arthrodesis

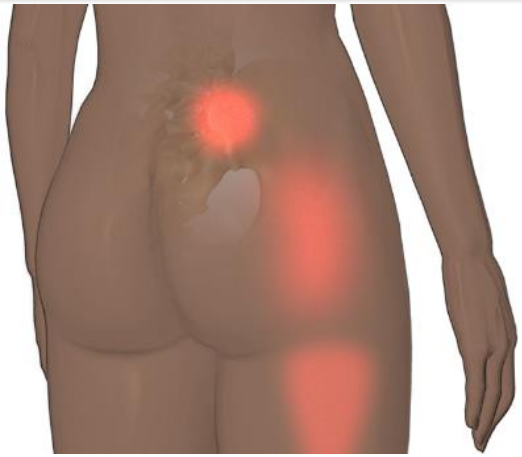


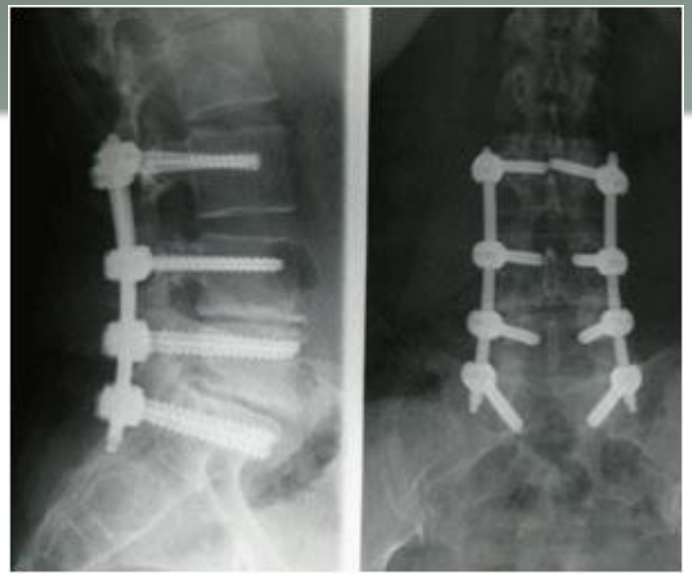
Infiltration

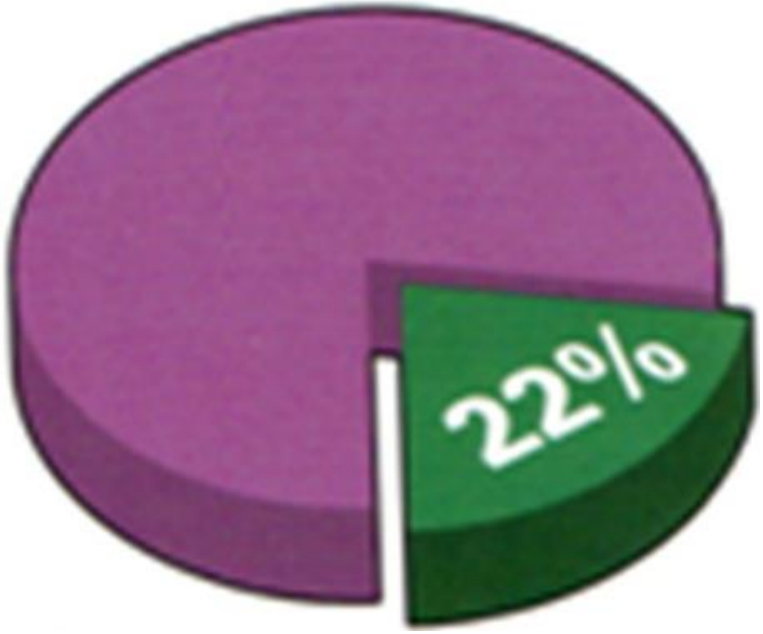
Orthosis

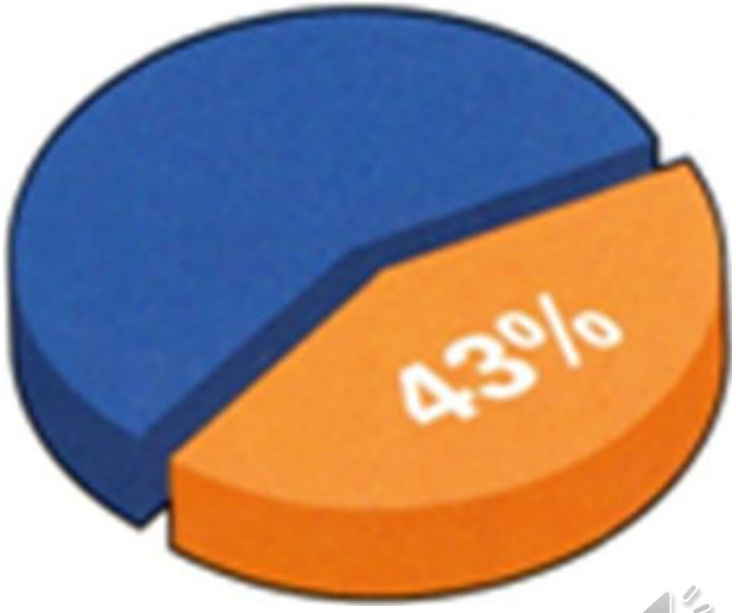
Arthrodesis

Pain in sacroiliac joint POST-lumbar arthrodesis







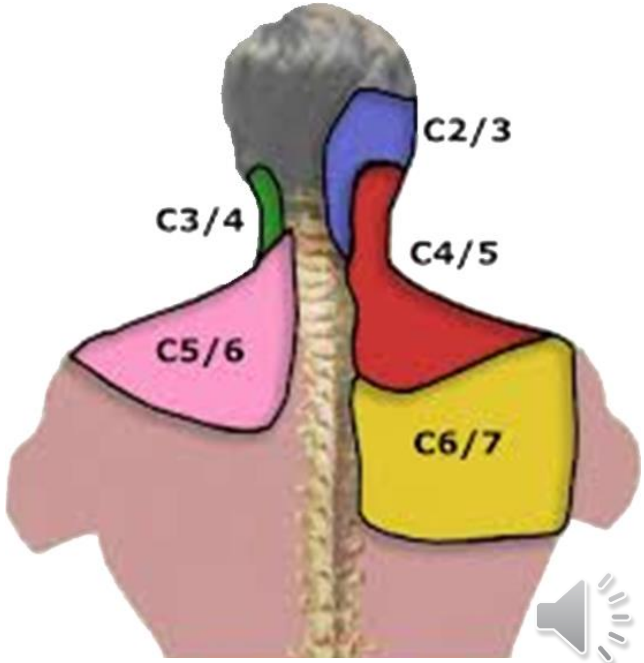


Chronic "low back" pain

Post-lumbar arthrodesis

In the neck all the above is applicable except:

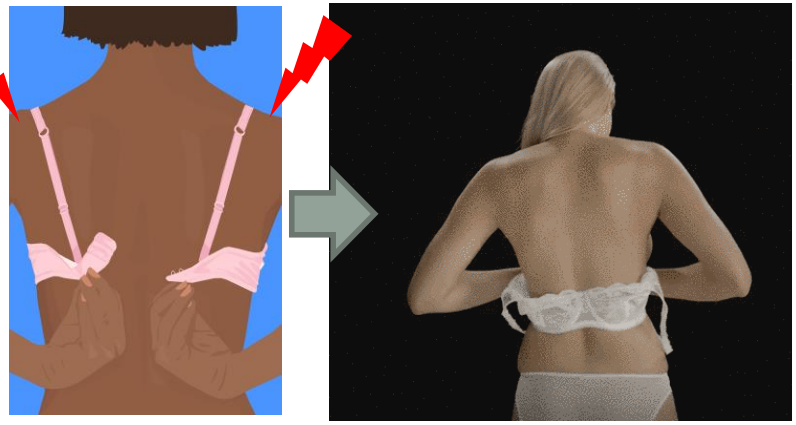
- Pain is cervical
- Differential diagnosis
  - Skull base pathology
  - SHOULDER PATHOLOGY (scapulohumeral periarthritis)
- *Whiplash*
- Radiculopathy in cervical nerve roots = pain radiating to arm
  - Differential diagnosis = brachial plexus injury secondary to cancer
- If spinal canal stenosis at the cervical level then myelopathy possible



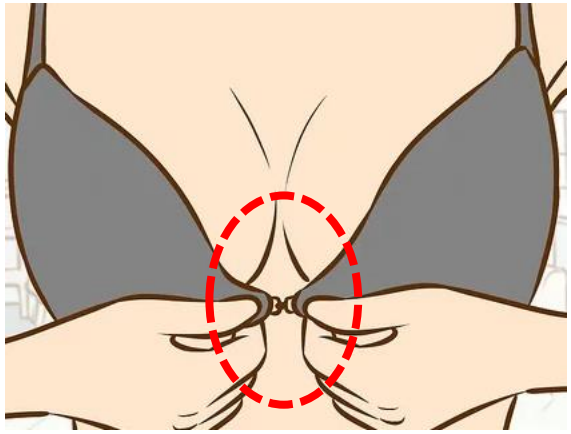
Neck pain vs scapulohumeral periarthritis

Pain when combing hair

Short hair

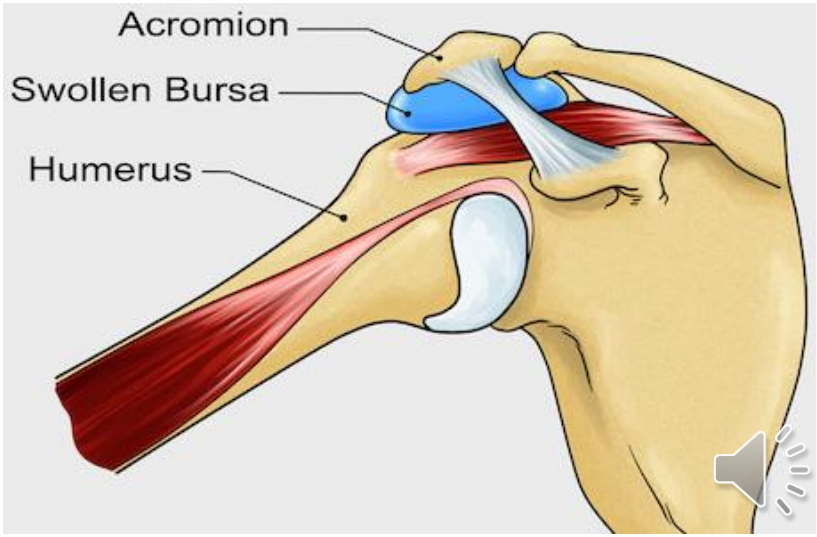


Pain when fastening bra

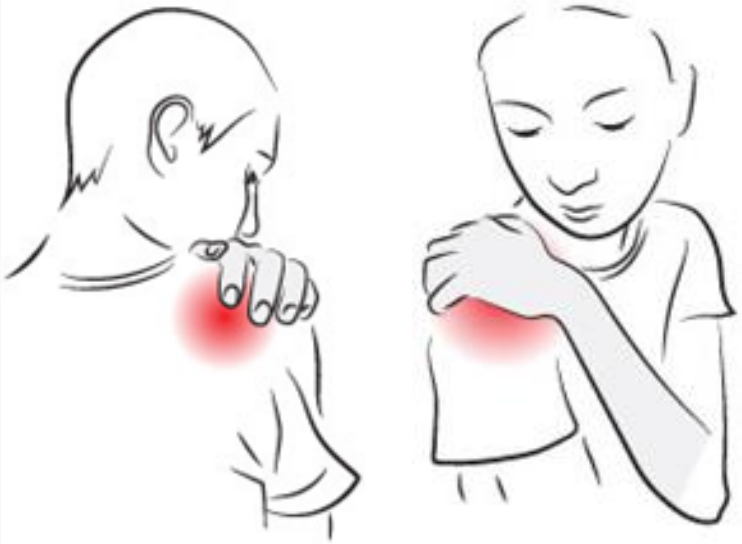


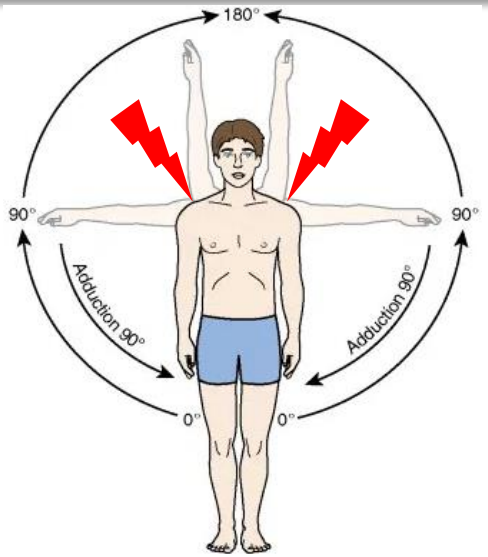
Bra that fastens in front

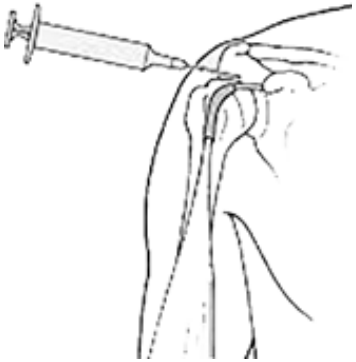
Pain when putting on sleeve



Scapulohumeral periarthritis examination







Treatment

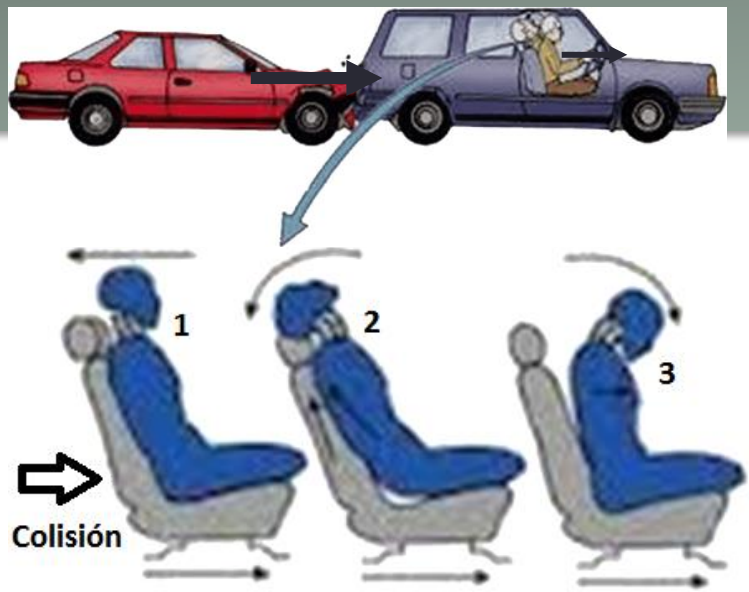
Hawkins-Kennedy's test

Cross arm test

Anterior apprehension sign

Whiplash

- "Traumatic soft tissue injury at the cervical spinal level" → cervical instability
  - Muscle-ligament injury
  - No fracture, dislocation, or hernia
- Mechanism: abrupt flexion/extension movement
- Symptoms
  - Delayed hours/days
  - Cervical pain
  - Muscle contracture
  - Vegetative symptoms
- Diagnosis = clinical symptoms + imaging (MRI)
  - Rule out other lesions

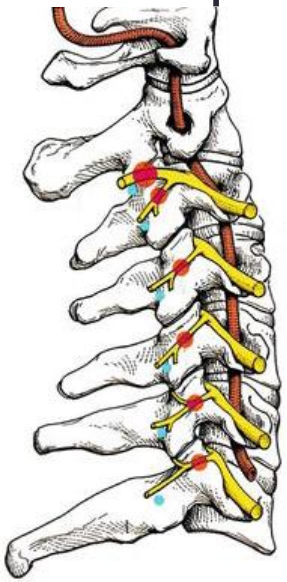


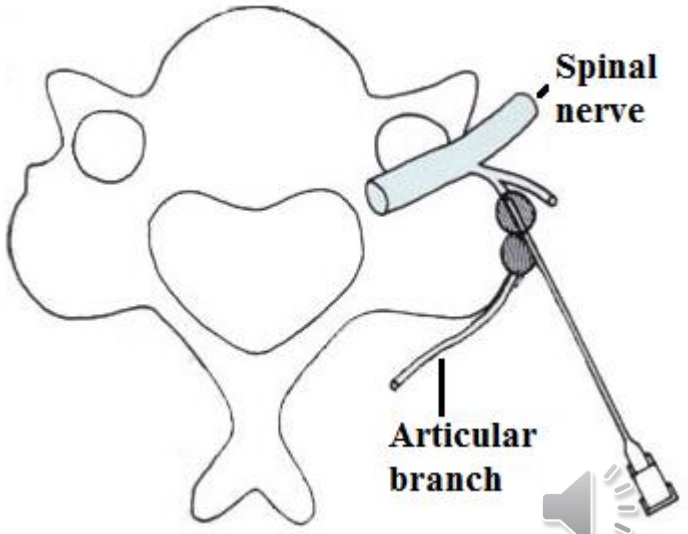
Disc injury

Ligament injury

Whiplash: treatment

- Conservative treatment: cervical collar, physiotherapy, NSAIDs
- Prognosis: 55% improve in three months, 80% in two years
- Conservative treatment failure = radiofrequency facet joint denervation

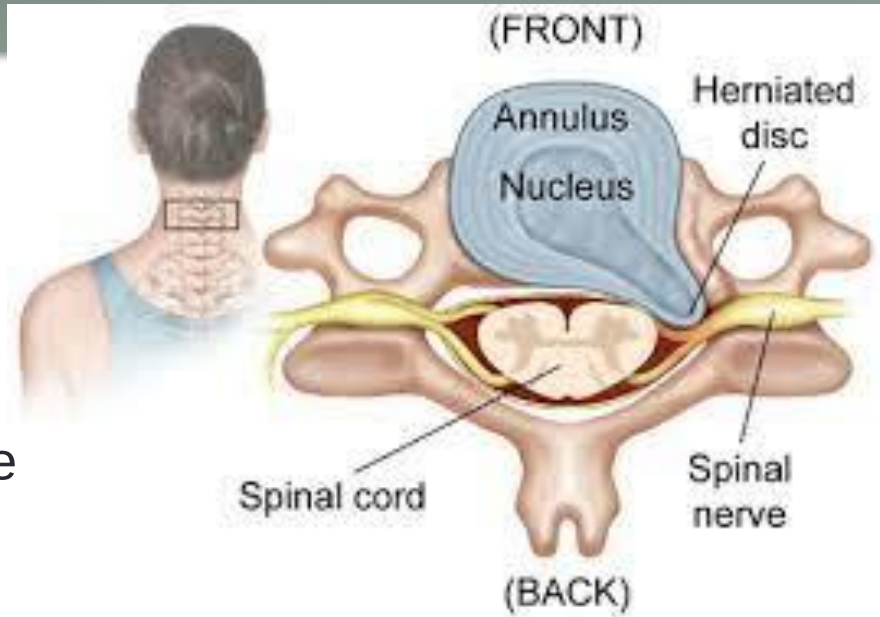




Cervical facet denervation by radiofrequency

Cervical disc herniation

- Clinical aspects
  - Nerve roots come out through SUPERIOR nerve root foramen
  - Nerve root foramen is very close to the lower disc
  - Disc herniation presses on the nerve root at the same level as the disc
    - Hernia C_6-C_7 → Radiculopathy C_7
- **Clinical symptoms = radiculopathy**
  - Improvement on placing the hand of the painful arm on head
  - Worsens when picking up weights with the hand
  - Often no trauma identifiable
  - ± Cervical myelopathy



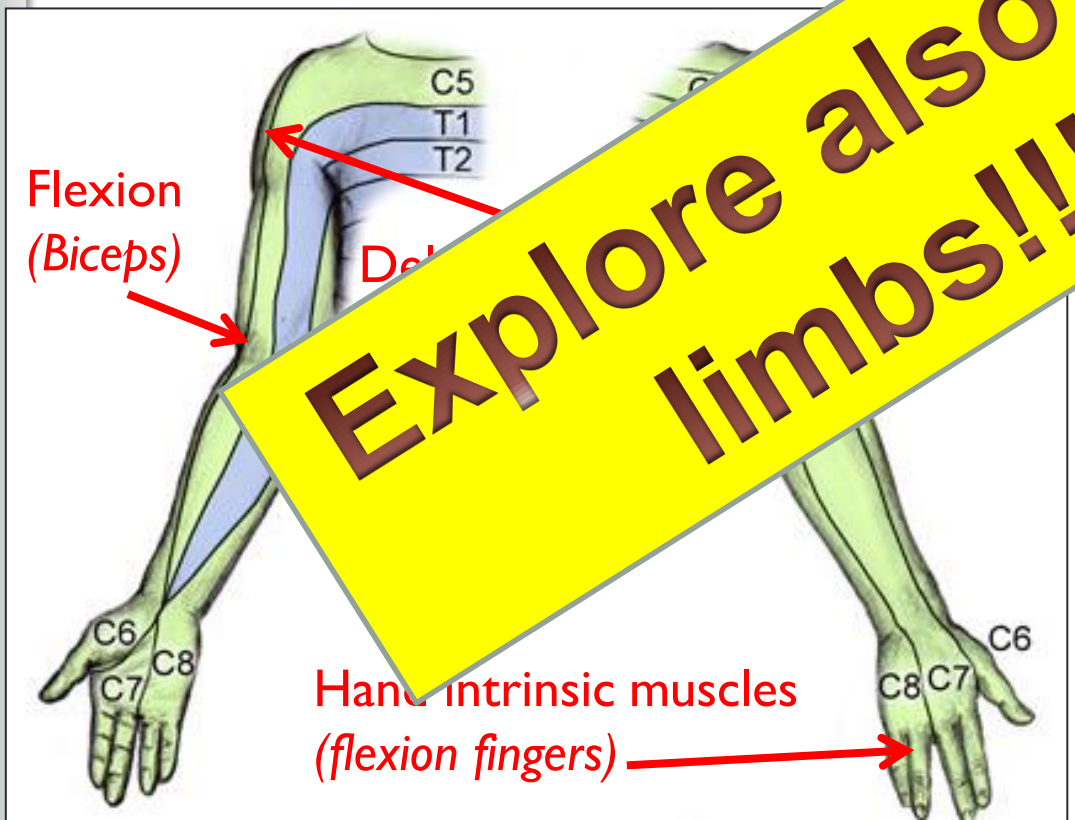
Hand on the head sign

Cervical disc herniation: clinical examination

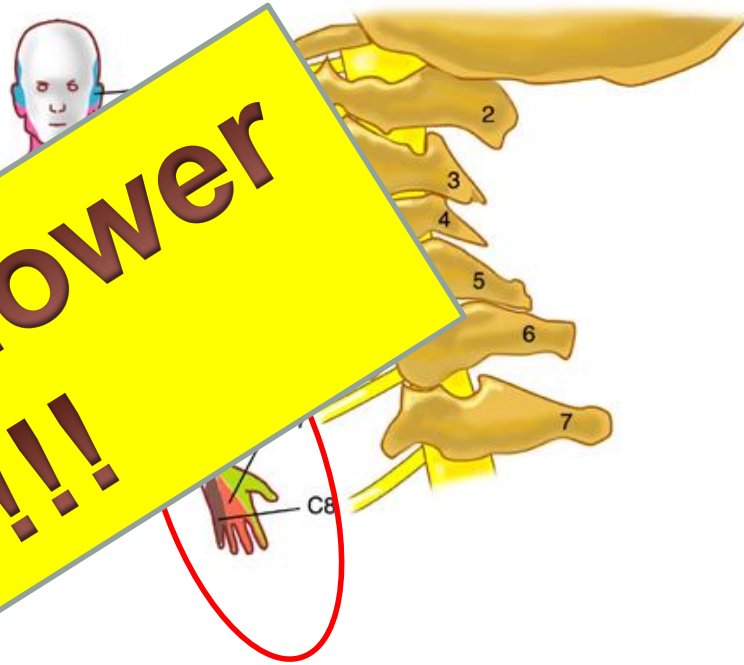
	CERVICAL DISC SYNDROMES			
	C_4-C_5	C_5-C_6	C_6-C_7	C_7-T_1
% incidence	2%	19%	69%	10%
Compressed nerve root	C_5	C_6	C_7	C_8
Decreased reflex	Deltoid & pectoral	Biceps & styloradialis	Triceps	Finger flexion
Motor weakness	Deltoid	Elbow flexion	Elbow extension & wrist dorsiflexion	Intrinsic hand musculature
Paresthesia & hypoesthesia	External shoulder aspect	Arm, thumb, forearm radial side	Fingers 2 & 3	Fingers 4 & 5
Other				*Horner syndrome*

Cervical disc herniation: clinical examination

- Sensory examination
- Motor examination
- Reflex examination



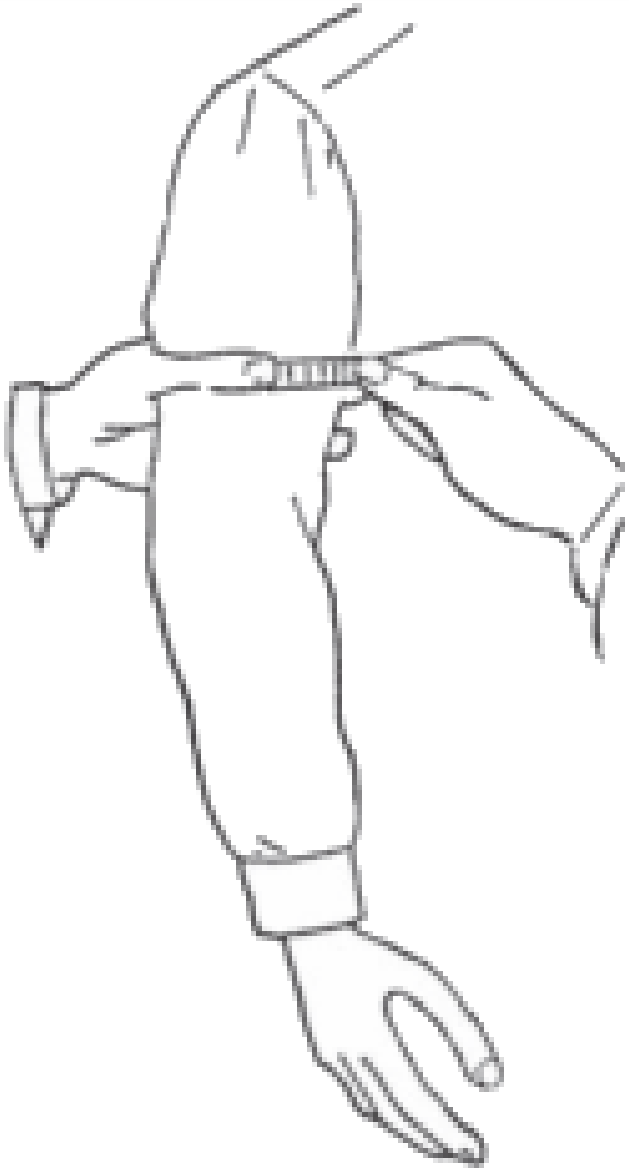
Explore also lower limbs!!!!!

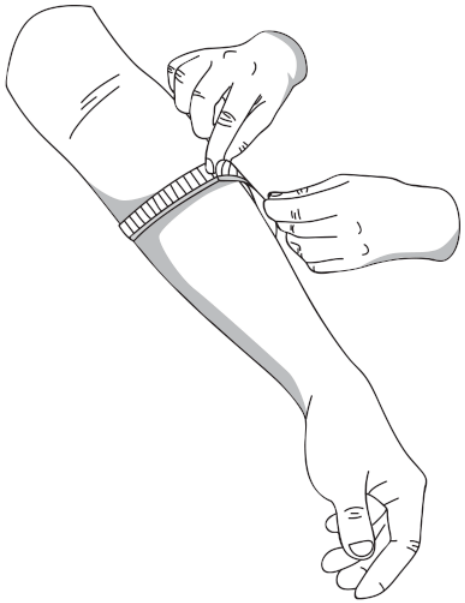


Sensory examination

Motor examination (reflexes)

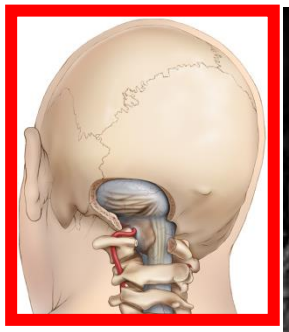
Perimeter measurement arm and forearm

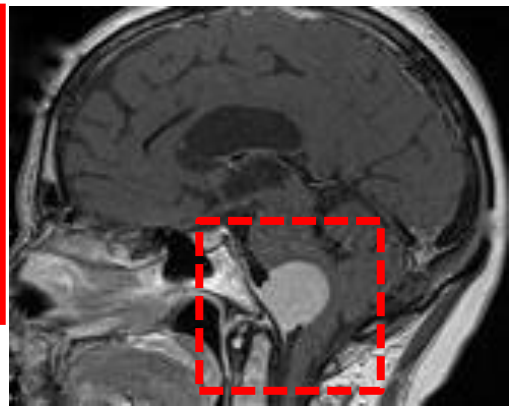




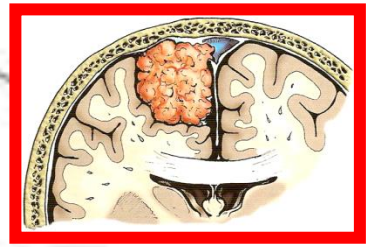
Palmomental reflex

- Purpose: to rule out lesions above the cervical spine



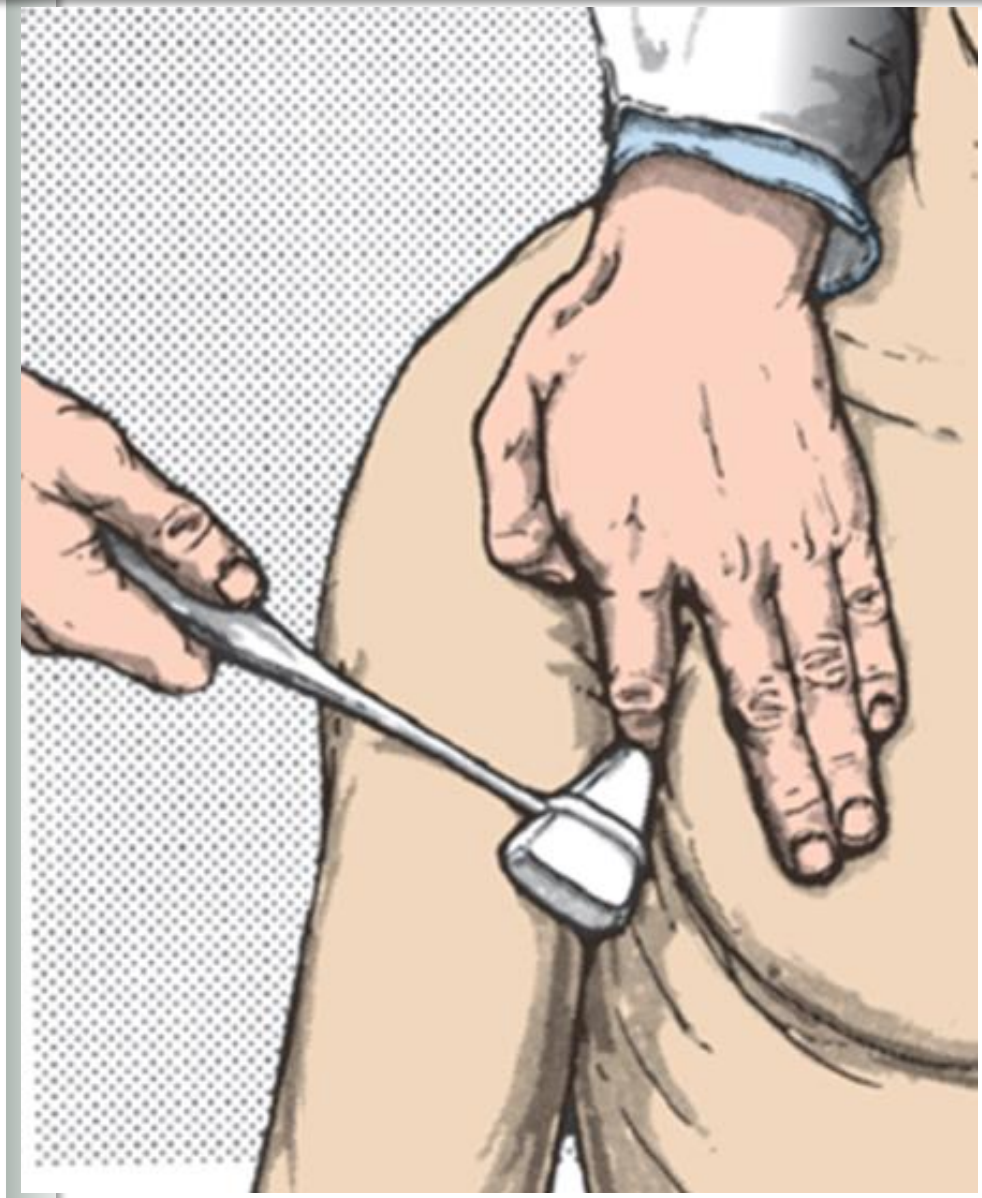


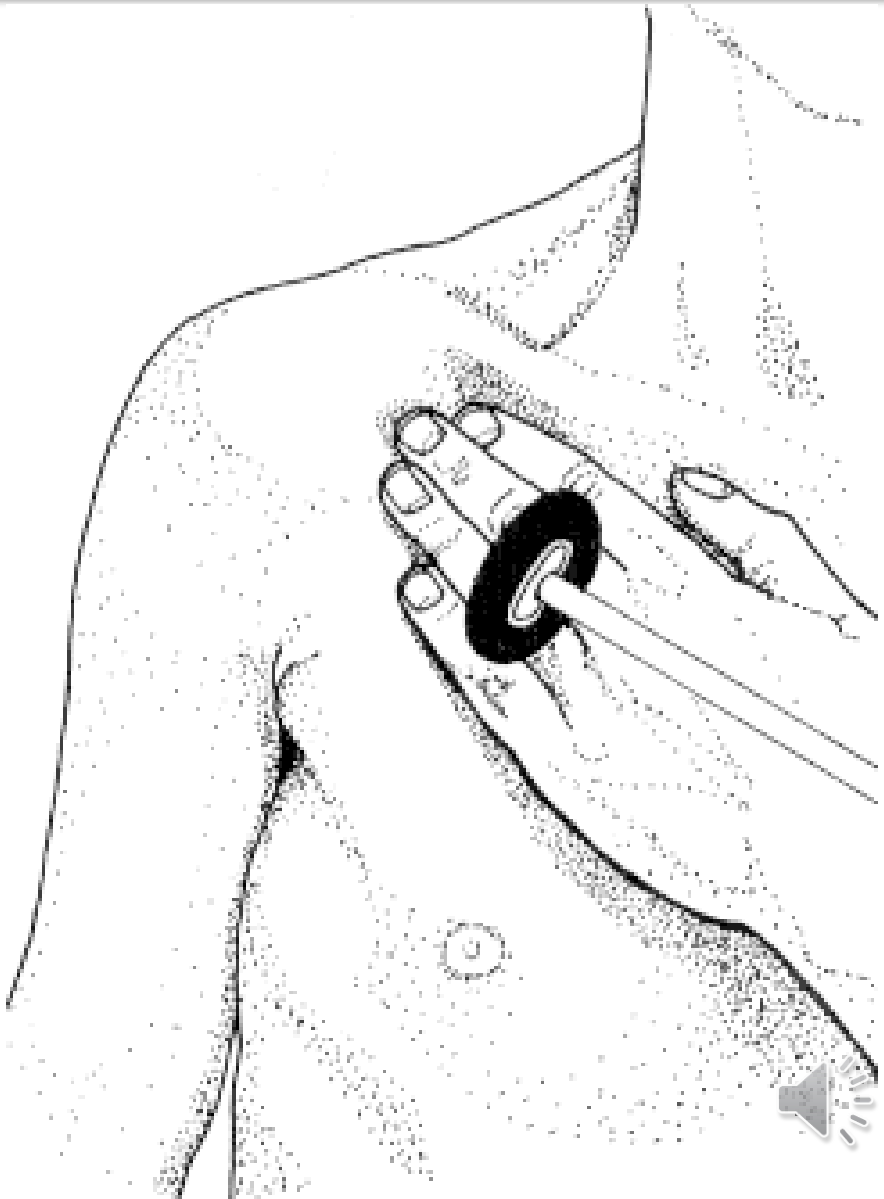
Foramen magnum meningioma



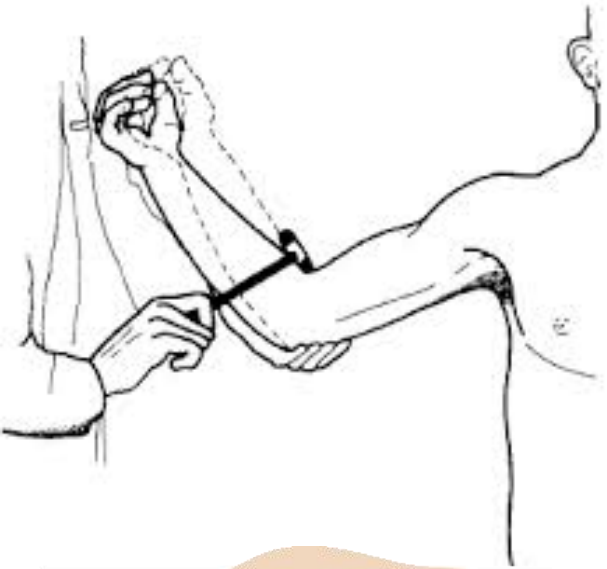
Parasagittal meningioma

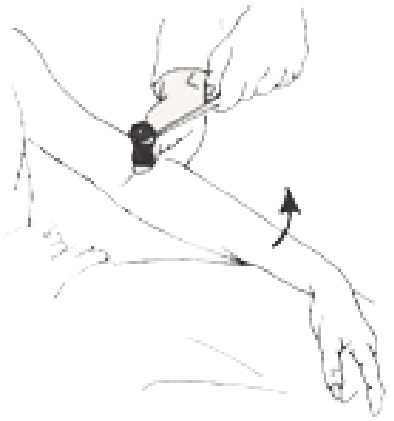
Pectoralis reflex

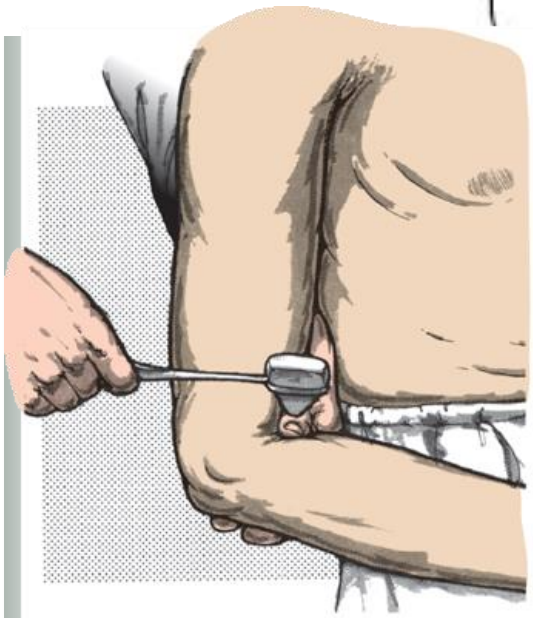


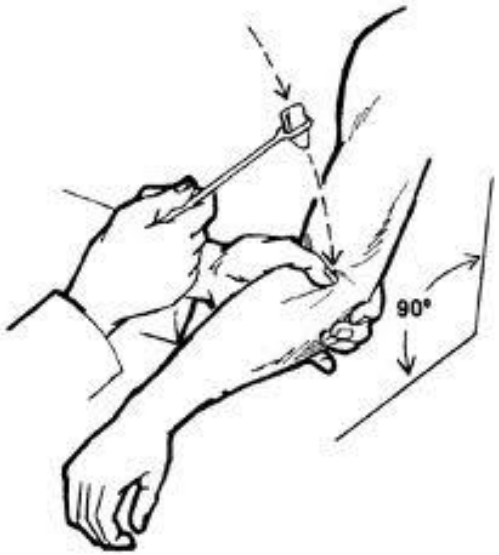


Biceps reflex: C_5 nerve root

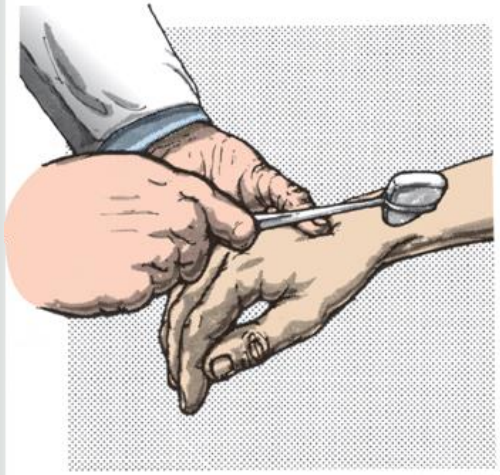


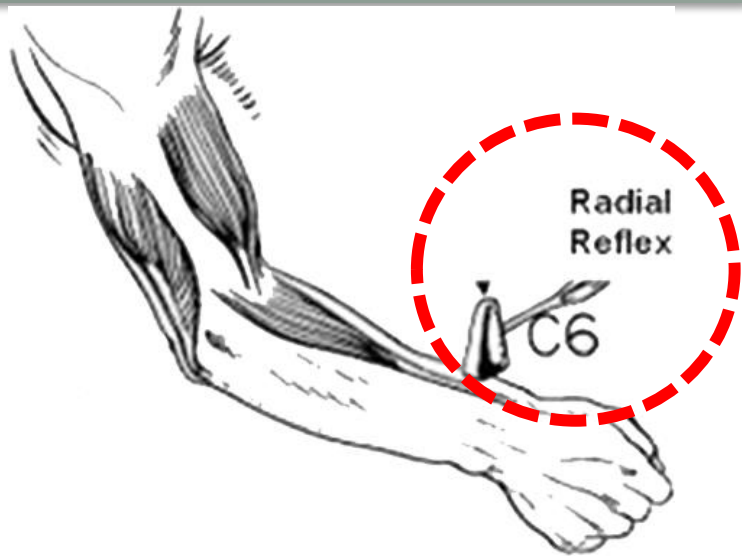


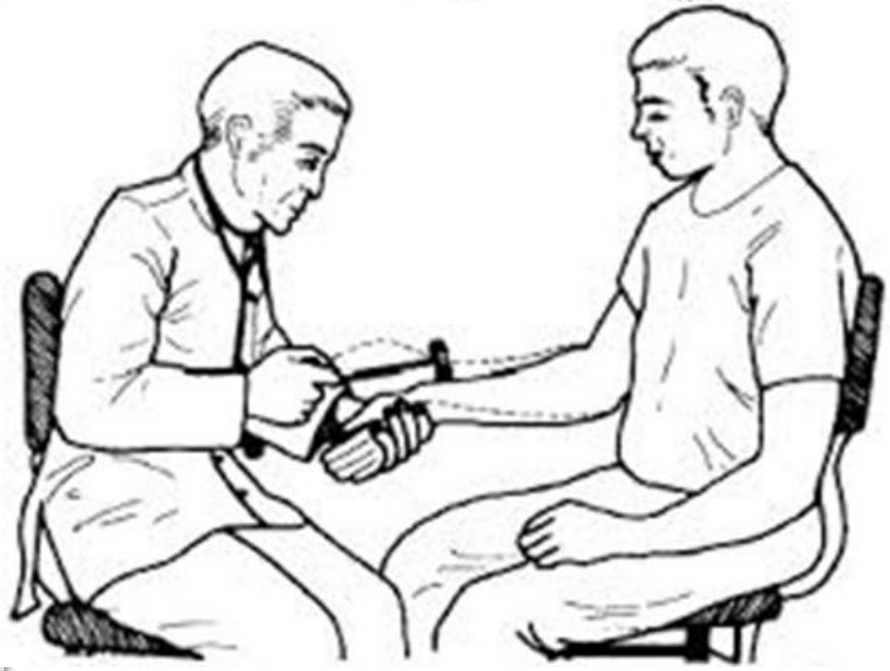


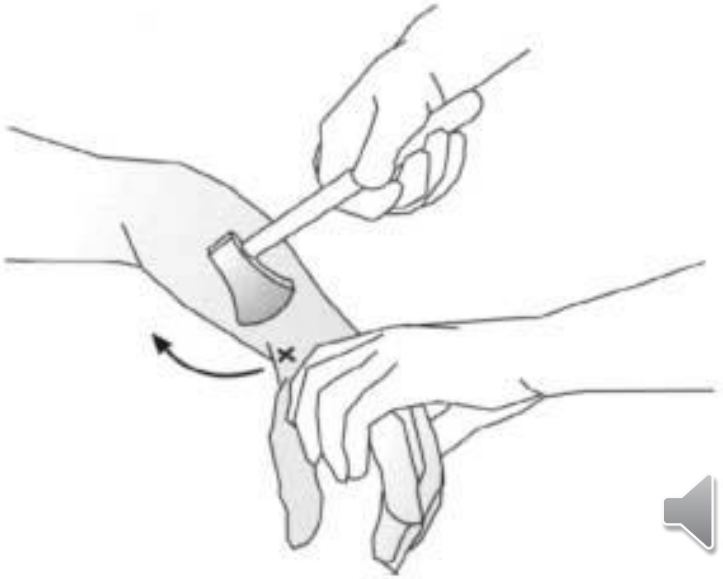


Styloradial reflex: C_6 nerve root

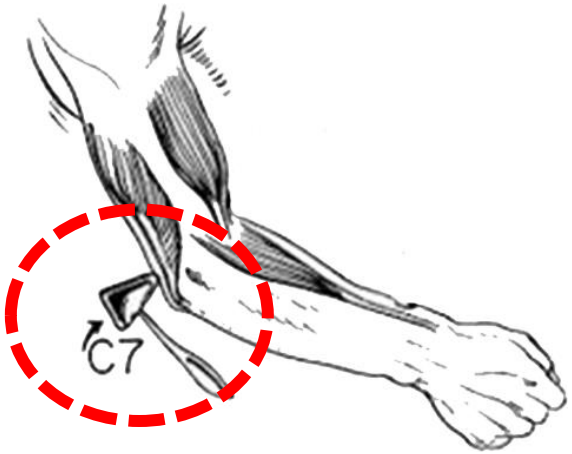


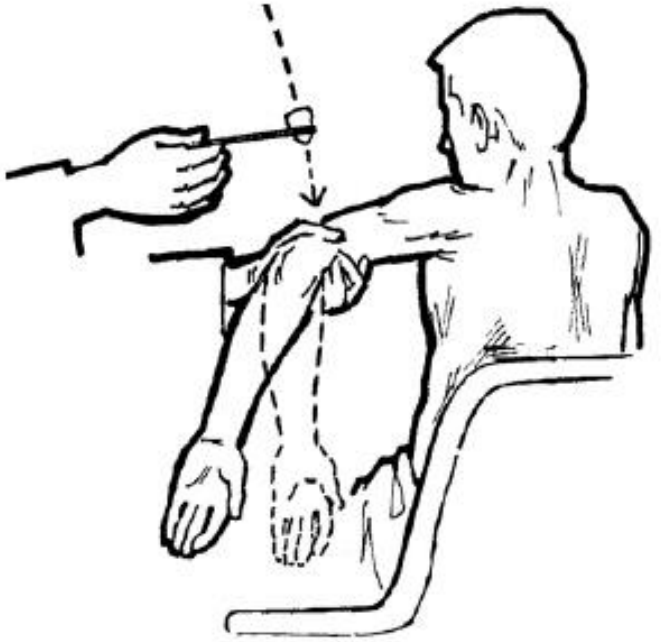


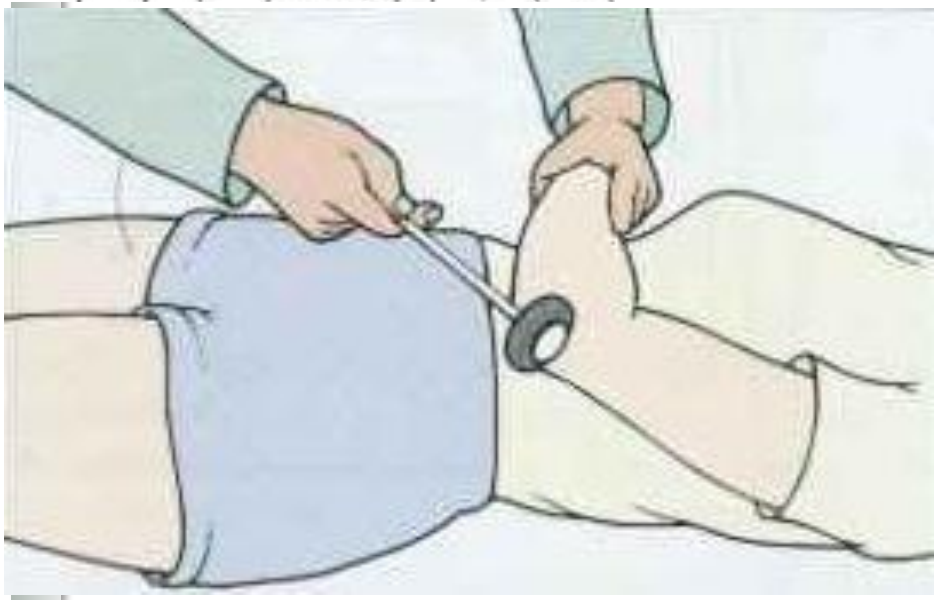




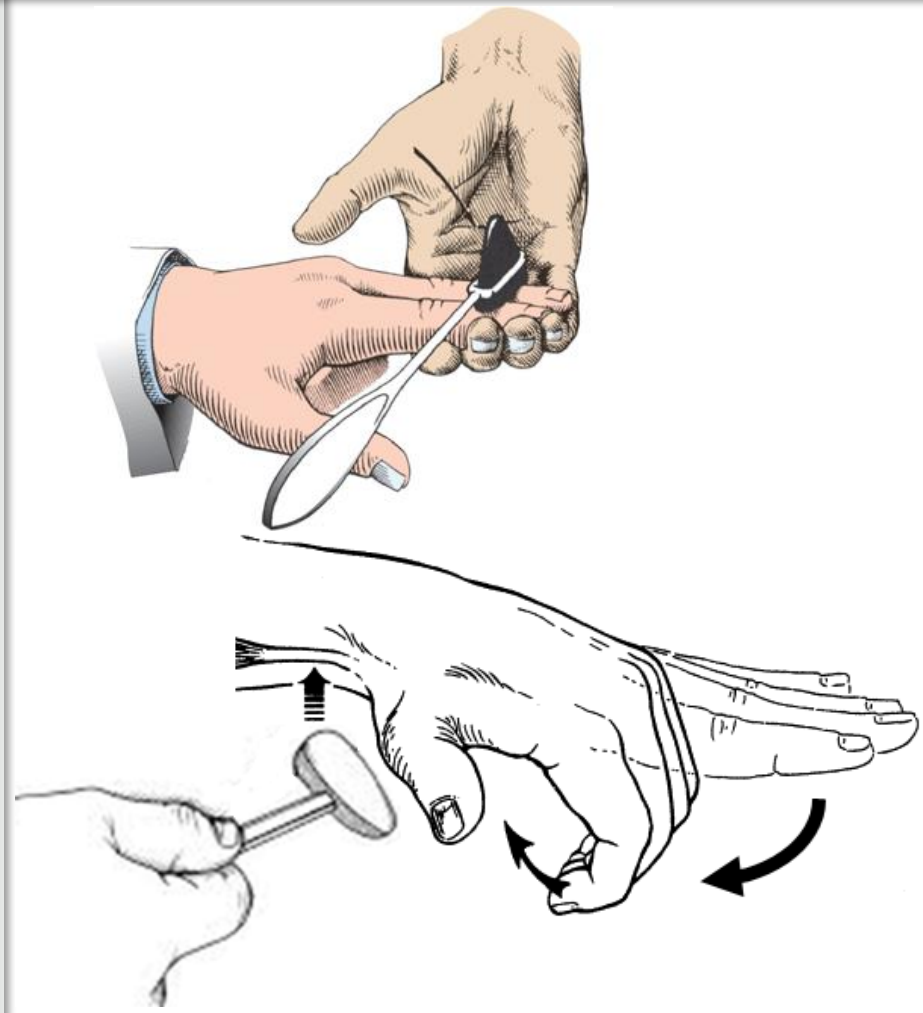
Triceps reflex: C_7



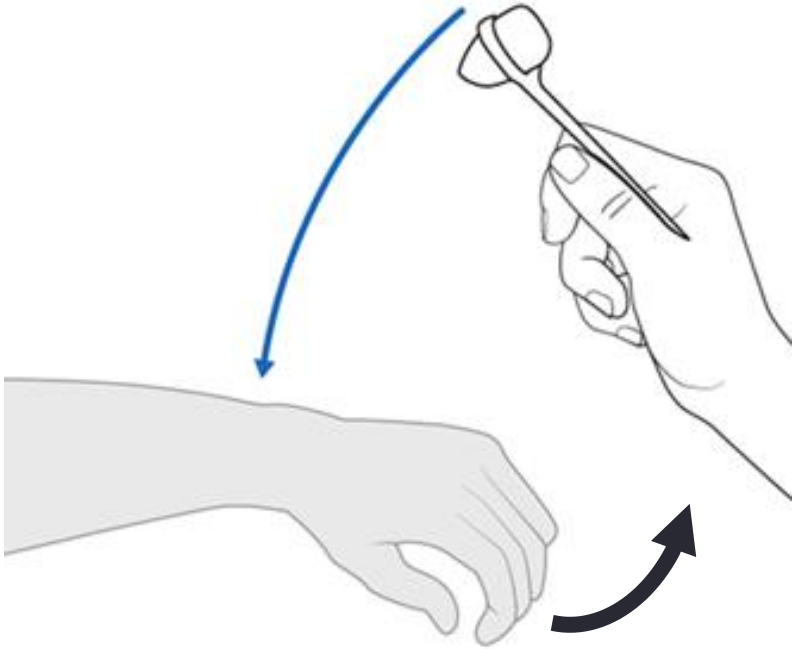




Finger flexor (C_8) & extensor (C_7) reflexes

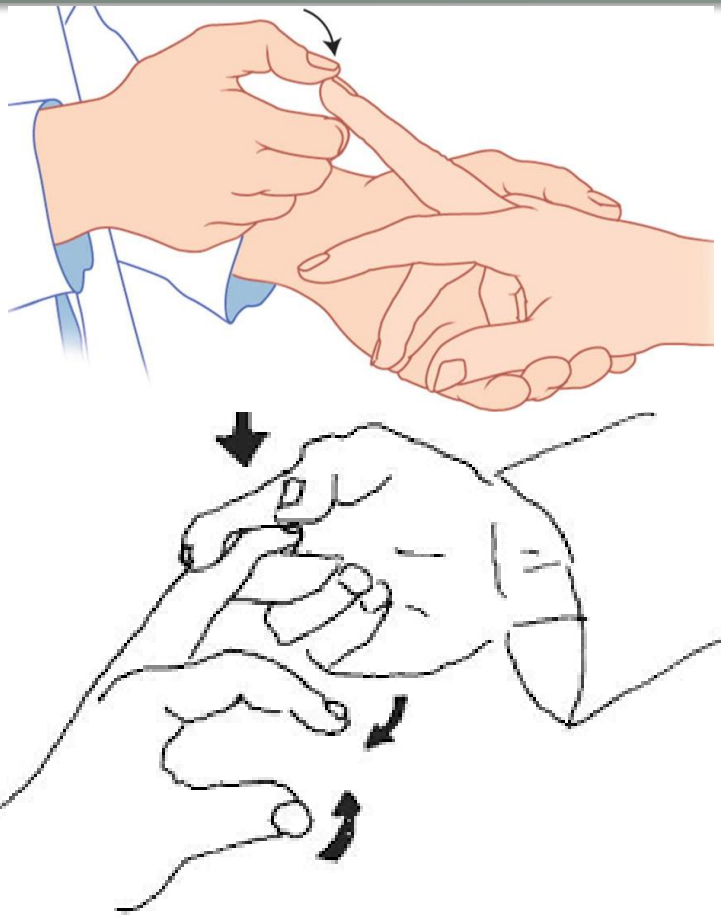


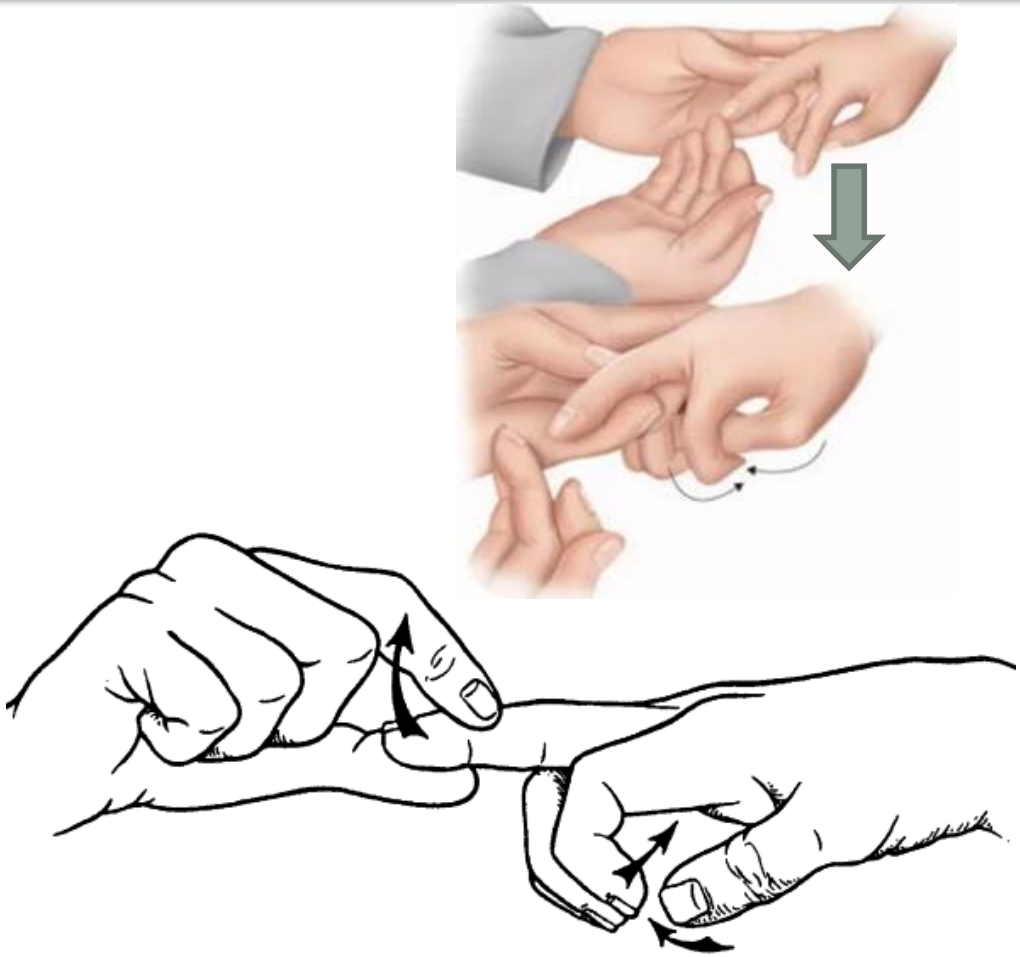
Flexor reflex C_8



Extensor reflex C_7

Cervical myelopathy signs





Hoffmann reflex

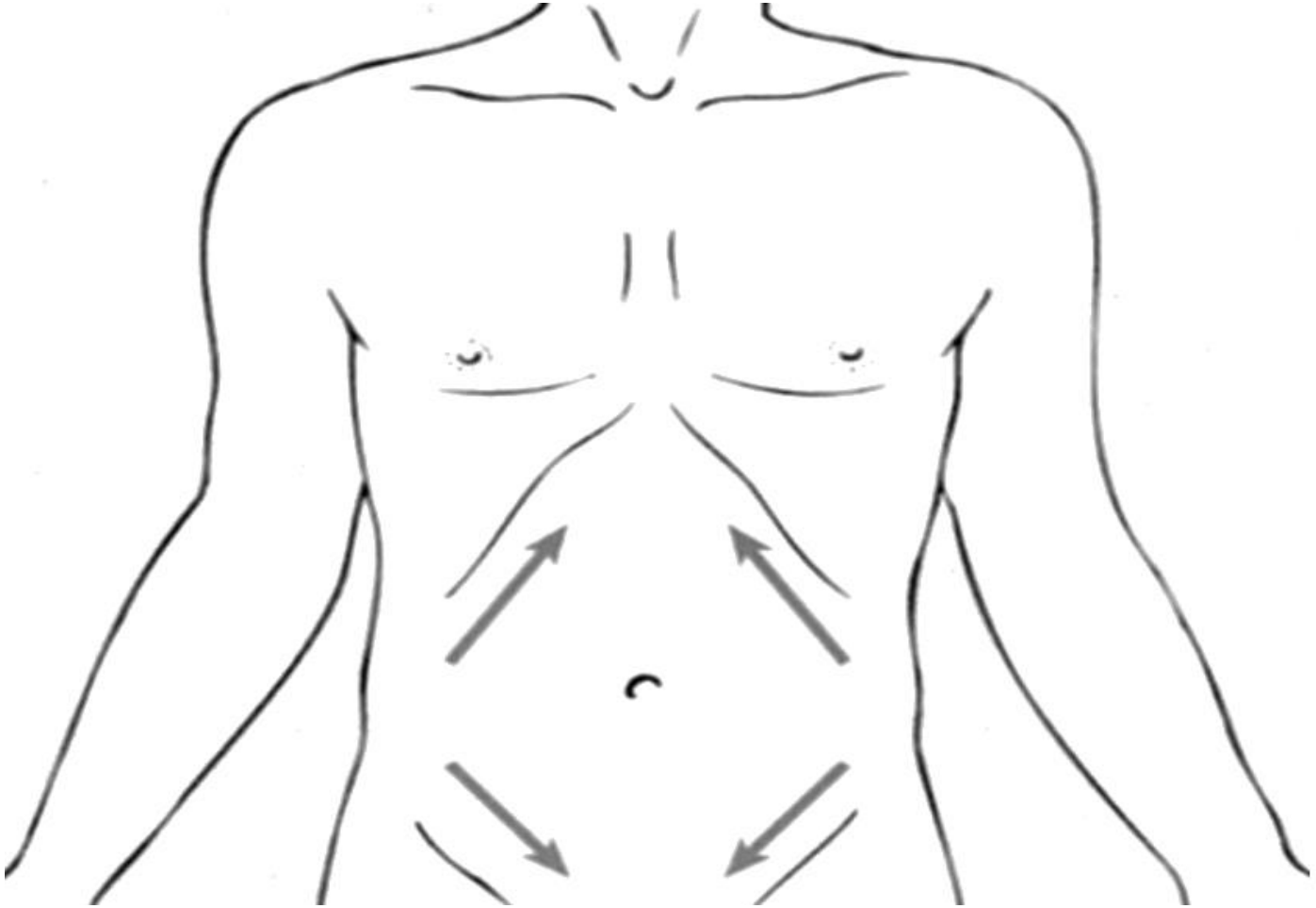
https://www.youtube.com/watch?v=dNfp9PyilrQ

Trömner reflex

https://www.youtube.com/watch?v=59Tw9hbbAZE

Abdominal cutaneous reflexes

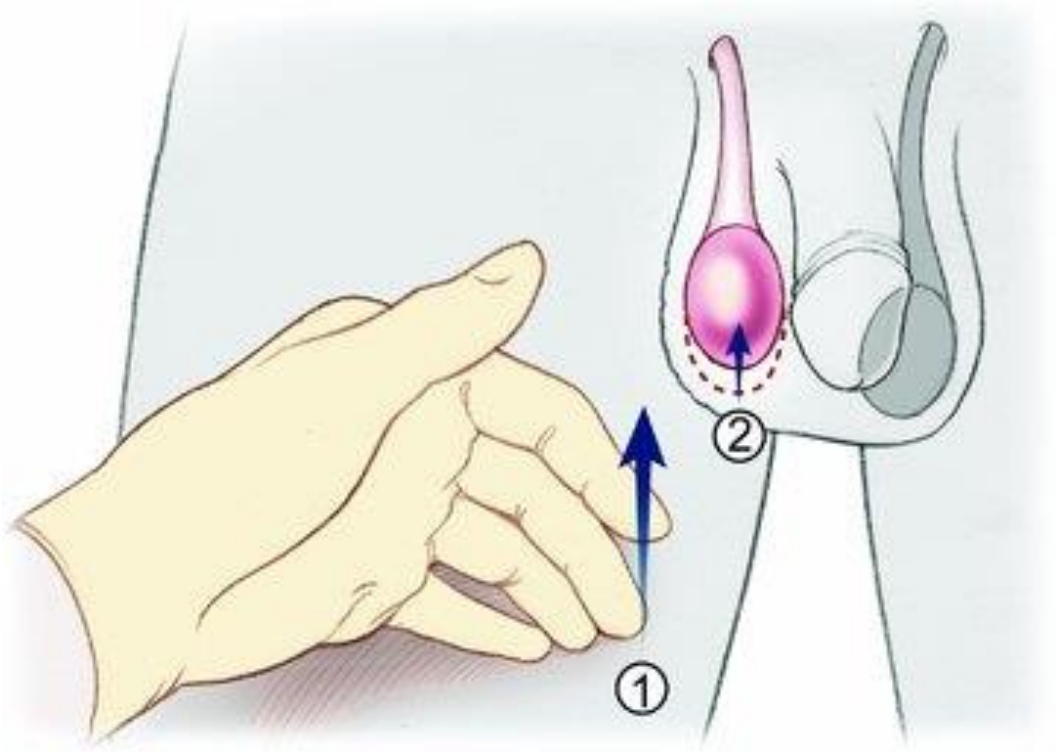
- The first to disappear in cervical myelopathy



https://www.youtube.com/watch?v=v4FyZydgHs0

Cremasteric reflex

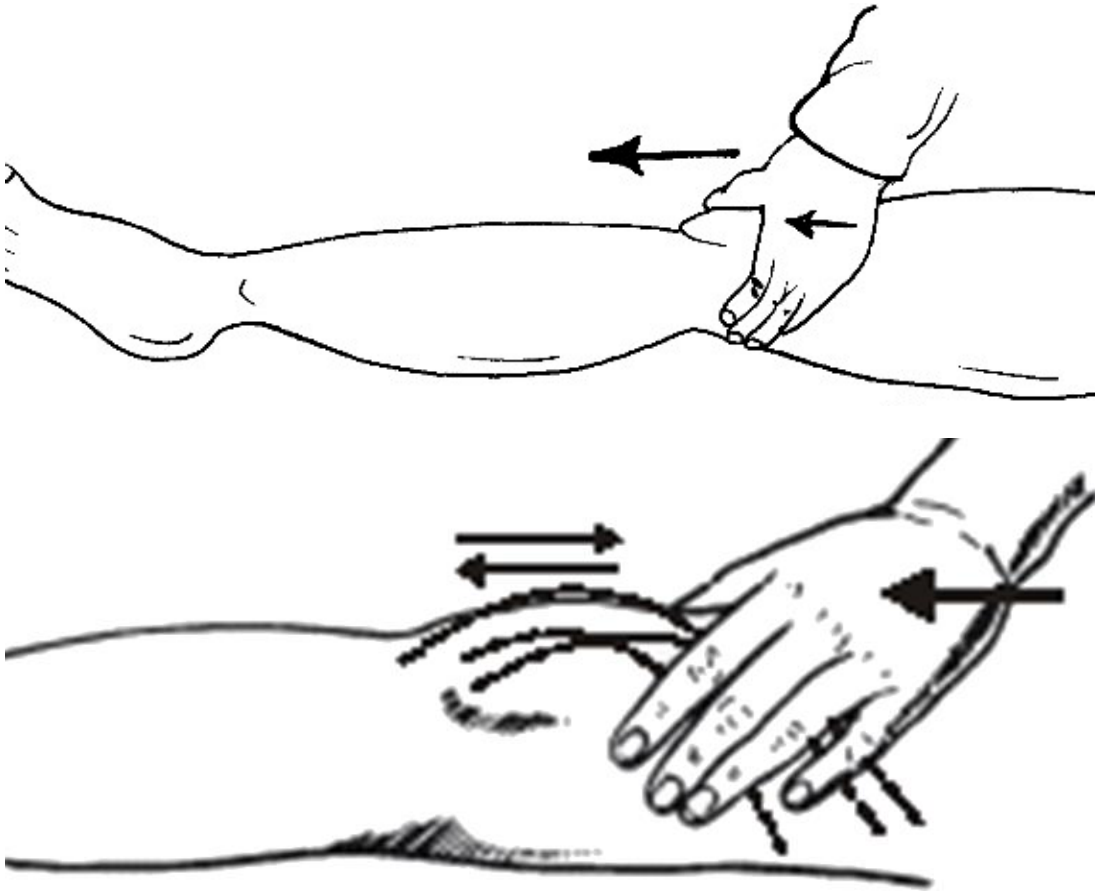
- Gently rubbing the skin on the inner thigh induces scrotum contraction on the same side and the testicle ascends
- Next to disappear after the abdominal cutaneous



https://www.youtube.com/watch?v=eVvInQNyXIU

Knee clonus

- Indicates an advanced clinical status

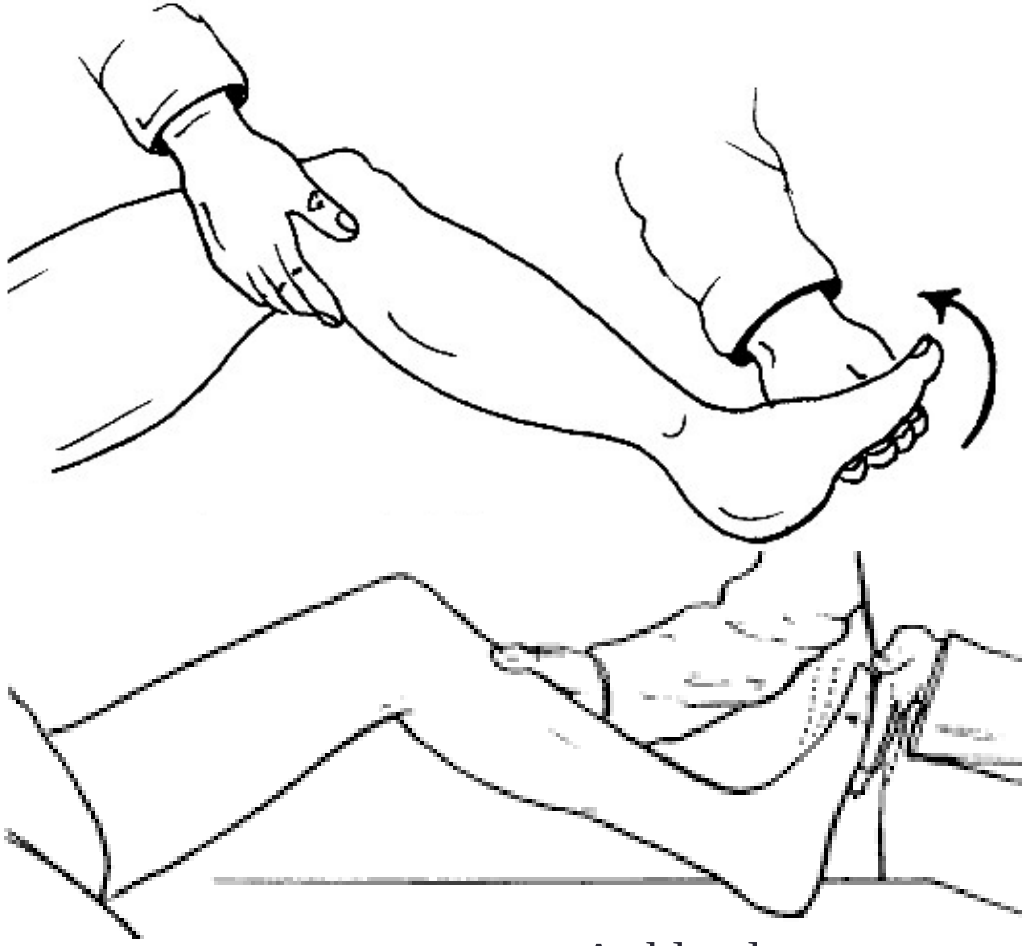


Knee clonus

https://www.youtube.com/watch?v=Ik4o_3bxb1w

Ankle clonus

- Indicates an advanced clinical status



Ankle clonus

https://www.youtube.com/watch?v=2_4POkGeZvQ

Extensor plantar reflex

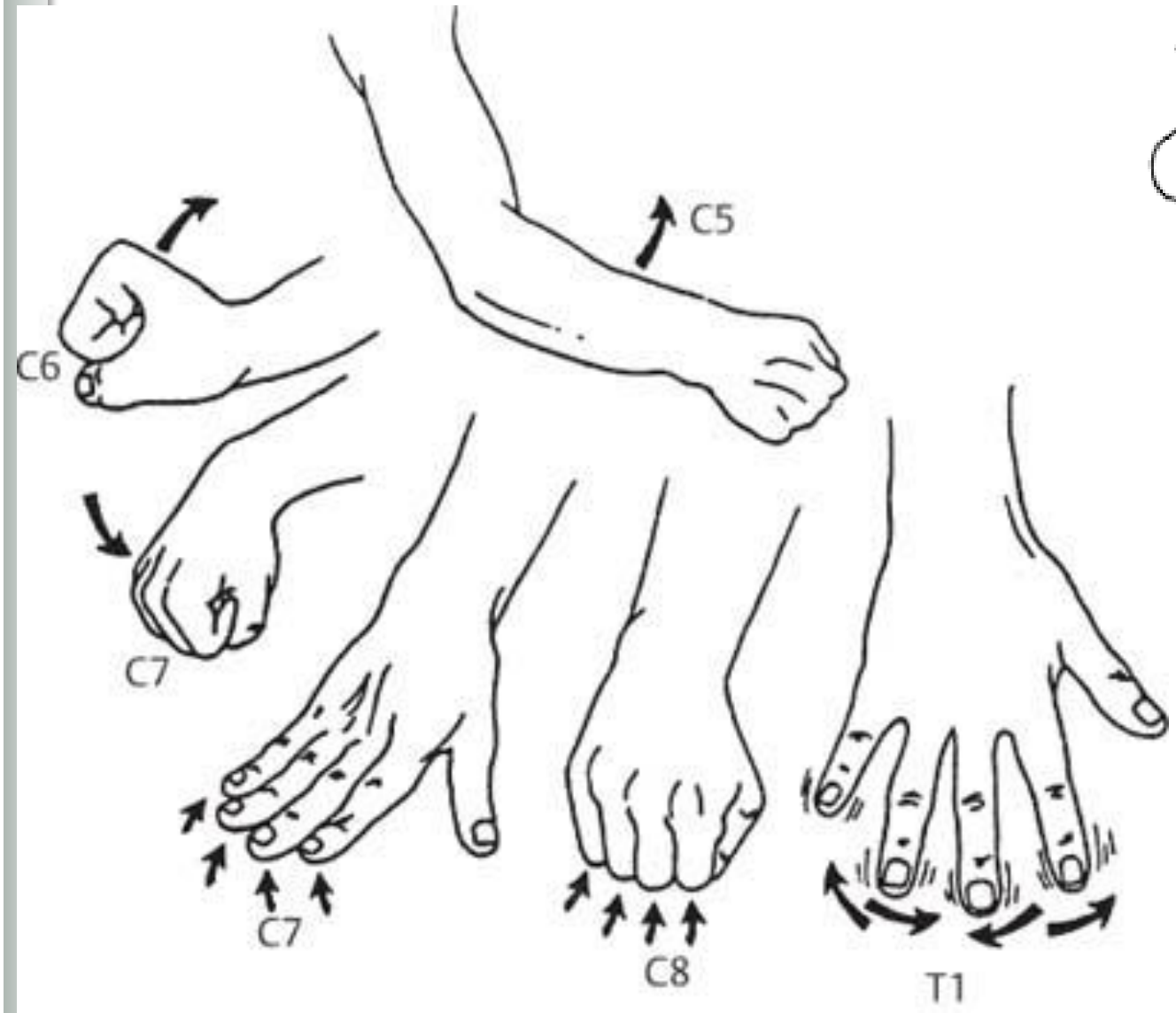
- Indicates an advanced clinical status

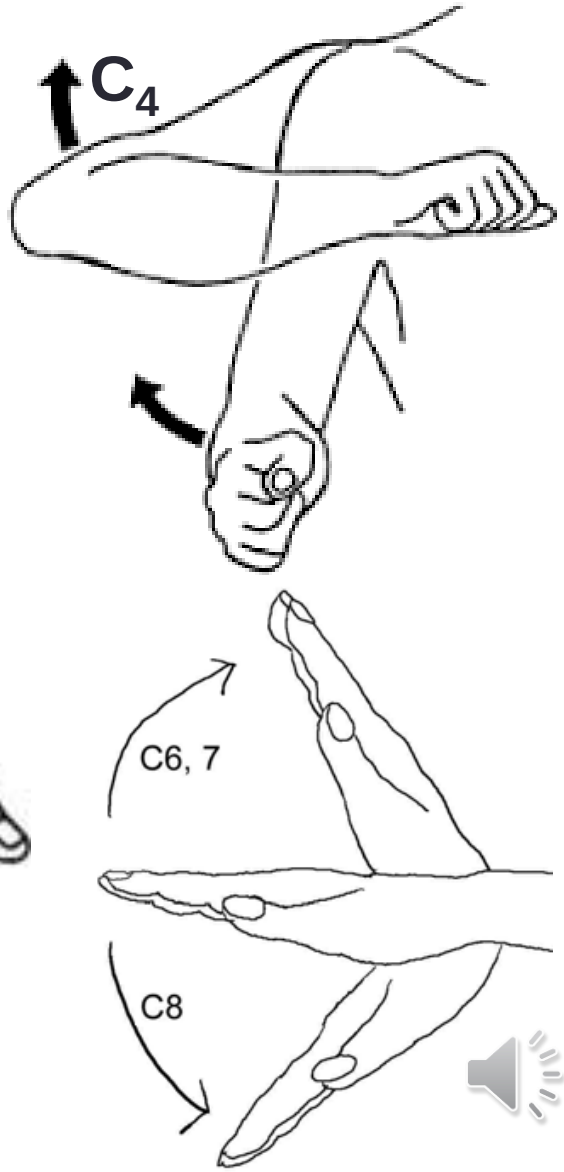
Normal plantar reflex

Extensor plantar reflex or Babinsky sign

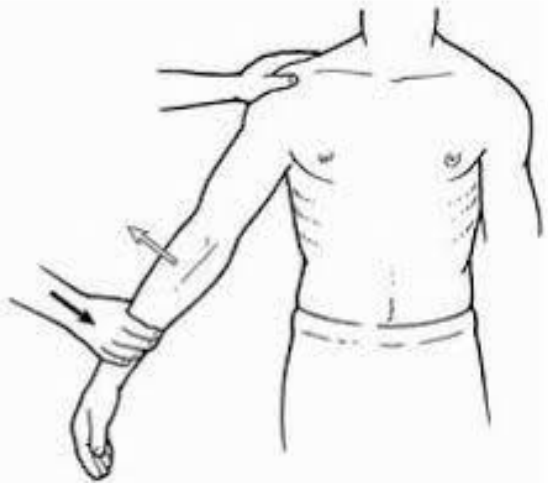
https://www.youtube.com/watch?v=iV_a2WSbdM8

Upper limb power muscle examination

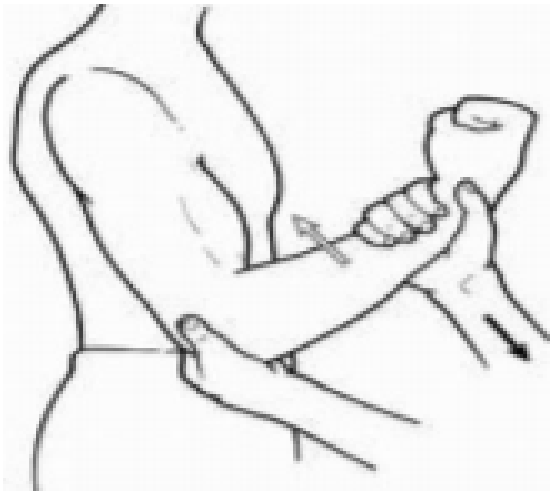




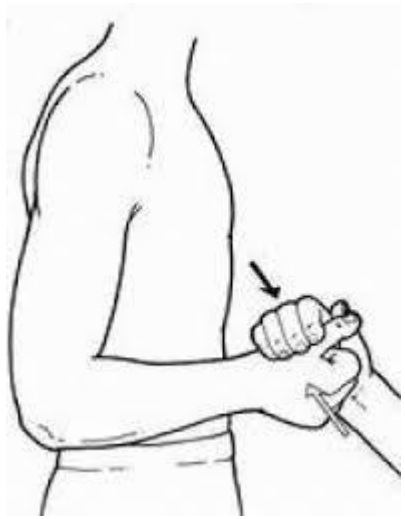
Upper limb motor examination



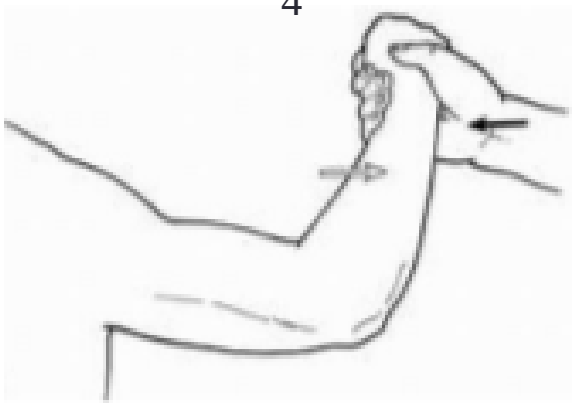
C_4



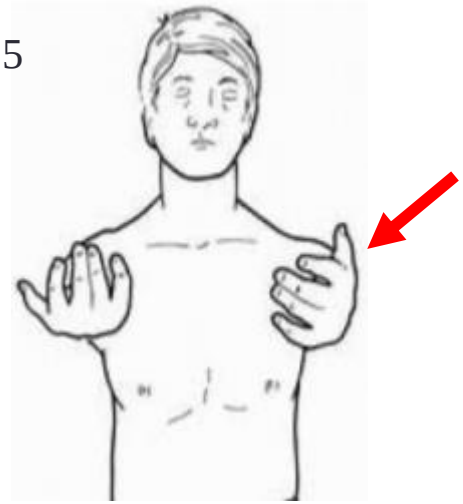
C_5



C_6

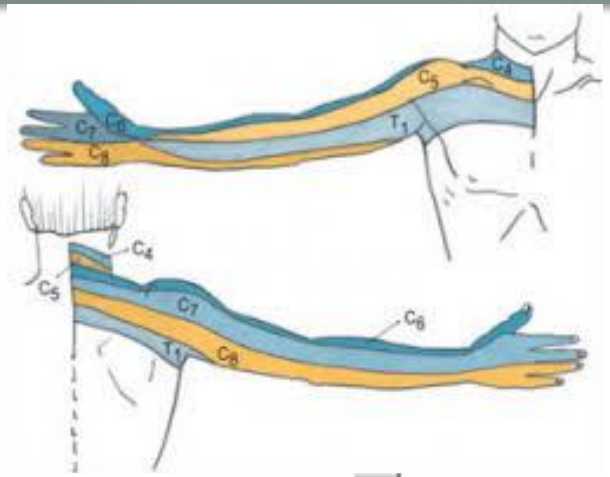


C_7

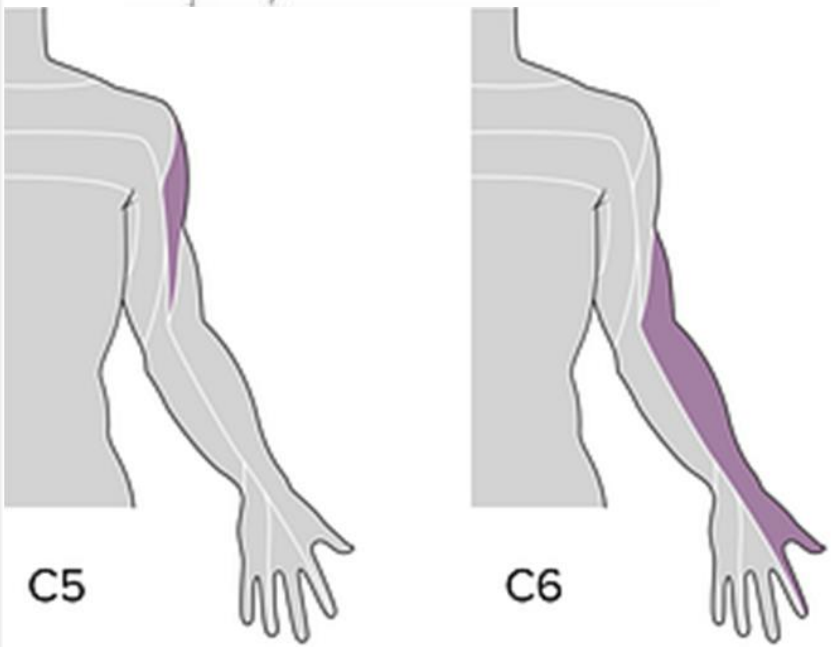


Loss of supination = corticospinal tract injury

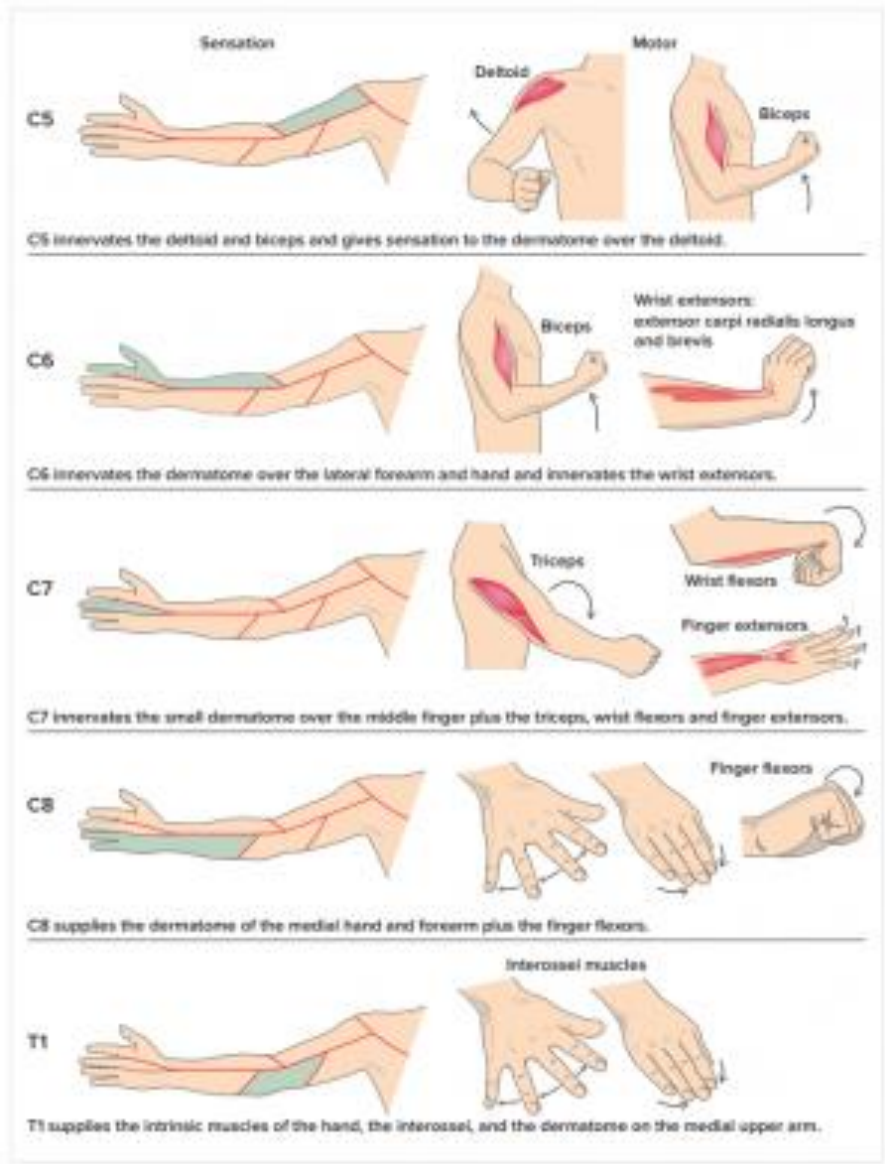
Sensory examination

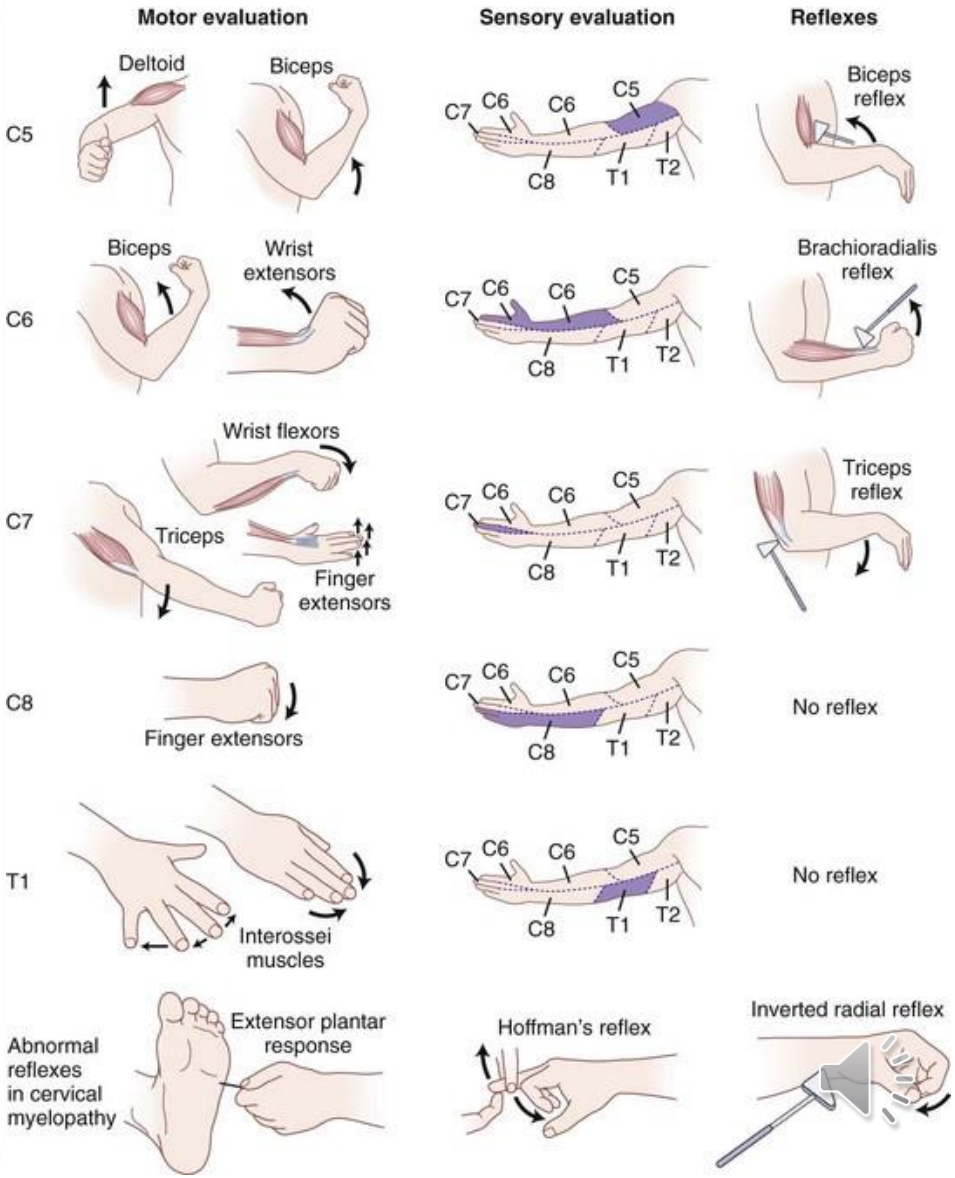


REMEMBER?



Summary neurological exam upper limb

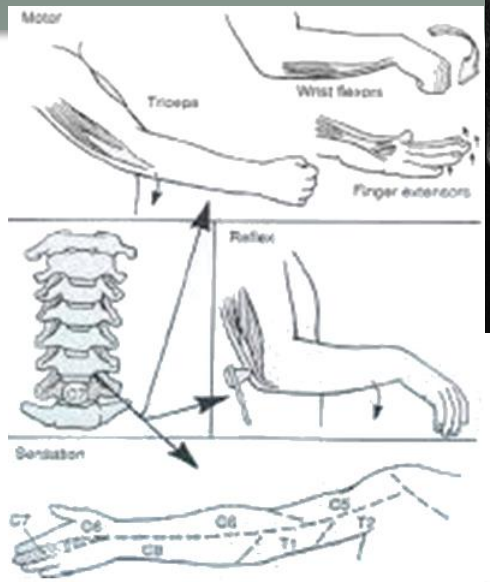




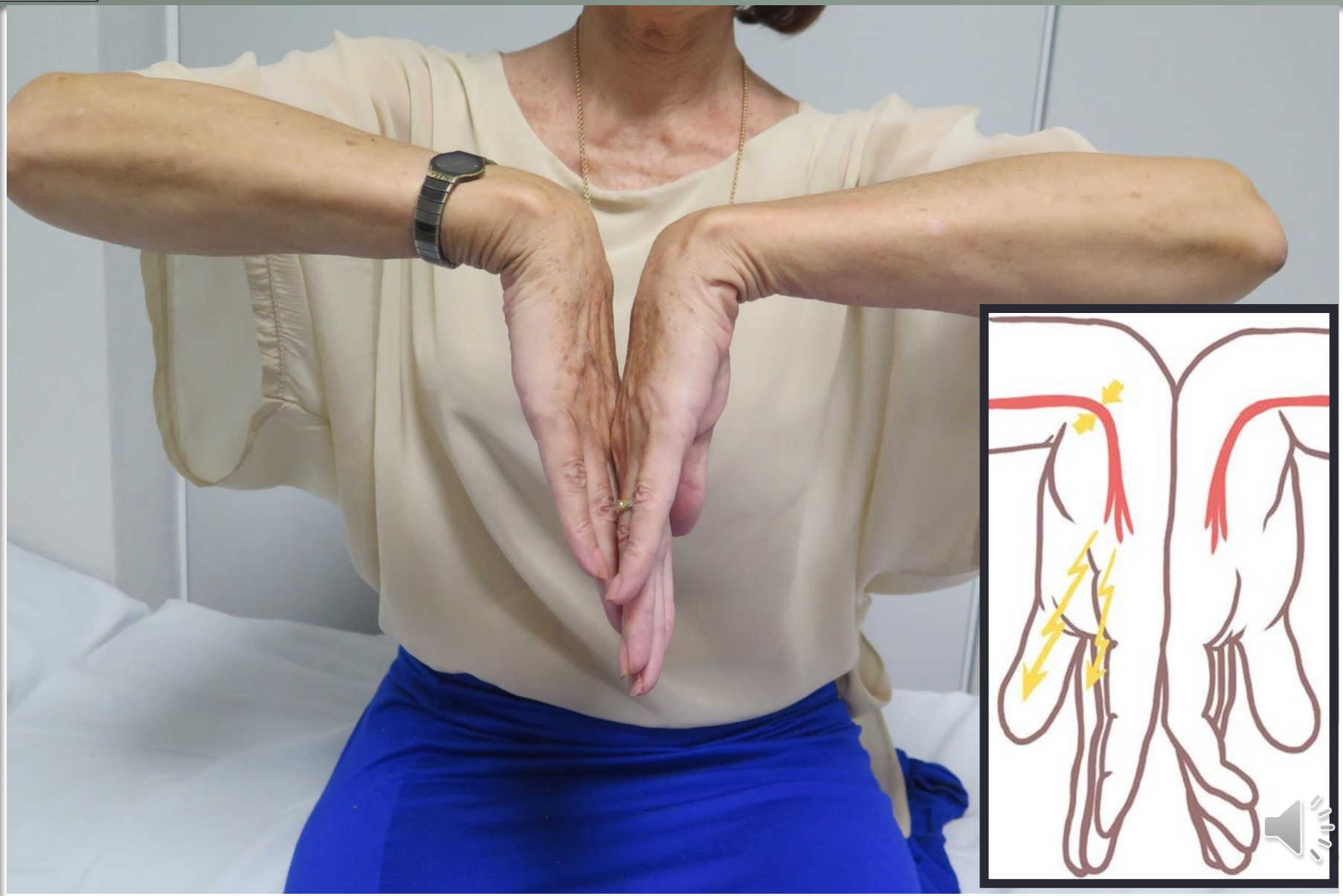
Cervical disc herniation C_6-C_7

Cervical disc herniation

- Most common (69% of cases)
- C_7 nerve root
- Wrist + elbow extension weakness
- ↓Triceps reflex
- Paresthesia palm hand, fingers 2-3 & all fingertips
- Differential diagnosis with carpal tunnel syndrome

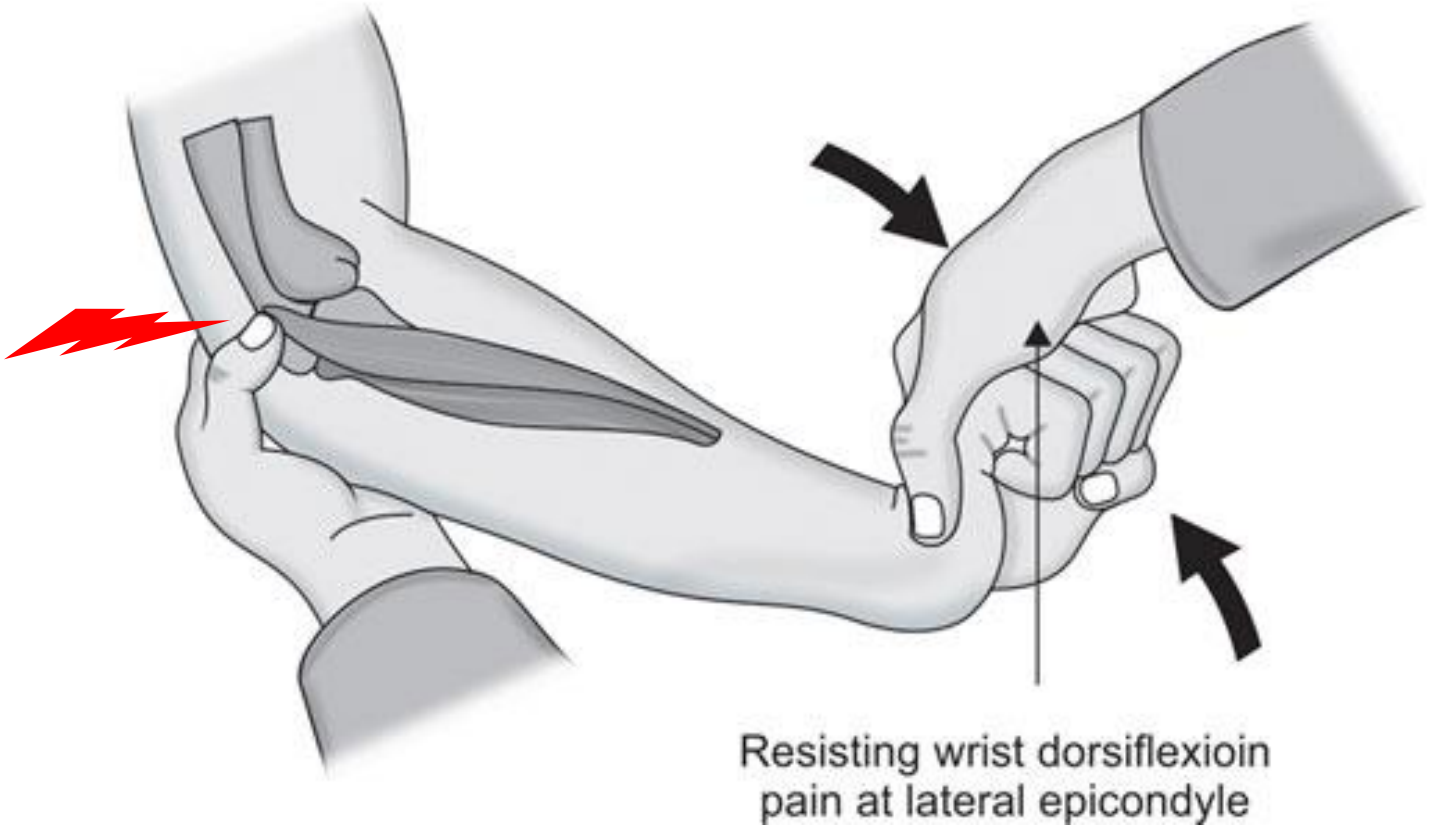


Carpal tunnel diagnosis: Phalen test



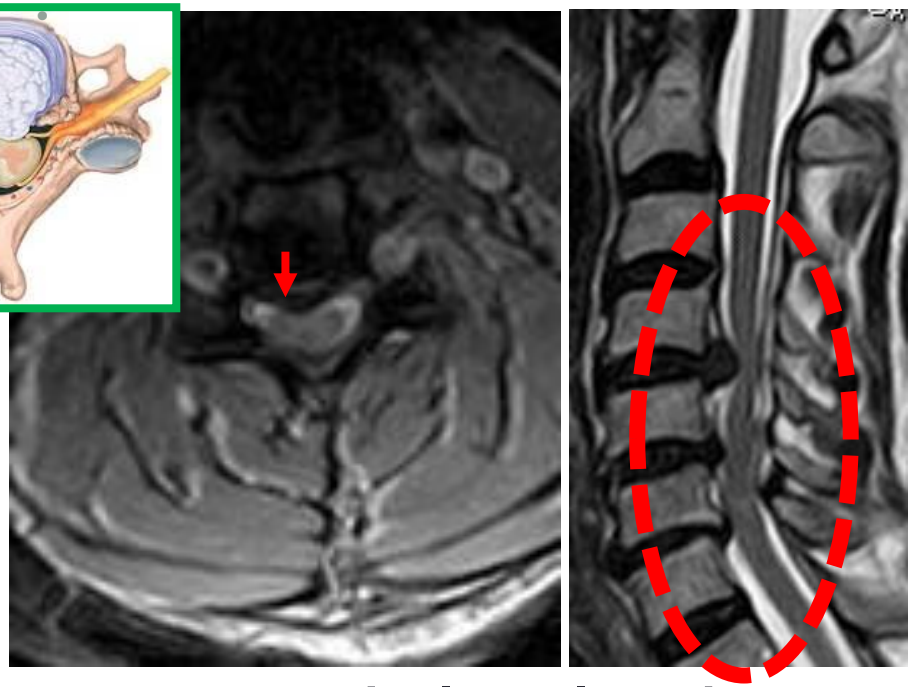
Epicondylitis

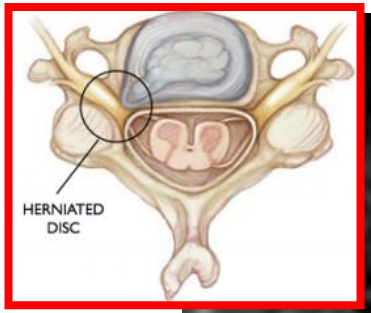
- Elbow pain
- Increases with hand extension against resistance

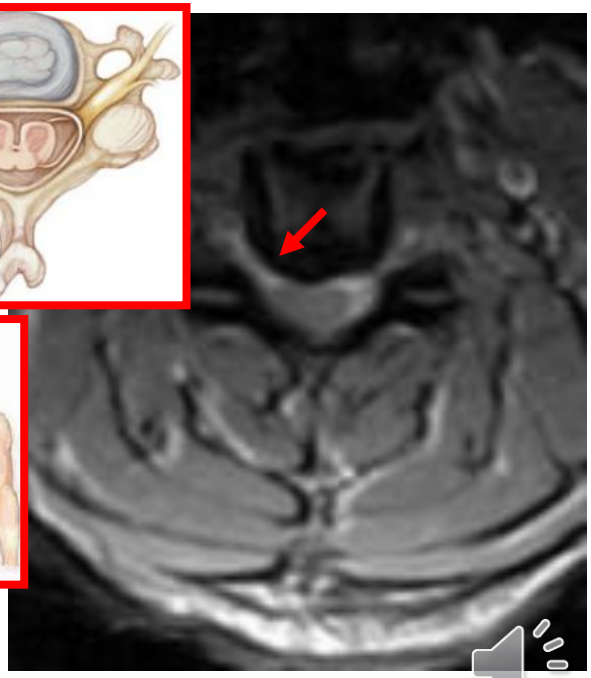


Cervical disc herniation: diagnosis

- **Diagnosis through imaging**
  - MRI = of choice
  - CT
    - If MRI cannot be done, or is of poor quality, or if bone information is needed





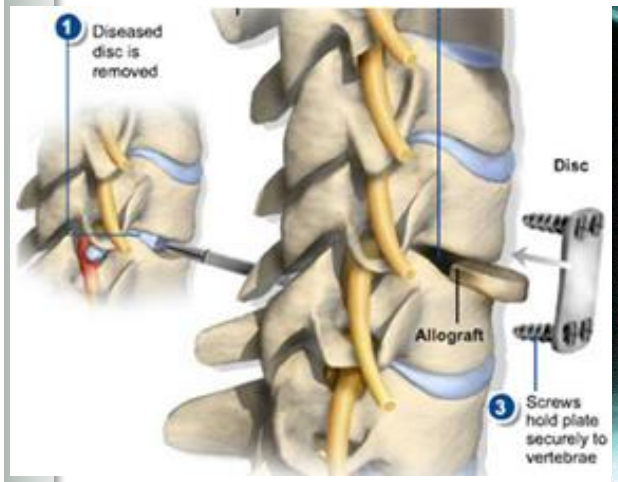


Cervical myelopathy

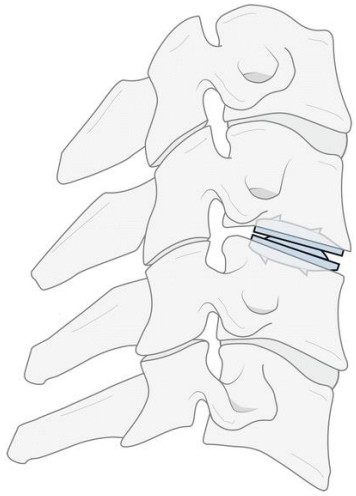
Brachialgia

Cervical disc herniation: treatment

- **Conservative** (NSAIDs, corticosteroids, physiotherapy) → improve 90% of patients
- **Surgical** → If myelopathy or progressive symptoms
  - Foraminotomy through a posterior route
  - Decompression ± anterior cervical arthrodesis
  - Cervical disc prosthesis



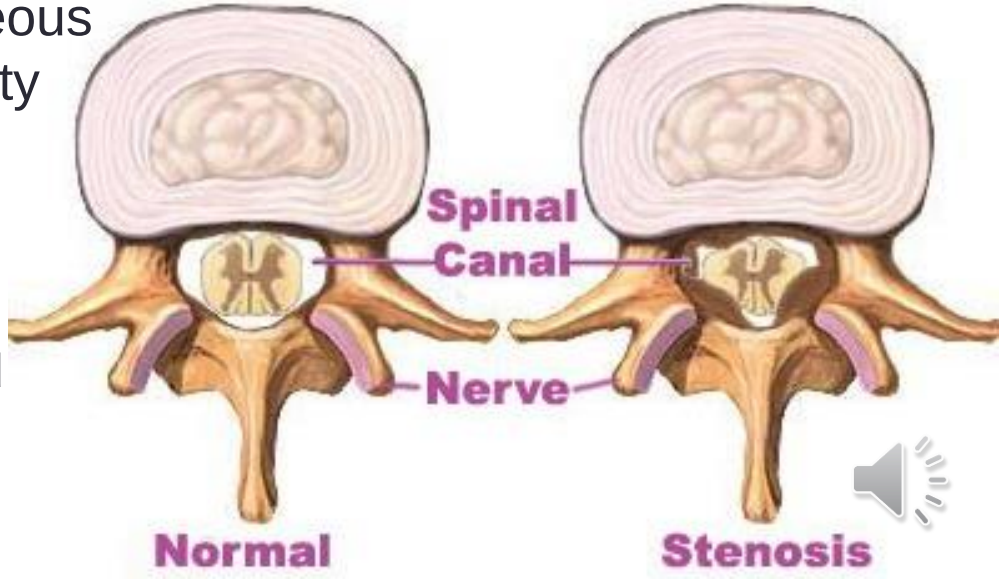
Discectomy + arthrodesis



Cervical disc prosthesis

Cervical canal stenosis: pathophysiology

- Includes one or more of the following:
  - Congenital spinal canal narrowing
  - Disc degeneration
  - Hypertrophy of laminae, facet joints and/or ligaments
  - Subluxation due to disc/facet joint degeneration
  - Impaired mobility → spontaneous vertebral fusion + hypermobility adjacent levels
  - Vertebrae telescoping
  - Curvature alteration
    - Loss lordosis → stranding and kyphosis
    - Hyperlordosis (less common)



Cervical canal stenosis: complementary diagnostic tests

- "Cervical spondylosis"

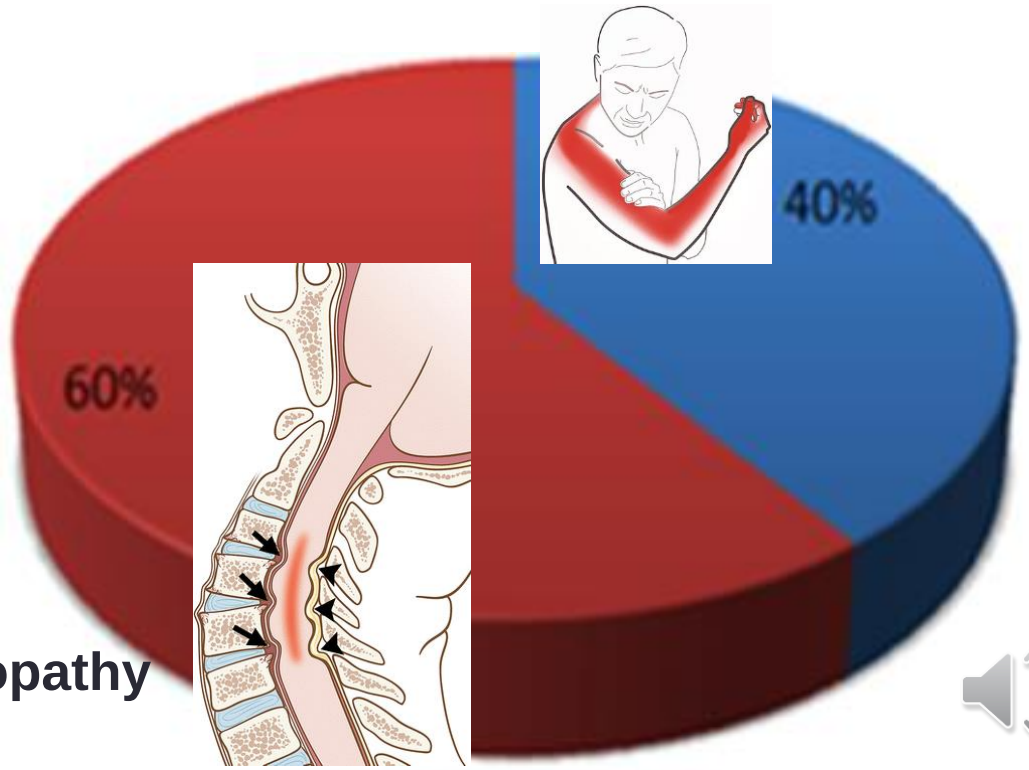
Plain x-ray image

Cervical MRI

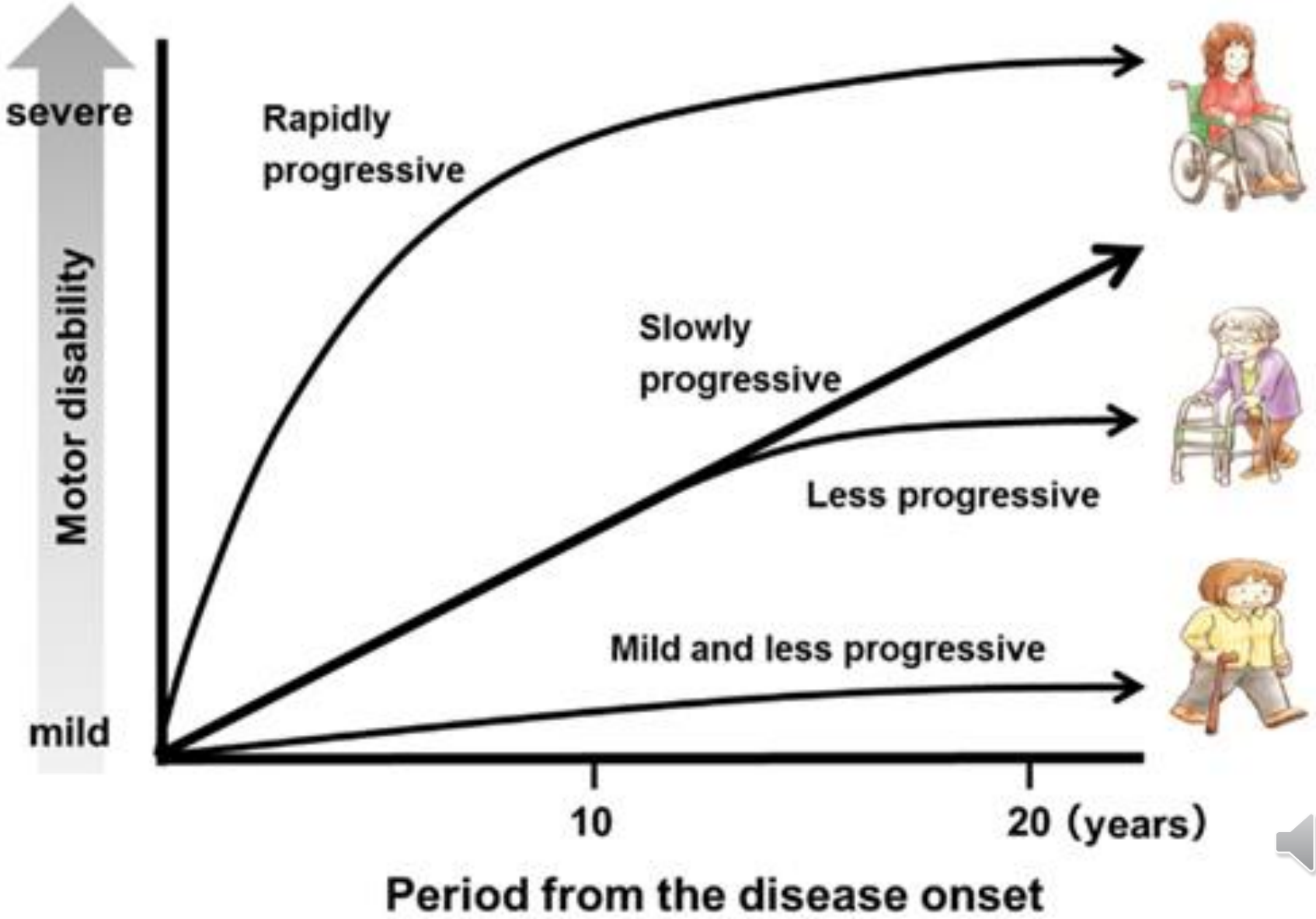
Most individuals > 50 years old have radiological signs of cervical spondylosis, WITHOUT ANY CLINICAL SYMPTOMS!!

Cervical spinal canal stenosis

- "Spondylotic" myelopathy
  - Spondylosis = ↑ common cause of cervical myelopathy in patients >50 years
  - Clinical symptoms when spinal canal narrowing >30%
  - Pathophysiology
    - Direct compression
    - Ischemia by compression of feeding vessels
    - Repeated microtrauma secondary to spondylosis



Cervical myelopathy evolution



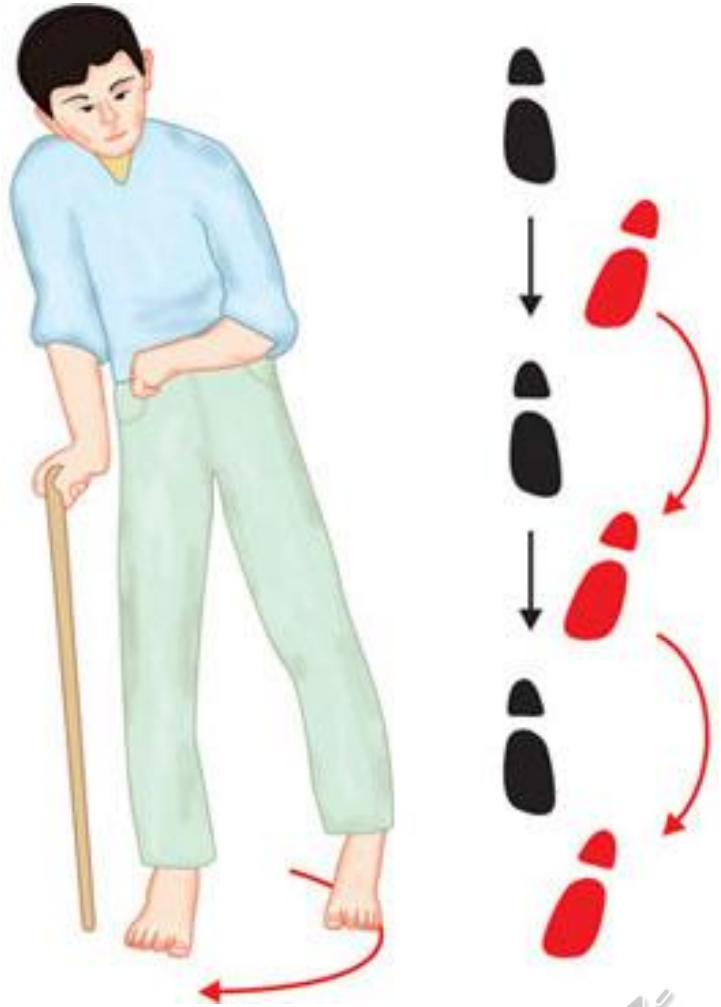
Cervical spinal canal stenosis

- "Spondylotic" myelopathy
  - **Clinical features**
    - Early signs: clumsiness buttoning clothes
    - Medium-term signs: gait disturbance, leg weakness
    - 40% brachialgia, 8% cervicalgia
    - Long-term = 50% urinary sphincter dysfunction (urgency, frequency)
  - **Motor examination**
    - Spinal cord ± nerve root compression
    - Early: weakness triceps (C_7) + hand intrinsic muscles (C_8)
    - Common: weakness arms (30%) and proximal muscle groups lower limb

Clumsiness in hands

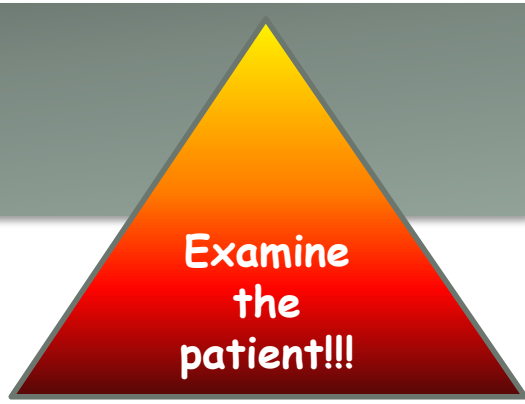
Cervical canal stenosis clinical symptoms: pareto-spastic gait

Spastic gait



Hemiplegic gait

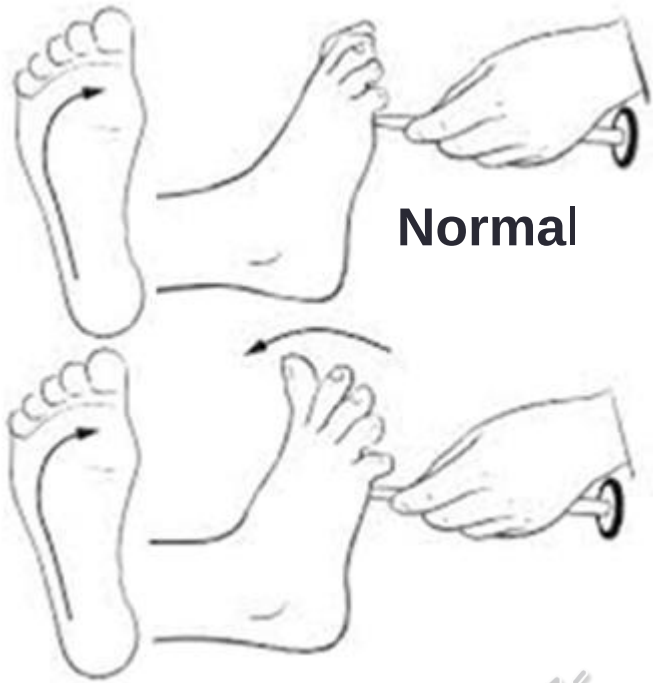
Cervical canal stenosis



- "Spondylotic" myelopathy
  - **Sensory examination**
    - Minimal changes, no nerve root distribution
      - Glove distribution
      - Sensory level (40%) for transverse spinal cord injury
    - Lower limbs
      - ↓ vibratory sense (82%), posterior spinal column damage (40%)
  - **Reflexes**
    - ↑↑ hyperactive under the canal stenosis (70 – 90 %)
    - Clonus, Babinski, Hoffman, Trömner
      - Positive Hoffman reflex in asymptomatic patients → 90% show significant spinal cord compression in cervical MRI

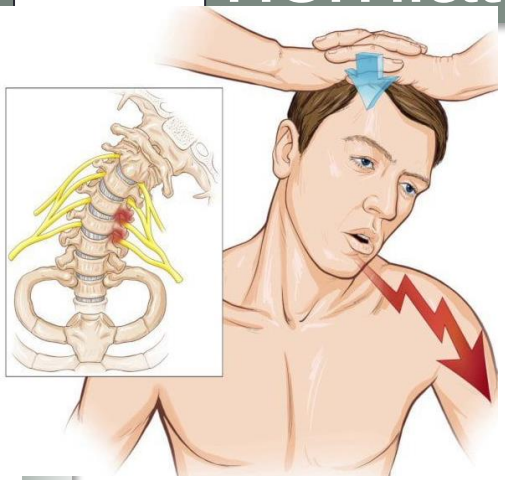
Trömner

Hoffman

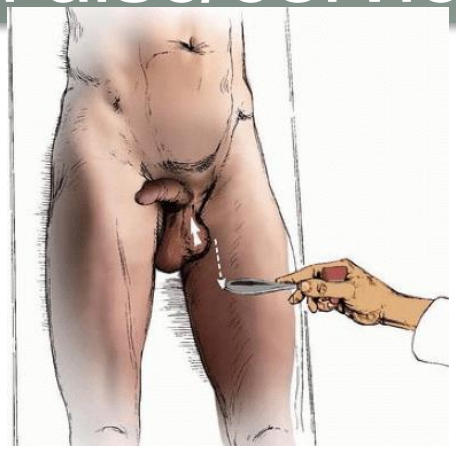


Babinsky

Summary neurological examination herniated disc/cervical canal stenosis

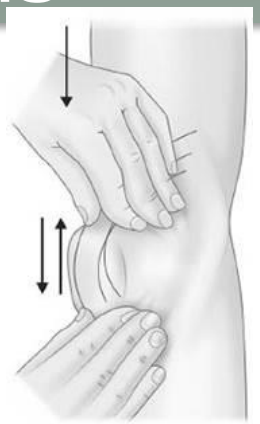


Spurling-Scoville

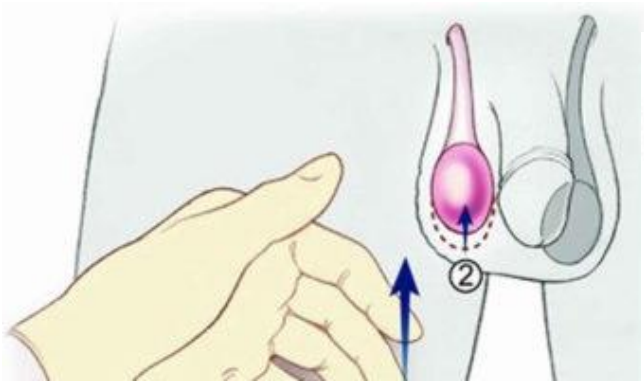


Cremasteric reflex

Patella clonus



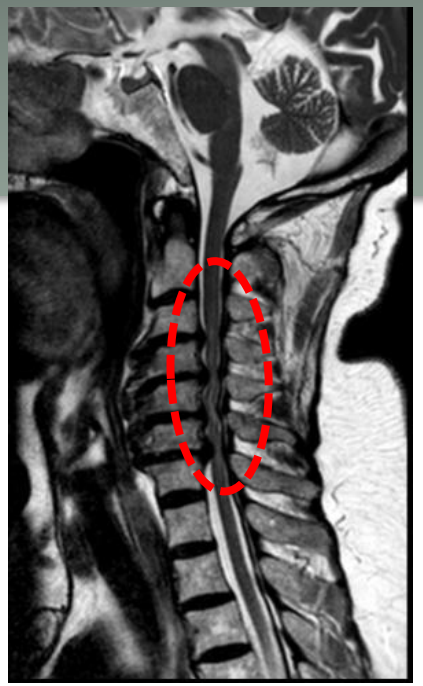
Abdominal cutaneous reflexes



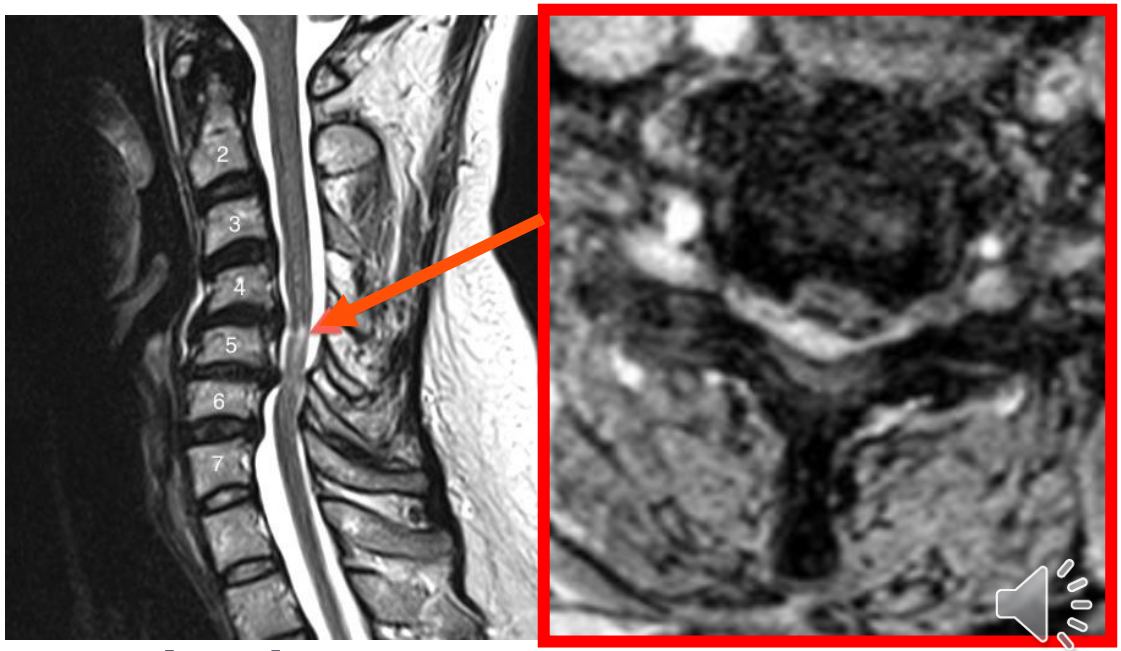
Cremasteric reflex

Ankle clonus

Cervical spinal canal stenosis



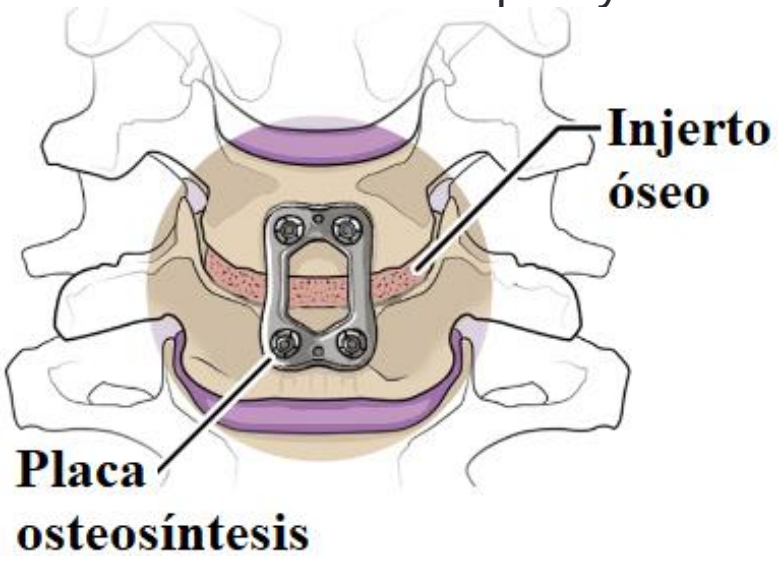
- "Spondylotic" myelopathy image = MRI (± multi-slice CT scan for bone)
  - Spinal canal → *Therapeutic options*
  - Spinal cord → Demyelination, syringomyelia, atrophy, edema, necrosis → *Prognosis*
  - Differential diagnosis: Chiari I malformation, tumour…



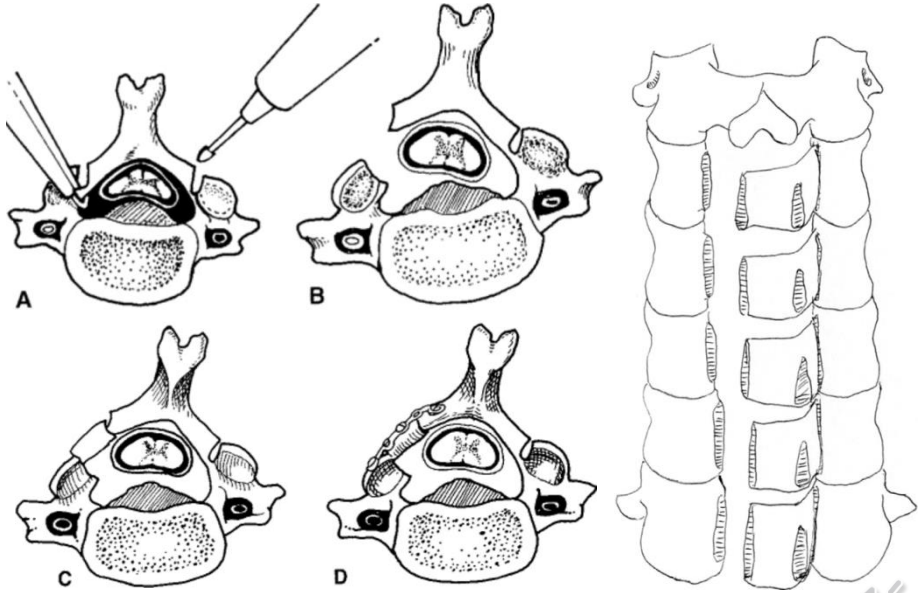
Myelomalacia image

Cervical spinal canal stenosis: treatment

- "Spondylotic" myelopathy
  - Treatment = surgical
    - Intraoperative monitoring (PESS)
    - Decompression + anterior cervical arthrodesis
      - Plate + screws + bone graft or cage
    - Laminectomy + posterior cervical arthrodesis
    - Cervical laminoplasty



Anterior cervical arthrodesis

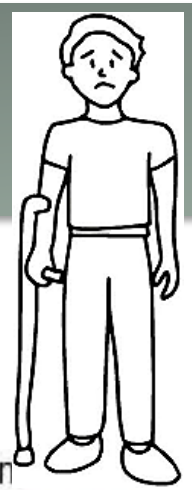


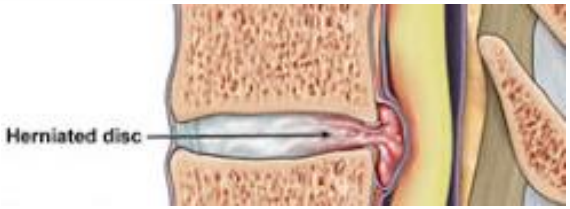
Cervical laminoplasty

Cervical + lumbar spinal canal stenosis

- The spinal column ages all at once!!
- Clinical features
  - Elderly people
  - Weakness in the legs + low back pain
  - But on neurological examination… predominates clinically the cervical myelopathy >> lower limb neurogenic claudication
- **Treatment**
  - **FIRST decompression & cervical arthrodesis**
  - In second surgical procedure, if necessary, decompression ± lumbar arthrodesis

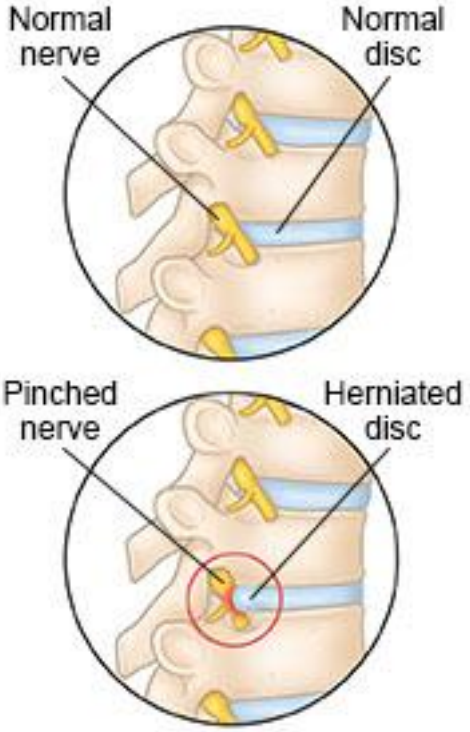
Thoracic disc herniation

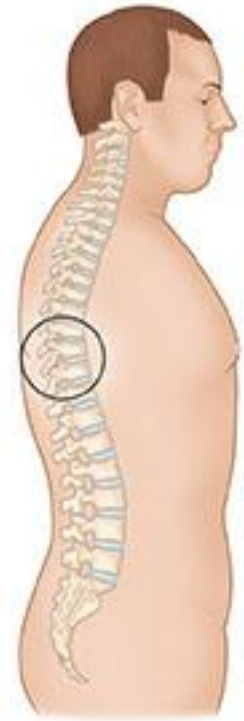




Thoracic Disc Herniation

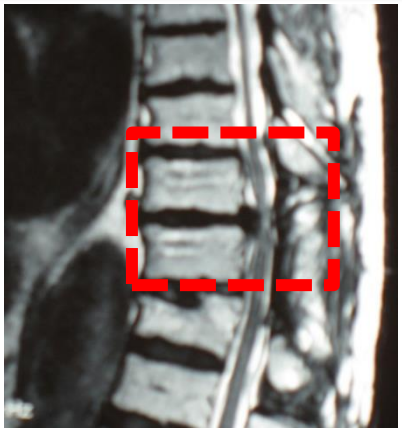
- Very rare, < 1% bulging discs
- Age 20 – 40 years
- Relationship with trauma in 25%
- Level below T_8 (75%)
  - 25% $T_{11} – T_{12}$
- Clinical features
  - Pain (60%)
  - Sensory changes (23%)
  - Motor changes (18%)
- Troublesome treatment
  - Frequently calcified discs
  - Difficult anterior approach (lung, mediastinum)
  - Dangerous posterior approach (spinal cord damage)

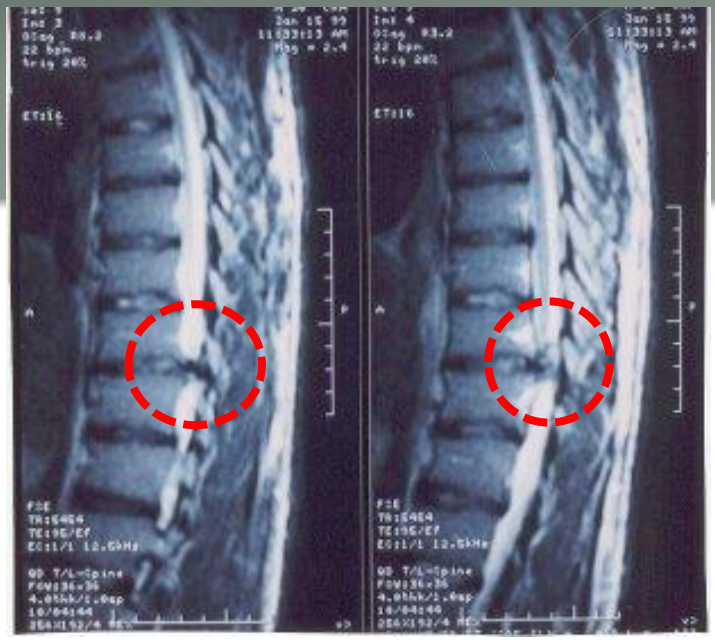


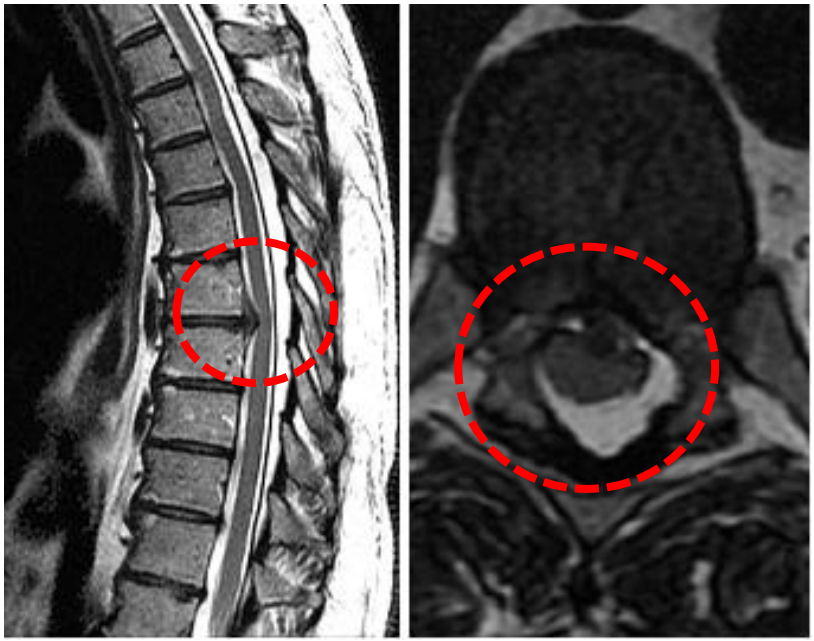


Disc herniation $T_{10} – T_{11}$

Thoracic disc herniation





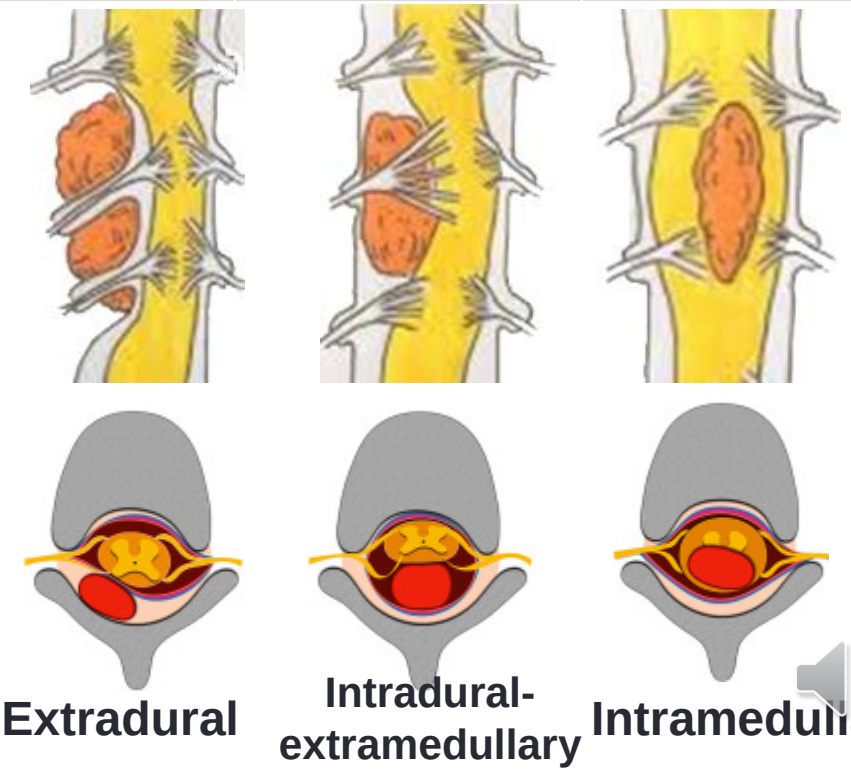


Spinal disc herniation $T_7 – T_8$ with spinal cord compression

Generalities

- Location spinal tumours
  - Extradural (55%)
    - Vertebral body, epidural space
  - Intradural-extramedullary (40%)
    - Meningiomas & schwannomas (55%) > other
  - Intramedullary (inside the spinal cord) (5%)

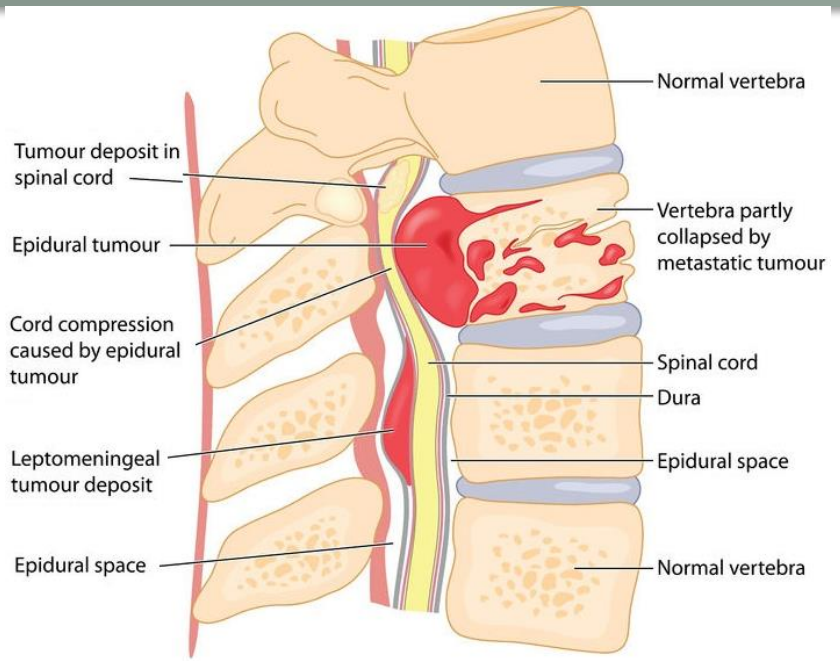
	Intracranial	Spinal cord
Location of primary CNS tumors	85 %	15 %
Astrocytomas	10 : 1	
Ependimomas	3-20 : 1	
Type	Malignant	Benign
Clinical features	Invasion	Compression



Spinal tumour types

EXTRADURAL TUMOURS

- **Metastases**
  - Osteolytic → lymphoma, lung, breast, prostate
  - Osteoblastic → prostate, breast
- Primary spine tumours (rare)
- Aneurysmal bone cyst (15% spine tumours)



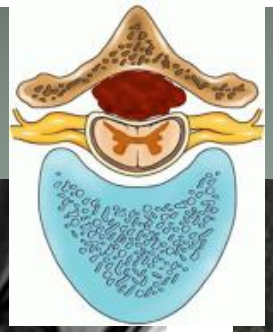
INTRADURAL-EXTRAMEDULLARY TUMORS

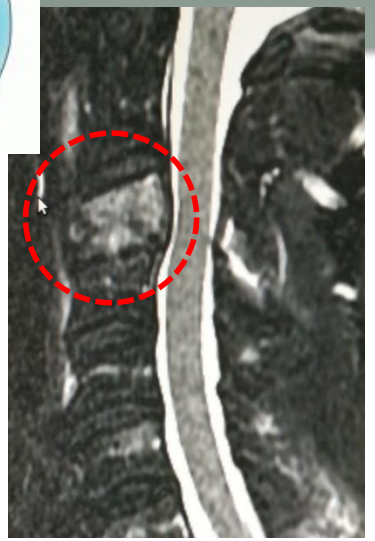
- **Meningioma, schwannoma** (can be intra and extradural at the same time)
- Lipomas
- Metastases (4% spinal cord tumours are metastases)

INTRAMEDULLARY TUMORS

- **Astrocytoma** (30%)
- **Ependymoma** (30%)
- Others (30%)
  - Glioma, teratoma, lipoma, etc.

Spinal metastases

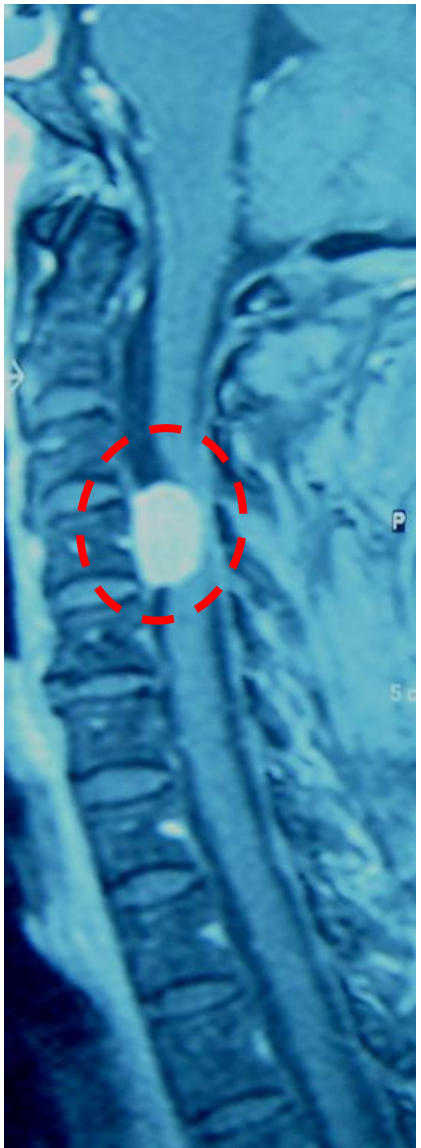


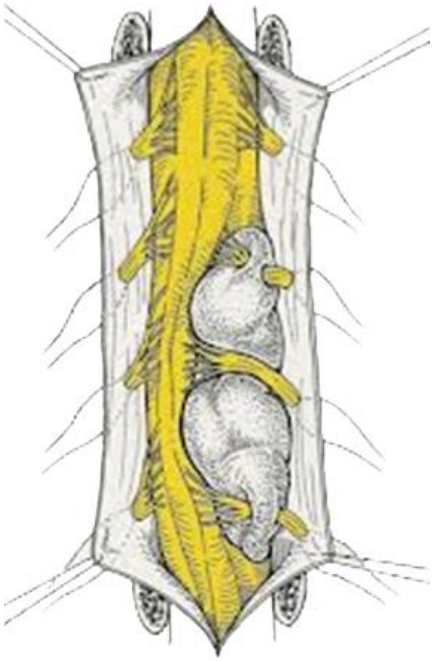


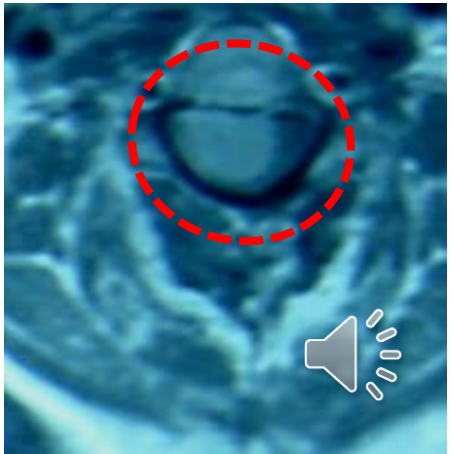
- ⇑ **frequent spine tumour**
- 80% come from lung, prostate, breast, colon, melanoma, lymphoma
  - **10% cancer patients**
  - **Clinical features**
    - *Local pain (95%) → Possible pathological vertebral fracture*
      - Suspicion if spinal pain that worsens lying down
    - *Motor weakness(85%)*
    - *Bladder dysfunction*
      - Bladder urgency/retention
  - **Surgical treatment ± radiotherapy**
    - **Essential to stabilise the spine**

Intradural-extramedullary tumour

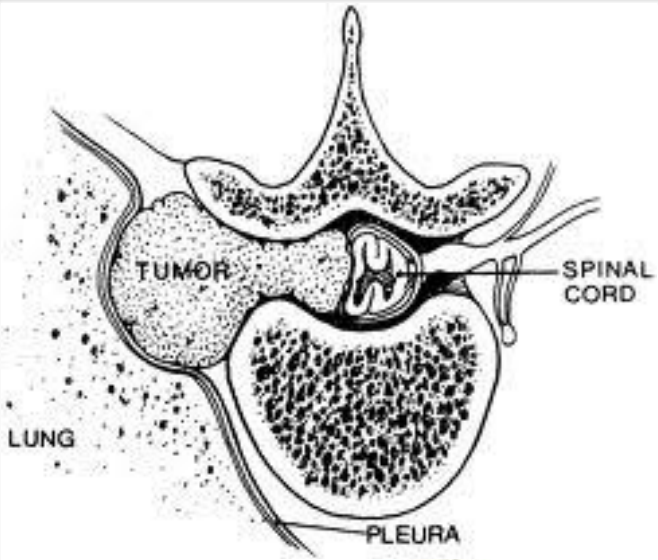
- Generally benign
- Meningioma, schwannoma
- Compresses and displaces the spinal cord
- Does not invade the spinal cord
- Possible growth in hourglass shape
- Surgical treatment

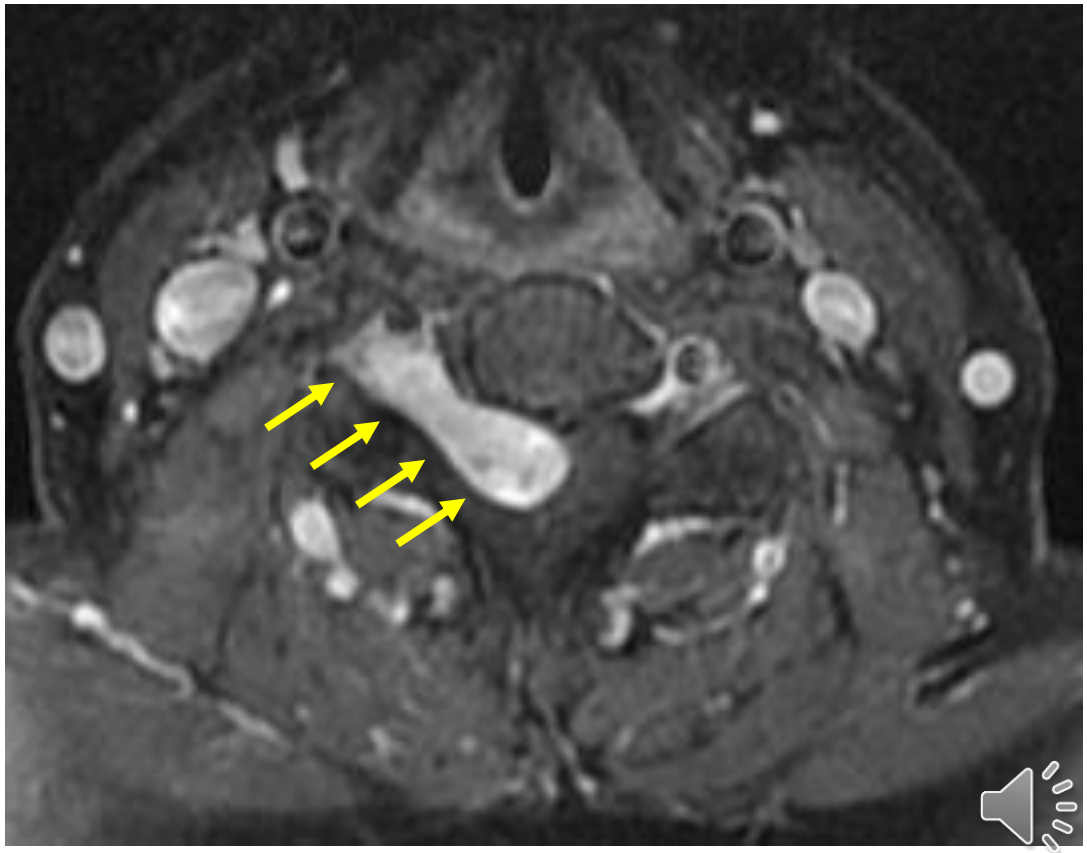






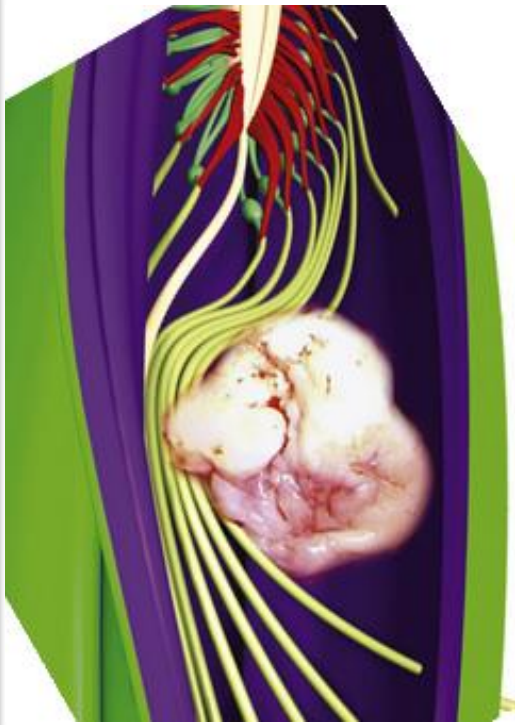
Hourglass tumour

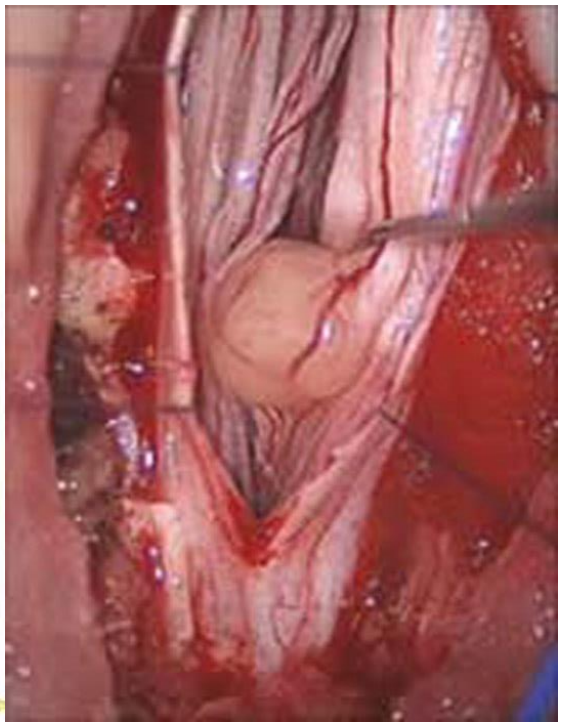


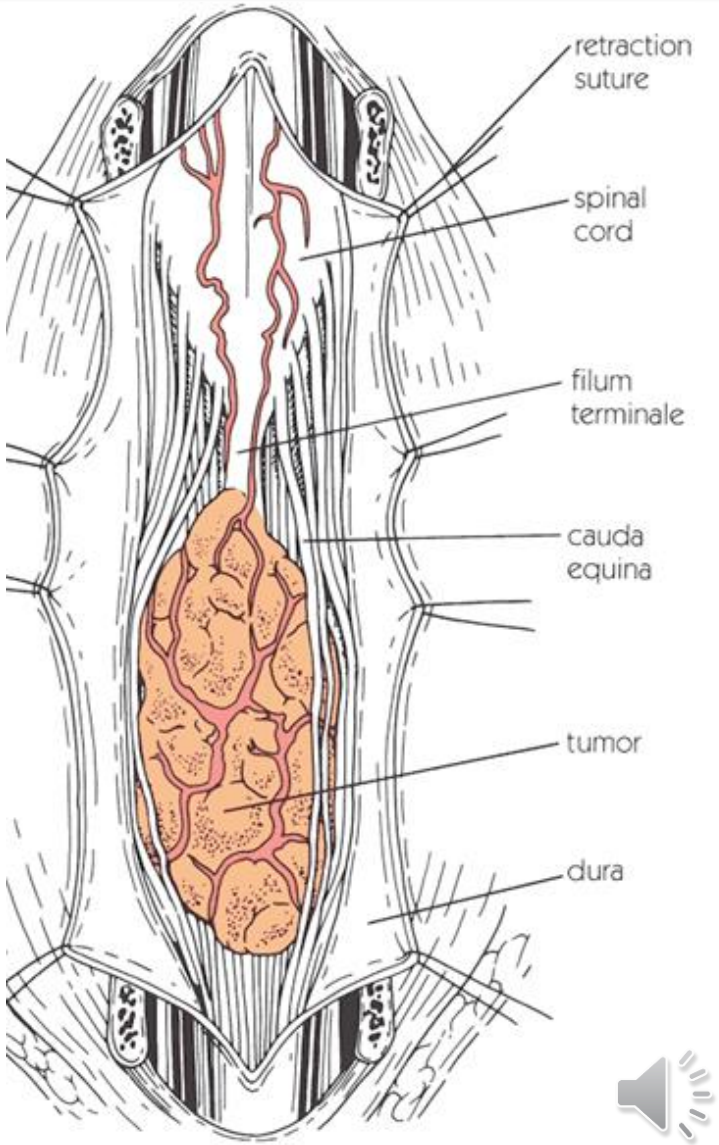


Cauda equina tumour

- Growth displacing cauda equina nerve roots
- Schwannoma > ependymoma
- Surgical treatment

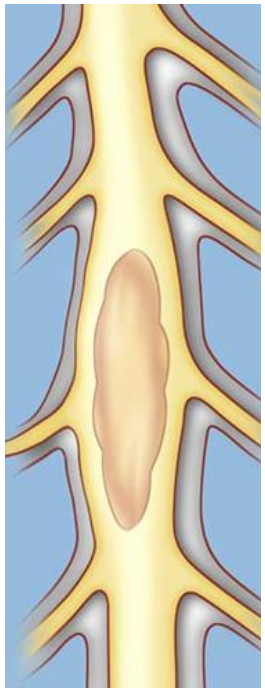




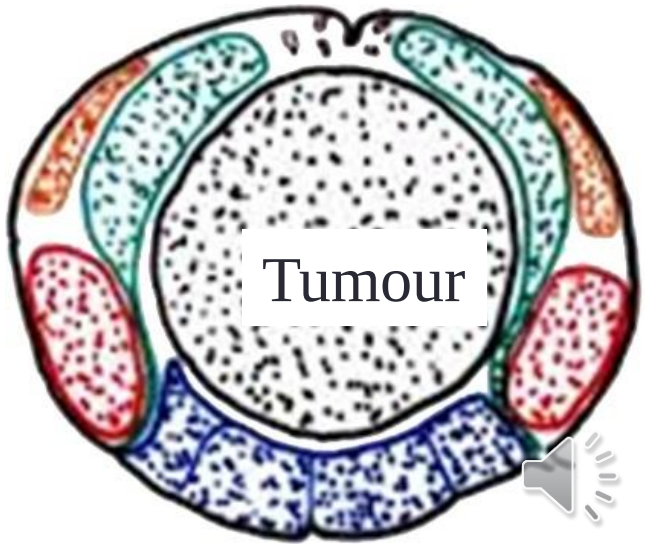


Intramedullary tumour

- Generally benign
  - Ependymoma or astrocytoma
- Displaces and invades spinal cord tissue
- May cause intramedullary cysts
  - Ependymoma above all
- Surgical treatment



Normal spinal cord



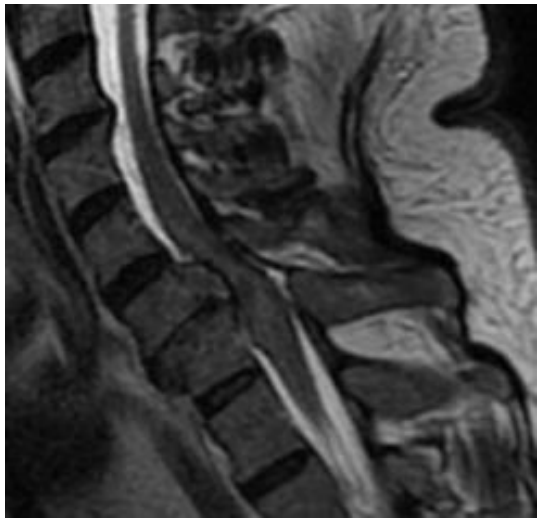
Intramedullary tumour + syringomyelic cyst

SPINAL TRAUMA

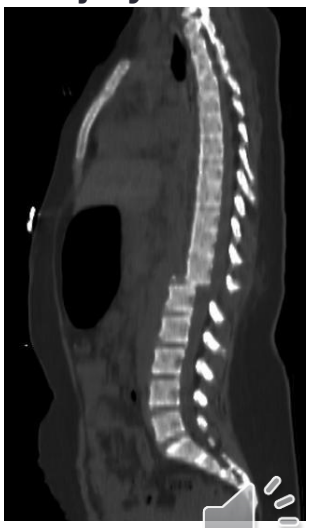
- Trauma involving the spine ± spinal cord ± its nerve roots
- **Etiology**
  - 46% traffic accidents
  - 22% falls
  - 16% aggressions
  - 12% sport activities
- The most important is always the spinal cord injury

Luxation C5-C6

Incomplete spinal cord injury



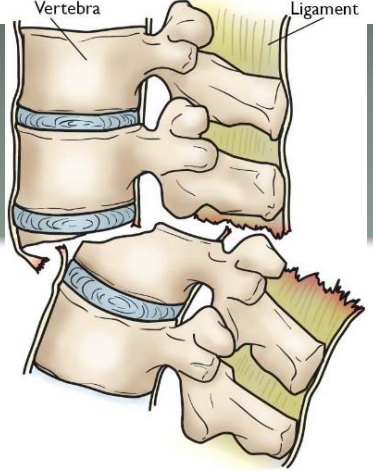
Spinal cord contusion



Spinal cord section

Terminology

- **Spine stability**
  - Spine capacity to avoid abnormal displacement and nervous tissue injury, deformity, or pain
- **Injury level: disagreement**
  - Lowest level with normal neurological function
  - Highest level with motor function ≥ 3/5 + thermoalgesic sensation preservation
- **Lesion type**
  - Complete = no motor or sensory function 3 levels below injury
  - Incomplete = residual function
    - Preserved sacral reflexes does not equal an incomplete spinal cord lesion



Spinal instability

Incomplete spinal cord injury

Terminology

…incomplete spinal cord injury

- Central medullary syndrome
- Anterior/posterior medullary syndrome
- Brown-Séquard syndrome (spinal cord hemisection)

Central medullary syndrome

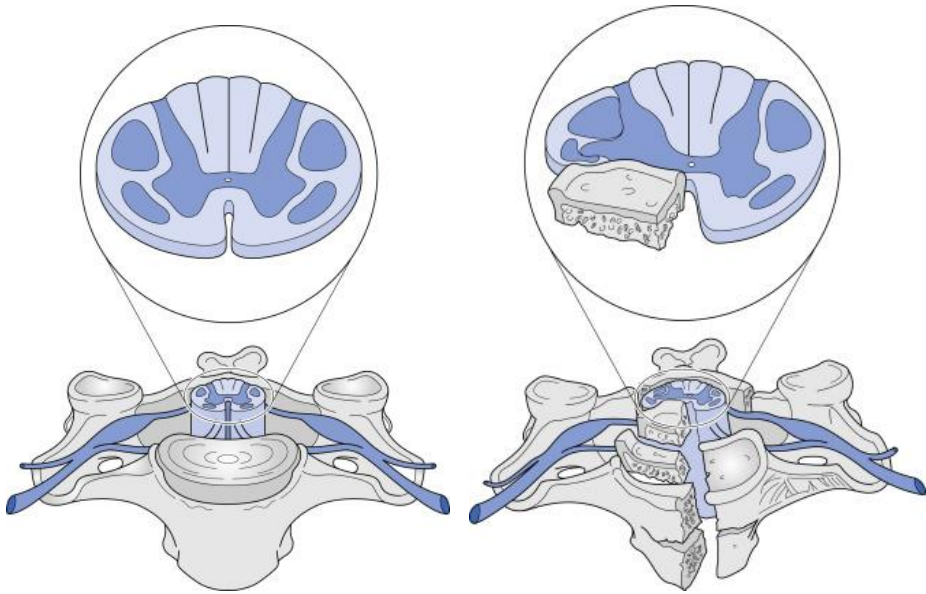
Anterior medullary syndrome

Brown-Séquard syndrome

- **Spinal shock**
  1. **Circulatory system**: Hypotension after spinal cord injury
     - (-) sympathetic (vasodilation + Bradycardia) + ↓ venous return (muscle paralysis) + bleeding from other injuries
  2. **Nervous system**: Loss of all neurological functions
     - (-) Segmental & polysynaptic reflexes → flaccid paralysis + arreflexia

Traumatic spinal cord injuries

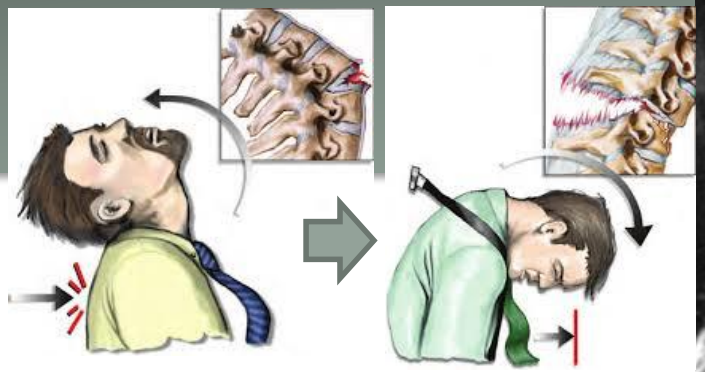
- Whiplash or cervical sprain
- Spinal cord injuries
  - Types of injuries
  - Neurological examination
  - Initial & hospital management

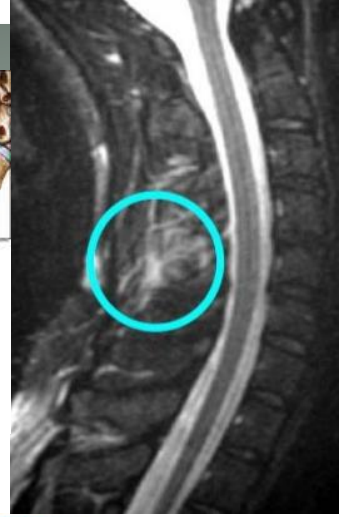


Normal

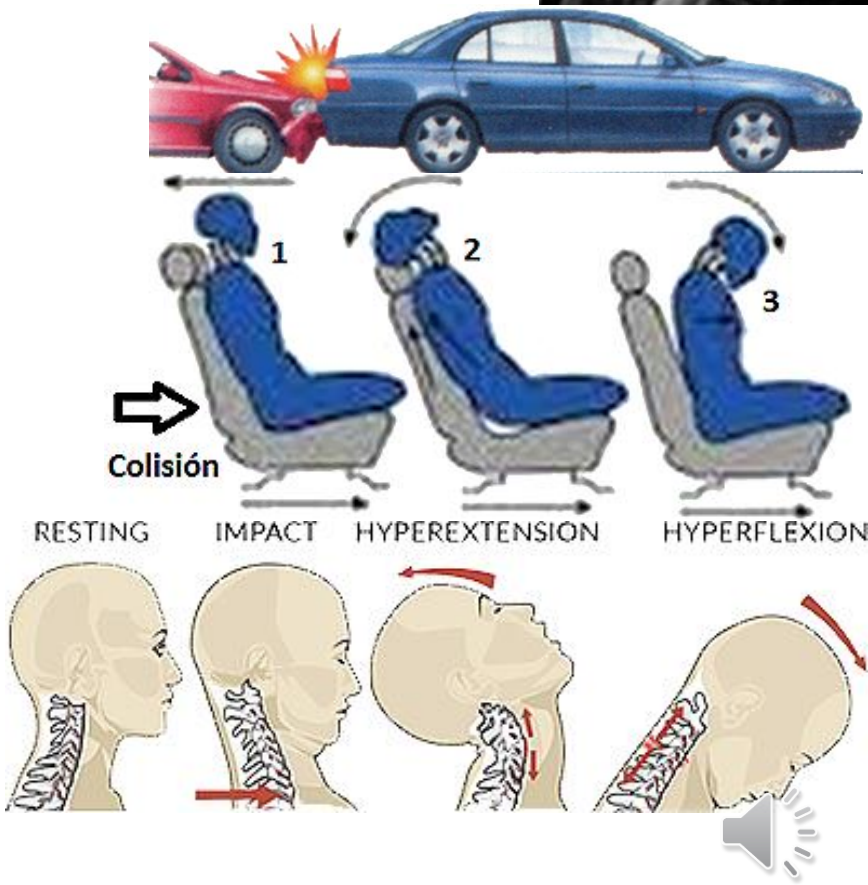
Spinal cord trauma

Whiplash

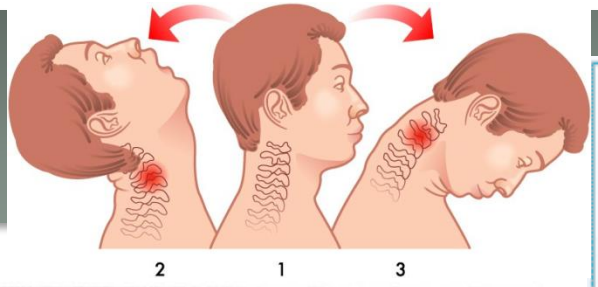


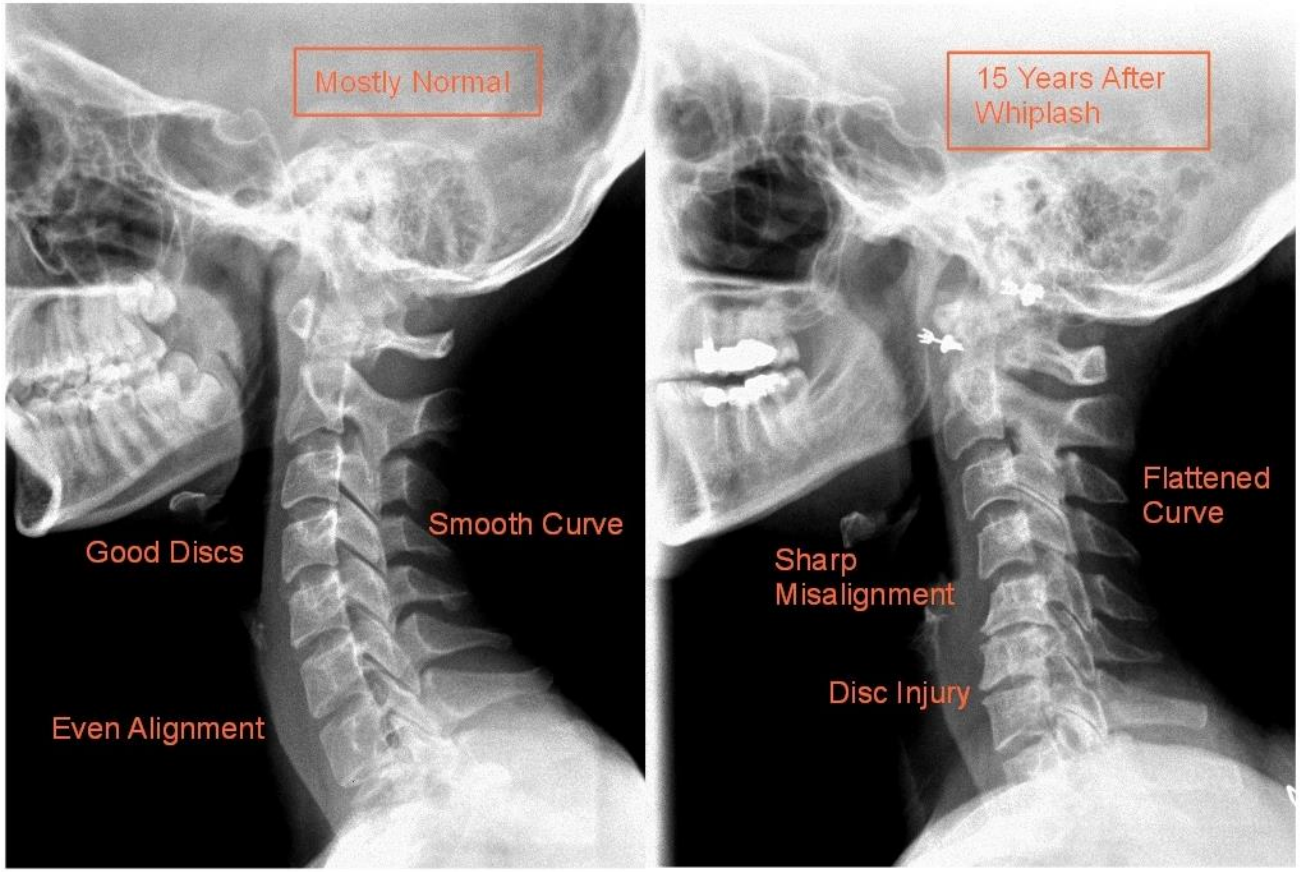


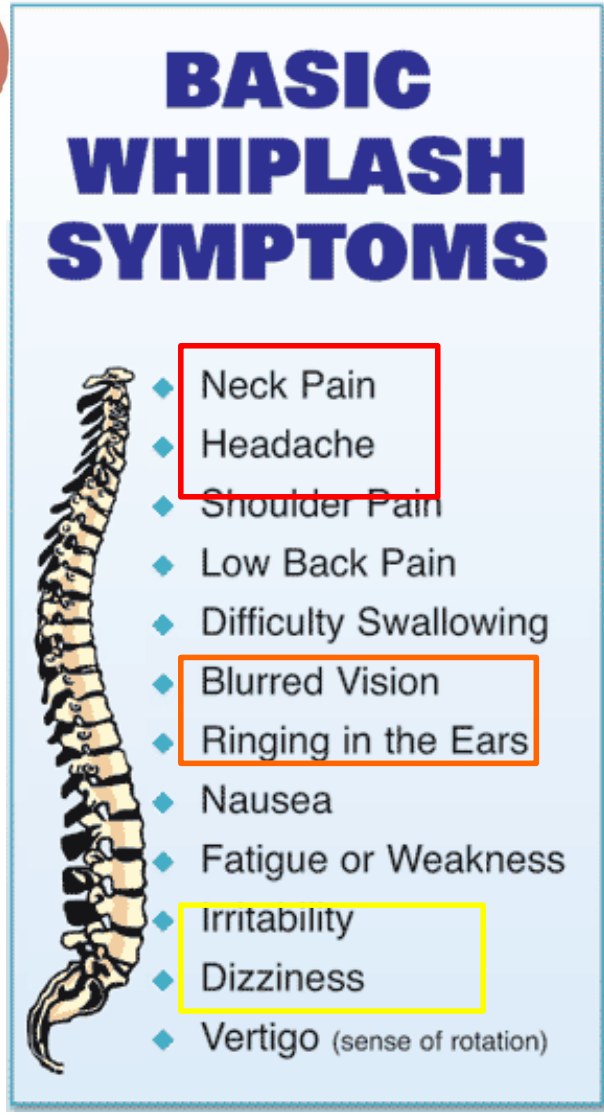
- Traumatic injury to ligaments/muscles at the cervical level → cervical instability
  - NO fracture, dislocation, or herniation
- **Mechanism:** abrupt cervical flexion-extension
- **Symptoms**
  - Delayed hours/days
  - Cervical pain, ↓mobility, weakness, nausea…
- **Diagnosis =** clinical symptoms + x-ray + MRI
  - Exclusion of other injuries



Whiplash



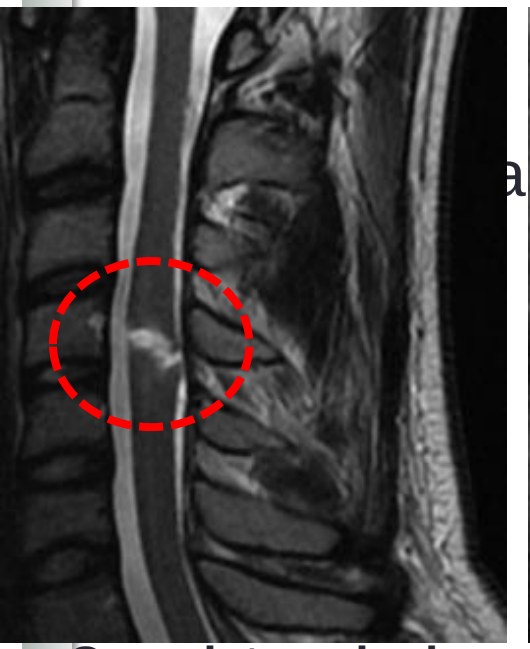




- Conservative treatment: cervical collar, physiotherapy, NSAIDs
- Prognosis: 55% improve in three months, 80% in two years

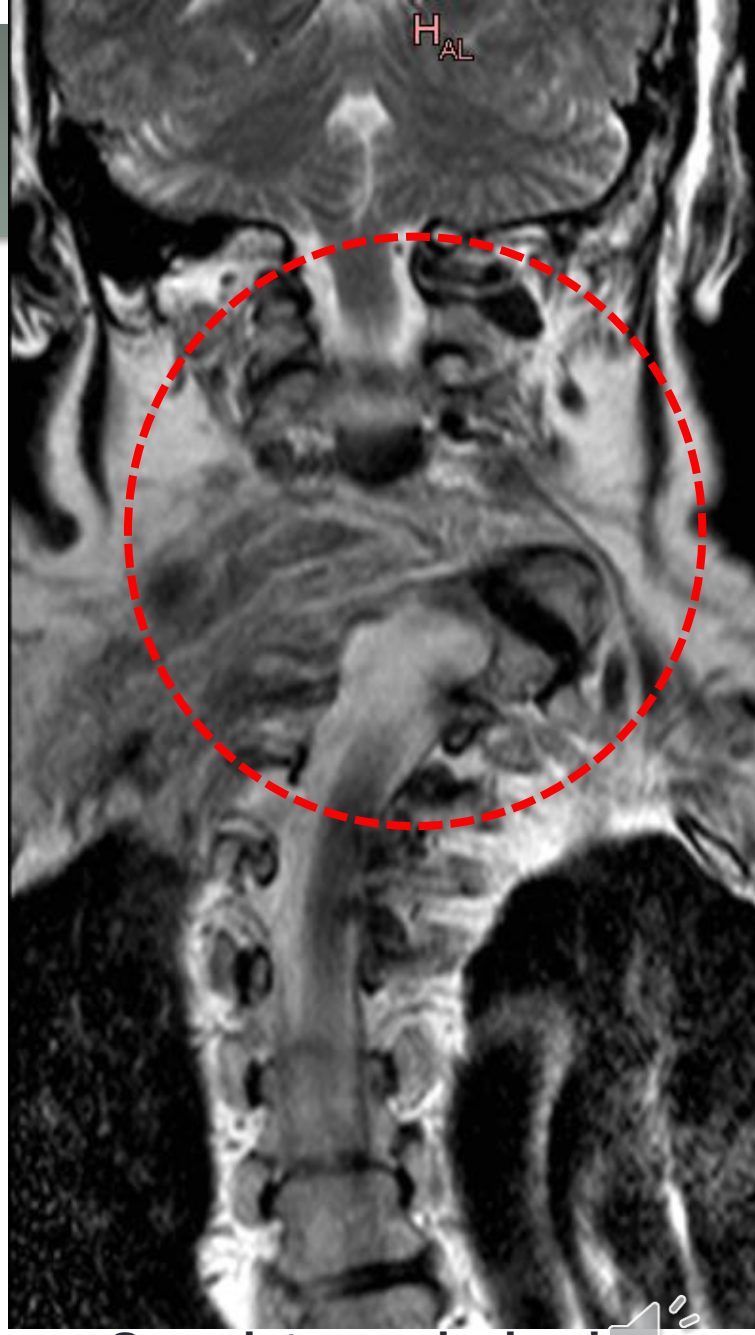
Spinal cord injuries

- **Types of spinal cord injuries**
  - Complete spinal cord section
  - Incomplete spinal cord injury
- **Neurological examination**
- **Initial and hospital management**



Complete spinal cord section

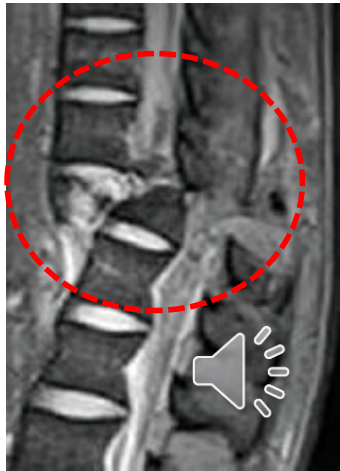
Incomplete spinal cord injury



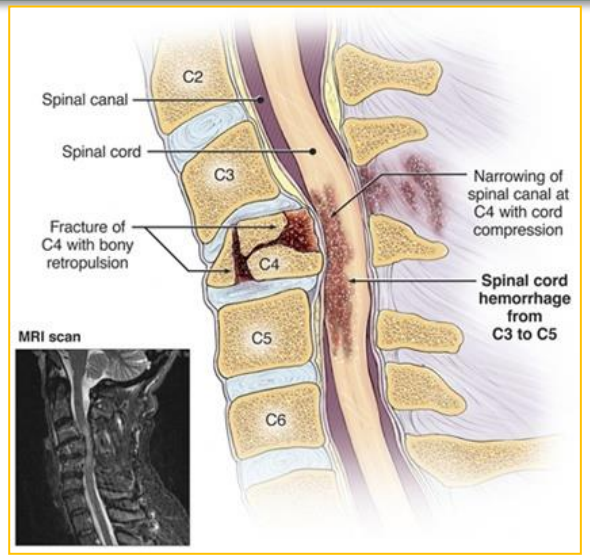
Complete cervical spine fracture-dislocation

Spinal cord section

- **COMPLETE spinal cord injury**
  - No motor/sensory function three levels below the spinal cord injury
    - NO voluntary movement, sphincter control, or skin sensation
    - Hypotension, bradycardia (depending on the spinal cord lesion level)
    - Intestinal/bladder palsy, priapism, impaired sexual function
- **Critical level**: C_3 = Medulla oblonga/cervical cord dissociation
  - Cardiac ± respiratory arrest
  - Quadriplegia, respiratory assistance
- **Etiology:** traffic, diving.



MRI and CT medullary section

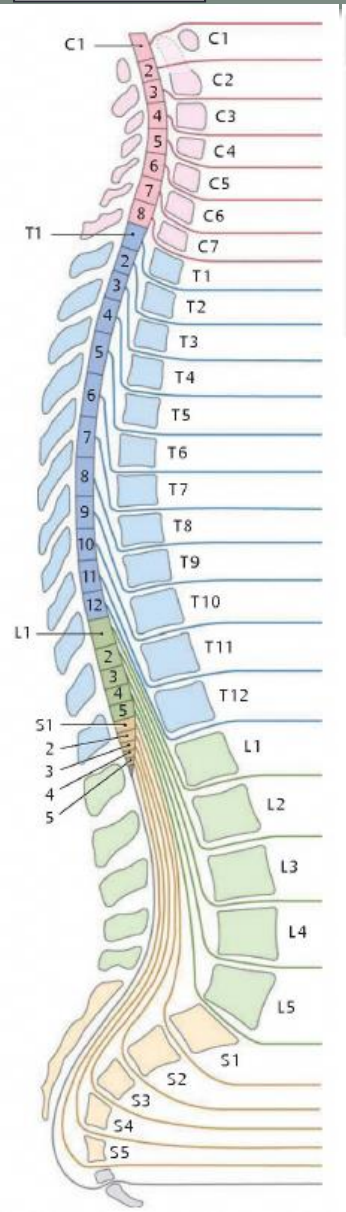


MRI

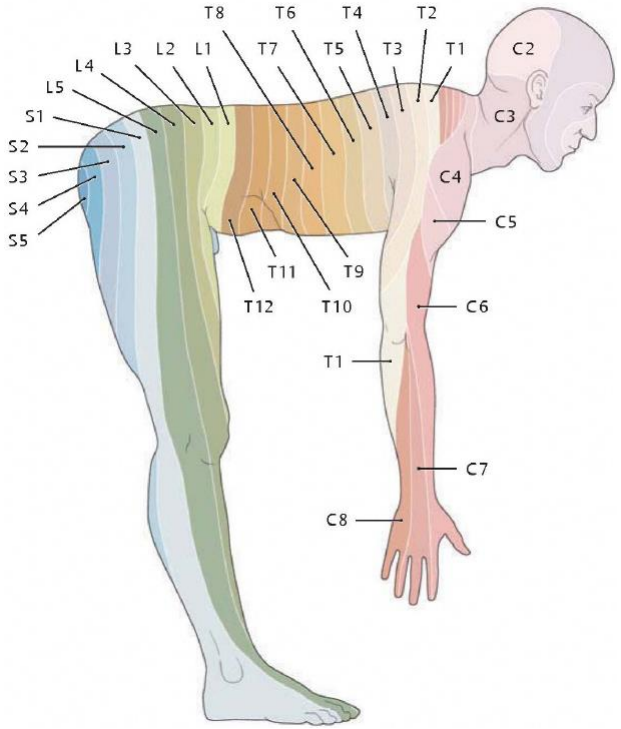
←CT

Anatomical review

¿REMEMBER?



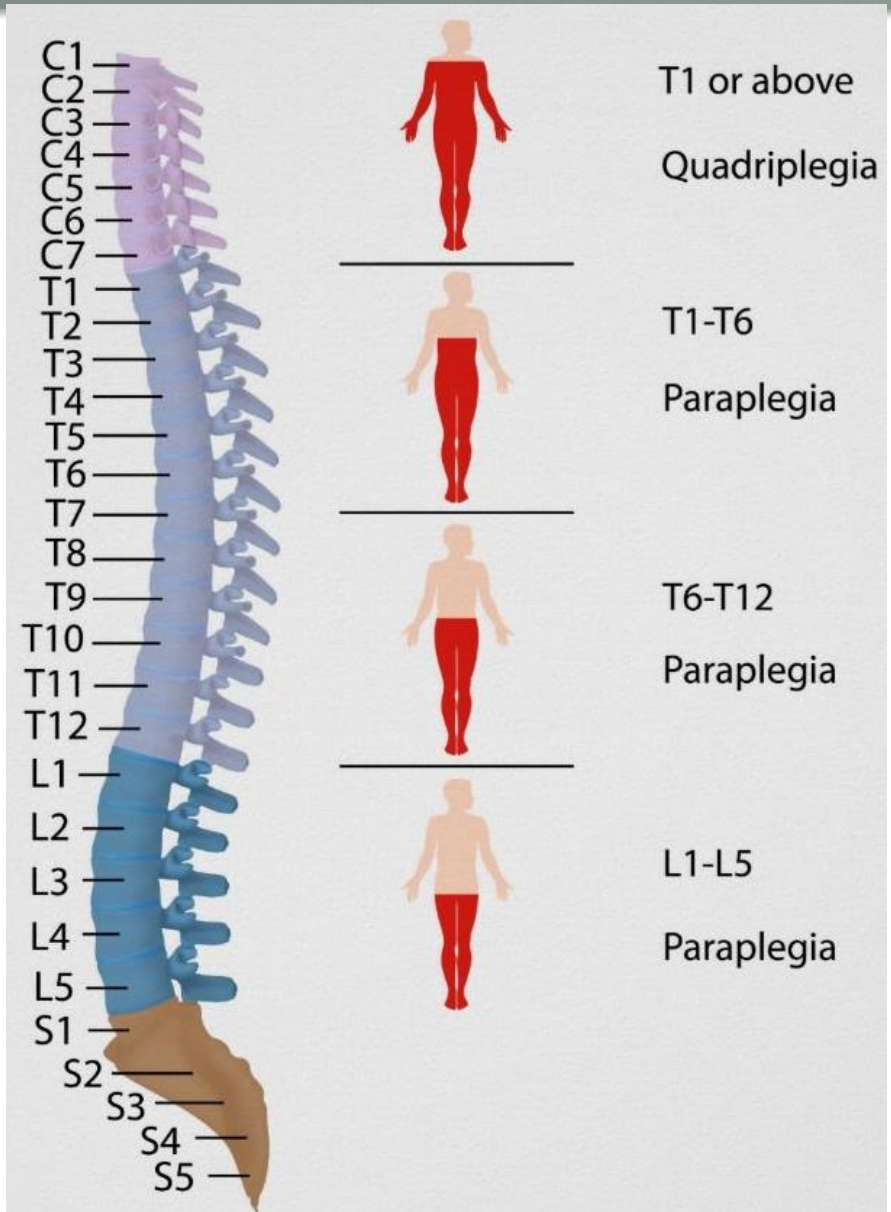
Spinal cord segment	Vertebral body	Spinous process
C8	Inferior margin of C6, superior margin of C7	C6
T6	T5	T4
T12	T10	T9
L3	T11	T11
S1	T12	T12



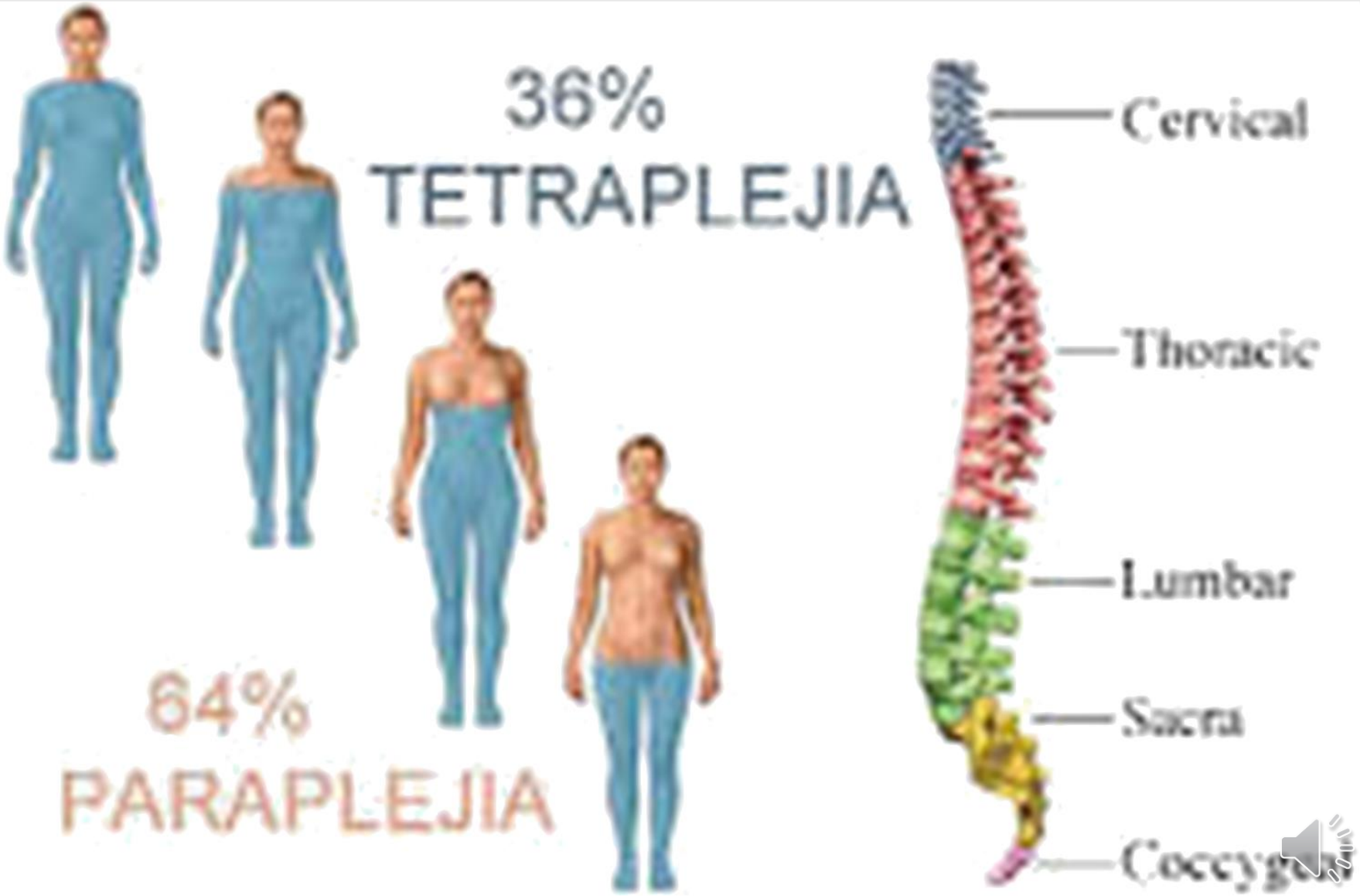
Trauma T_{10}
Neuro lesion
T_{12}

- Vibration and position sense loss
- Pain and temperature sense loss
- Motor loss

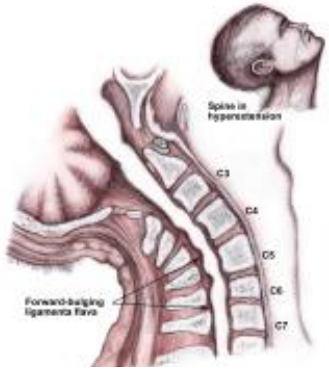
Type of spinal cord injury according to level



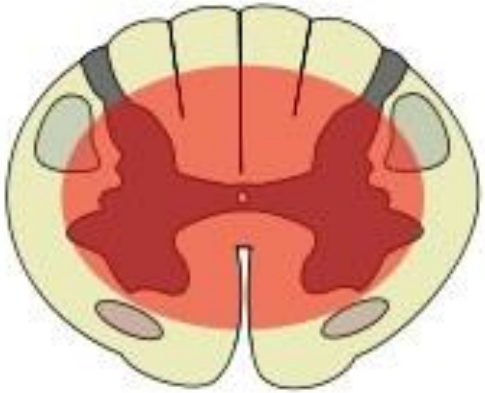
Percentage of spinal cord injuries

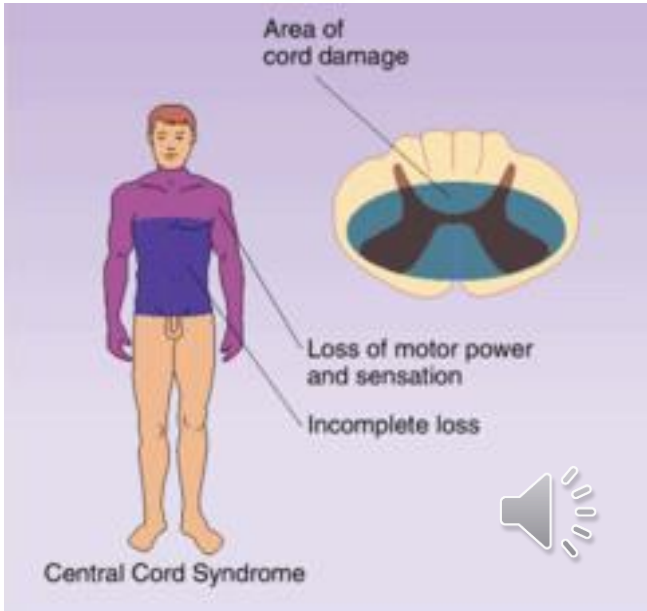


Central spinal cord syndrome



- Most common spinal cord injury
- Mechanism
  - Neck hyperextension in the elderly (spinal canal stenosis, ischemia)
  - Central spinal cord damage with vascular deficit + edema
- Clinical symptoms ≈ syringomyelia
  - Weakness upper limbs >> lower limbs
  - Myelopathy: sphincter dysfunction
- Neuroimaging diagnosis: MRI
- Treatment: surgical decompression



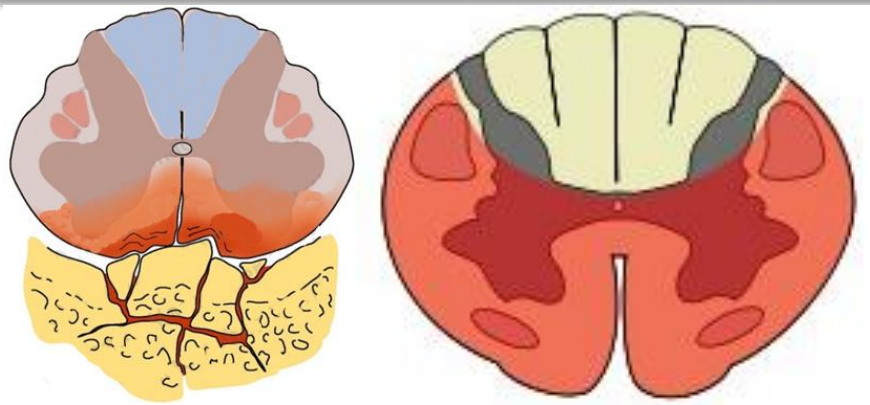


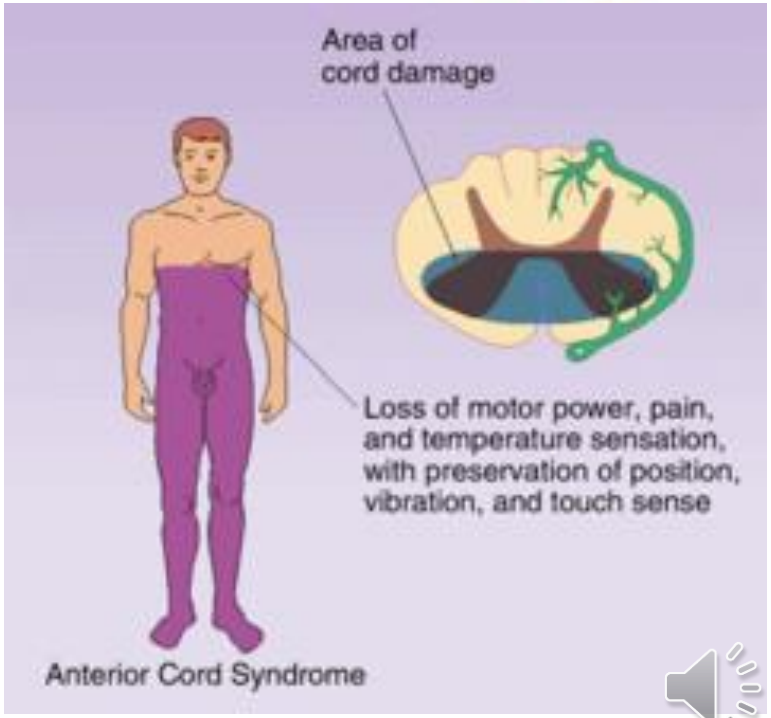
Incomplete spinal cord injury

Anterior spinal cord syndrome

Incomplete spinal cord injury

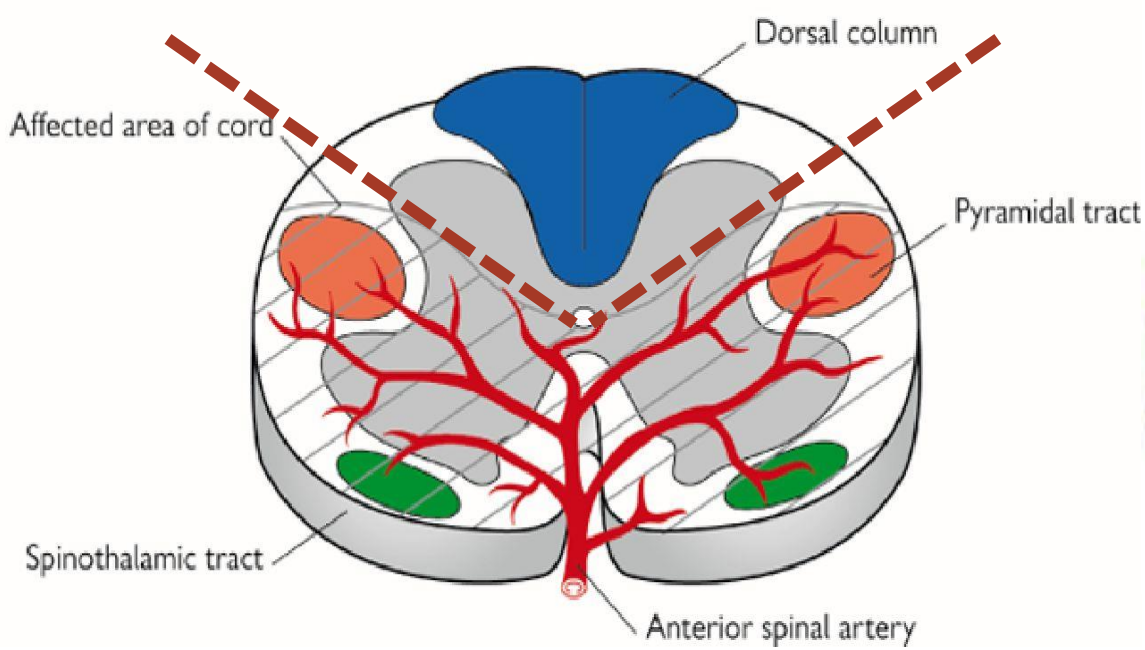
- Mechanism
  - Infarction in anterior spinal artery distribution (due to vessel compression or occlusion)
- Clinical symptoms
  - Paraplegia (quadriplegia above C_6)
  - Sensitive dissociation
    - Thermoalgesic sensation lost (spinothalamic tract lesion)
    - Deep sensation maintained (posterior spinal columns preserved)
- Neuroimaging diagnosis: MRI
- Treatment: if there is compression = surgical decompression

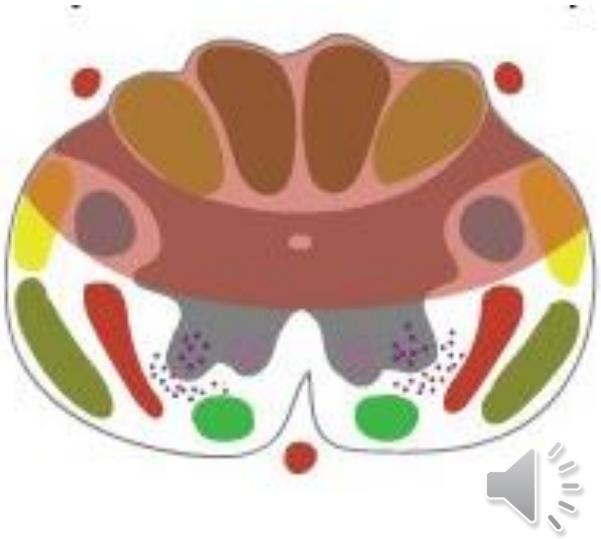




Posterior spinal cord syndrome

- Rare
- Etiology: posterior cervical spinal cord contusion
- Symptoms
  - Paresthesias, sometimes burning pain (neck, arms, torso)
  - Possible motor weakness, minimal long tract signs





Brown-Séquard syndrome

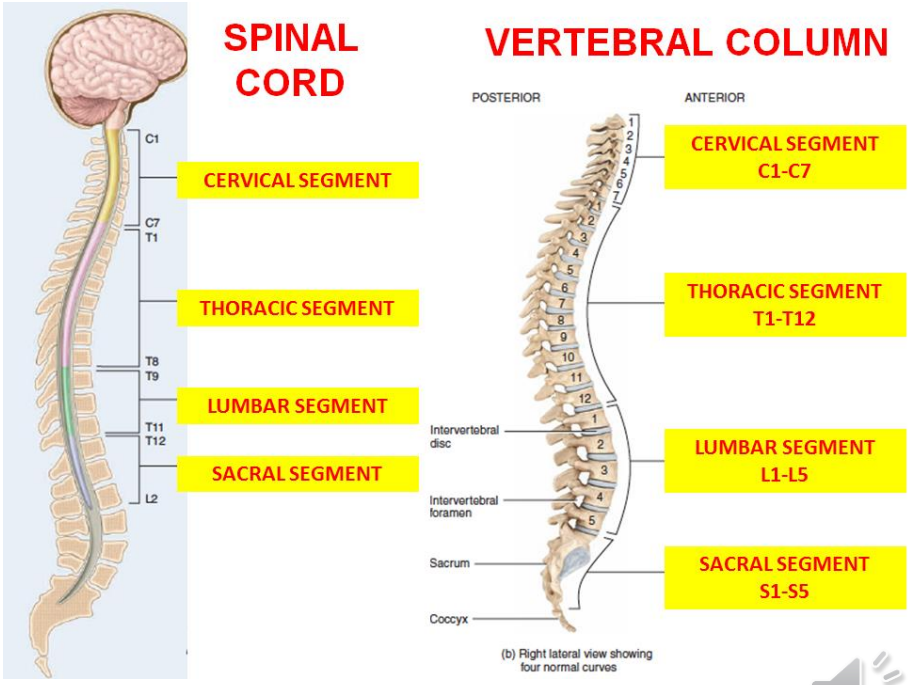
Lesión medular incompleta (LMI)

- Spinal cord hemisection
- **Mechanism**
  - Penetrating trauma > radiation myelopathy, epidural hematoma, tumour…
- **Clinical symptoms**
  - Contralateral: Sensory dissociation
    - Thermoalgesic sensory loss 1-2 segments below injury
  - Ipsilateral: Motor impairment + proprioception loss
- **Diagnosis: MRI**
- **Treatment**
  - If there is compression = surgical decompression
- **Prognosis**
  - 90% achieve ambulation + sphincter control

Anatomical relationship bone canal – spinal cord – nerve roots

- Eight cervical nerve roots come out ABOVE pedicles of vertebra numerically equivalent
  - Thoracic – lumbar – sacral nerves come out below the pedicle
- Bone growth > spinal cord
  - T_2- T_{10} → add +2 to the number of the spinous process
  - T_{11}-L_1 → contain spinal cord from L_1 until coccygeal
  - L_1 vertebra → conus medullaris

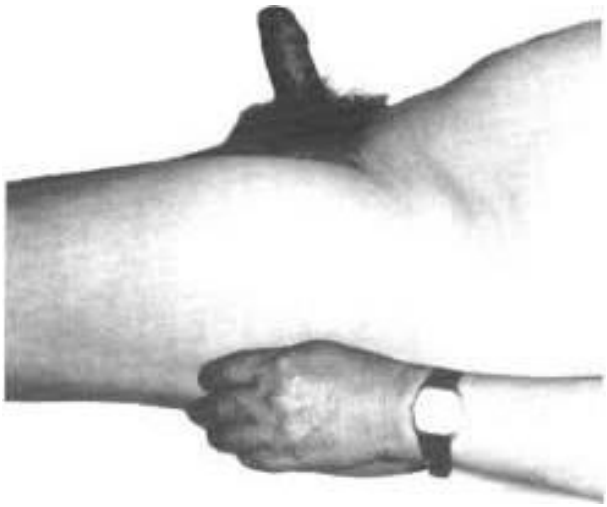
¿REMEMBER?



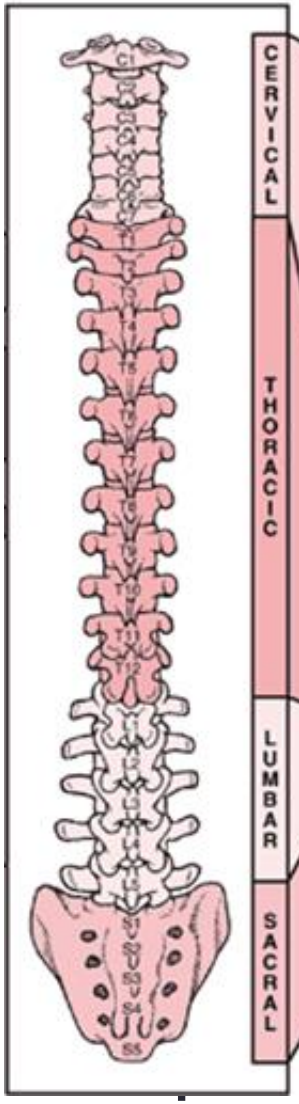
Spinal cord examination

¿REMEMBER?

- Motor level / reflexes
  - $C_4 \rightarrow$ diaphragm
  - $T_2 - T_9 \rightarrow$ intercostal nerves
  - $T_9 - T_{10} \rightarrow$ upper abdominal nerves
  - $T_{11} - T_{12} \rightarrow$ lower abdominal nerves
- Sensory level
  - Pain
  - Proprioception
- Priapism?



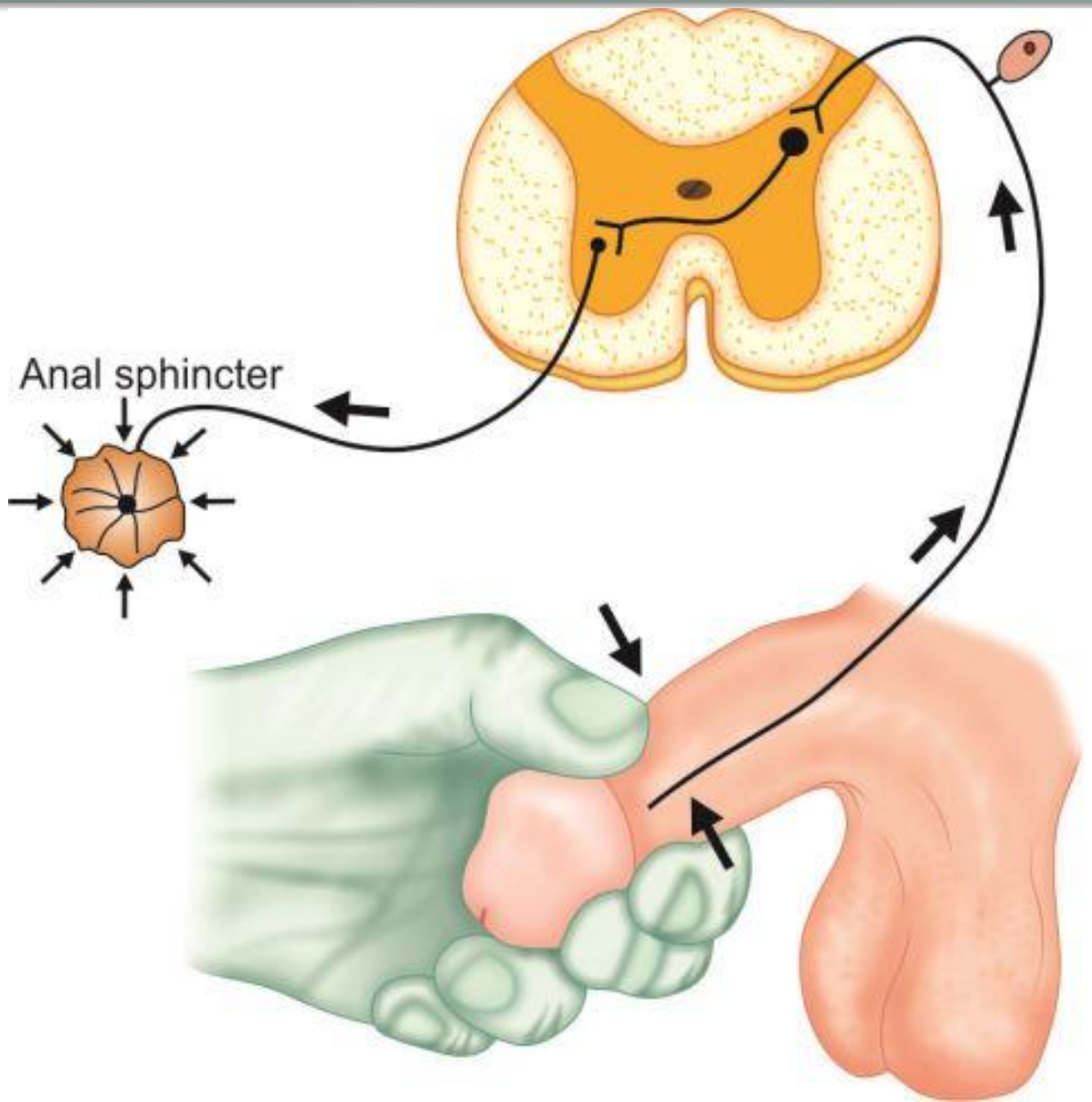
Effects of Spinal Injury



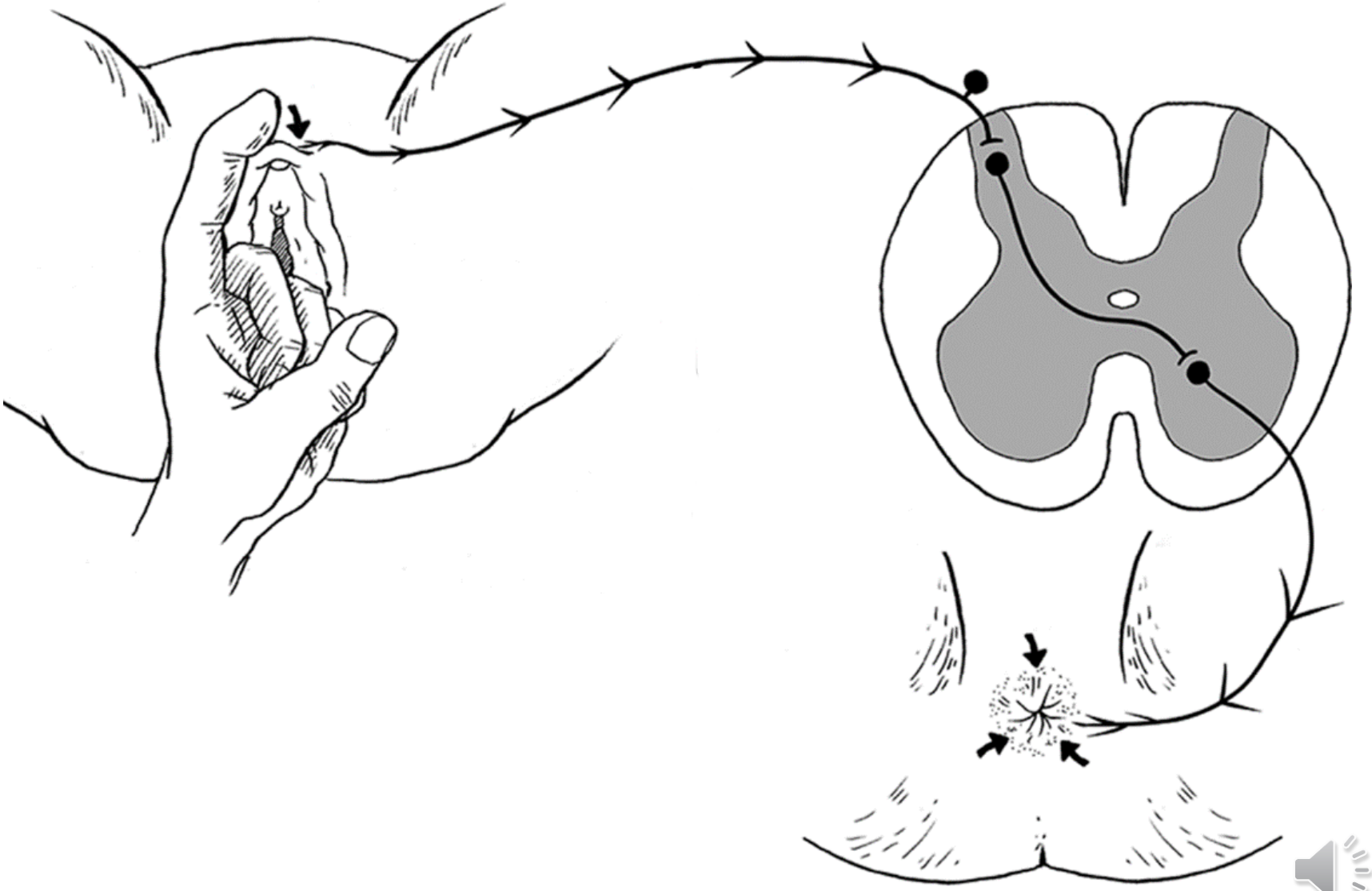
Level of Injury	Effect*
C1 to C5	Paralysis of muscles used for breathing and of all arm and leg muscles; usually fatal.
C5 to C6	Legs paralyzed; slight ability to flex arms
C6 to C7	Paralysis of legs and part of wrists and hands; shoulder movement and elbow bending relatively preserved
C8 to T1	Legs and trunk paralyzed; eyelids droop; loss of sweating on the forehead (Horner's syndrome); arms relatively normal; hands paralyzed
T2 to T4	Legs and trunk paralyzed; loss of feeling below the nipples
T5 to T8	Legs and lower trunk paralyzed; loss of feeling below the rib cage
T9 to T11	Legs paralyzed; loss of feeling below the umbilicus
T12 to L1	Paralysis and loss of feeling below the groin
L2 to L5	Different patterns of leg weakness and numbness
S1 to S2	Different patterns of leg weakness and numbness
S3 to S5	Loss of bladder and bowel control; numbness in the perineum

*Loss of bladder and bowel control can occur with severe injury anywhere along the spinal column

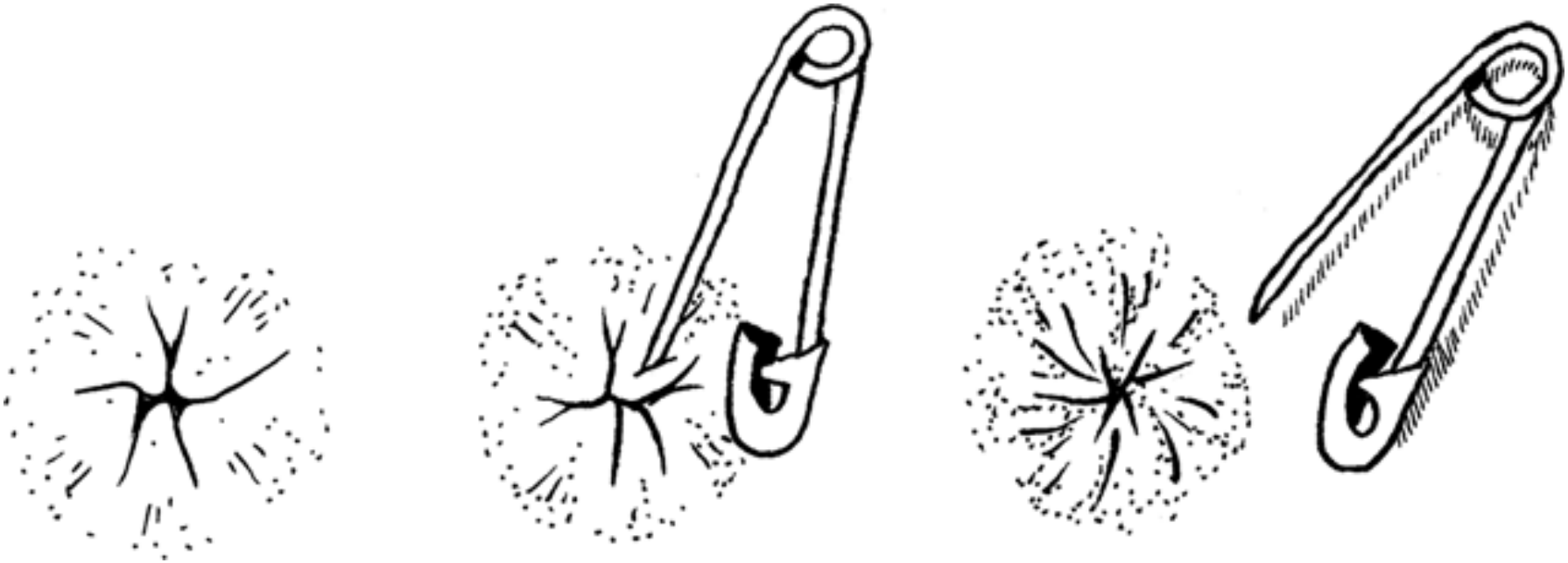
Bulbocavernosus reflex in the male



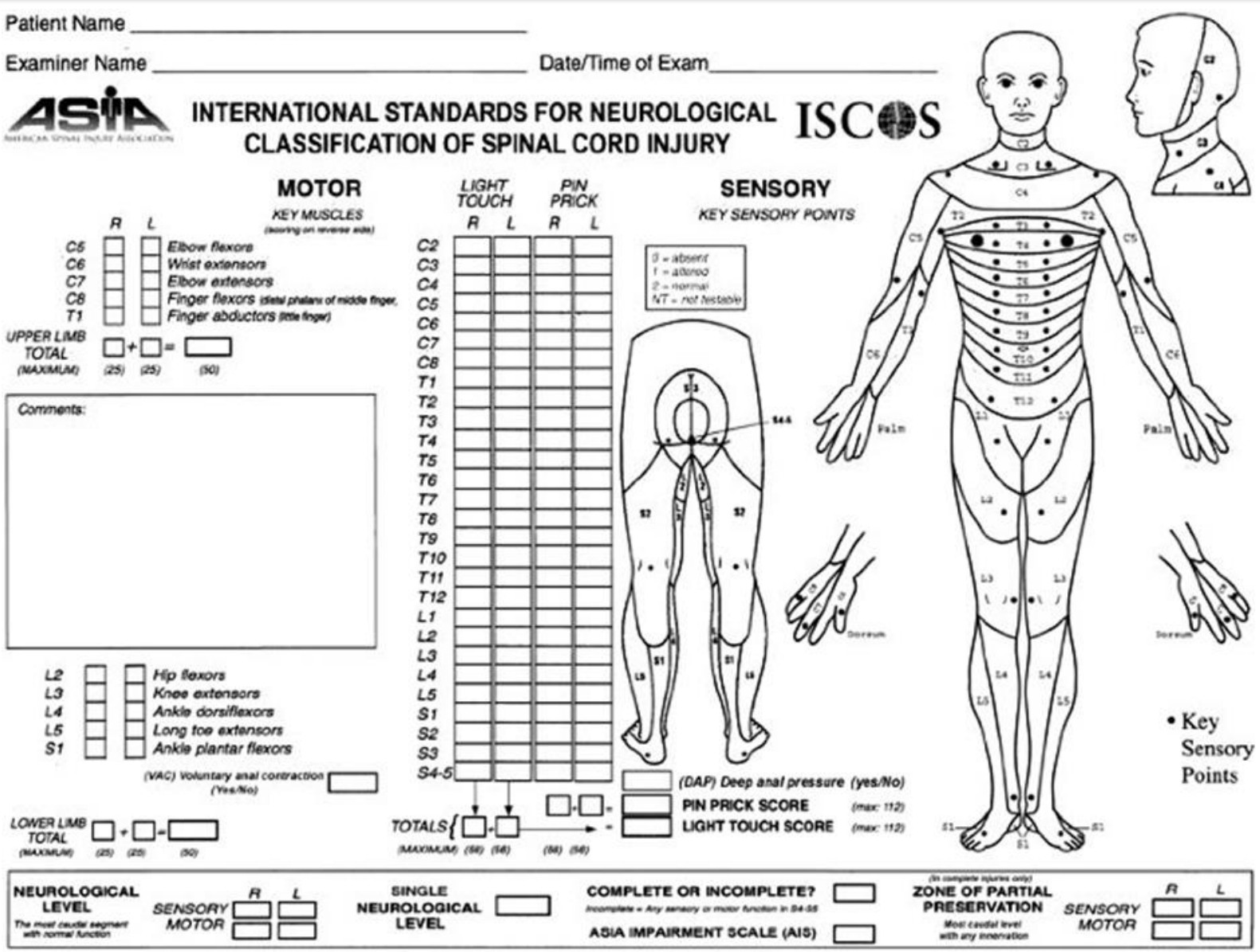
Bulbocavernosus test in the female



Anal reflex



Spinal cord injury classification: ASIA scale



Spinal cord injury classification

American Spinal Injury Association (ASIA) Scale for Traumatic Spinal Cord Injuries		
Class	**Symptoms/Findings**	**Overall recovery of ambulation**
A Complete	No sensory or motor function is preserved in the sacral segments S4-S5.	2.5-10%
B Sensory incomplete	Sensory but not motor function is preserved below the level of injury, including the sacral segments.	33%
C Motor incomplete	Motor function is preserved below the level of injury, and more than half of muscles tested below the level of injury have a muscle grade less than 3	75%, moreso in patients <50yo
D Motor incomplete	Motor function is preserved below the level of injury and at least half of the key muscles below the neurological level have a muscle grade of 3 or more.	100%
E Normal	No motor or sensory deficits, but deficits existed in the past.	

Initial treatment

- **Suspicion**:
  - Trauma victims especially if loss of consciousness
  - Minor trauma but neurological symptoms or spinal pain
  - Suggestive findings: abdominal breathing, priapism
- **Treatment according to patient situation**
  - Significant trauma without clear evidence of spinal cord injury → rule out bone injury to prevent secondary spinal cord damage
  - Neurological deficit → define spinal damage → stabilisation

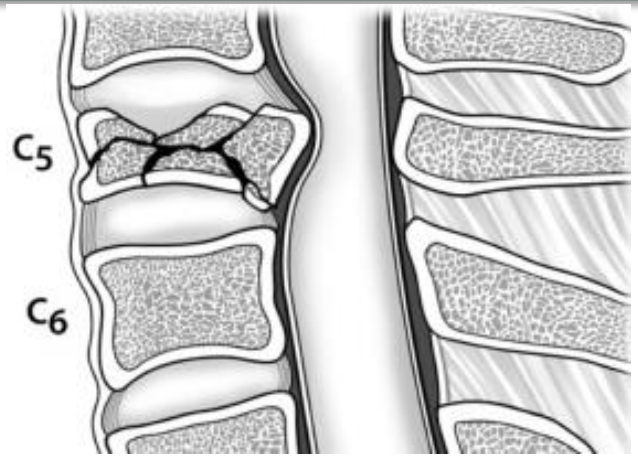
Stabilisation – Evaluation – Treatment

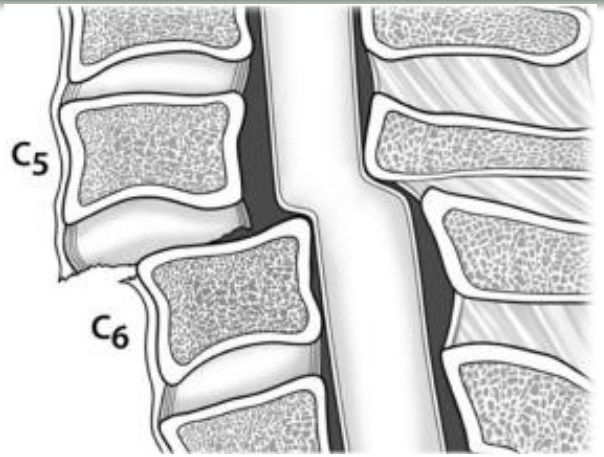
Neck collar

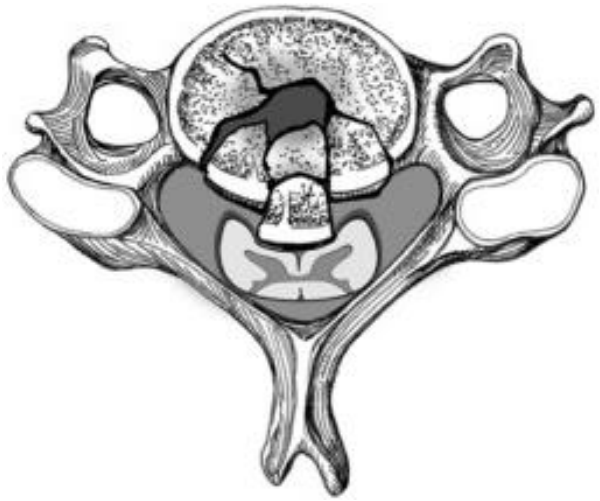
Halo-jacket

Corset

Need for spinal column immobilisation





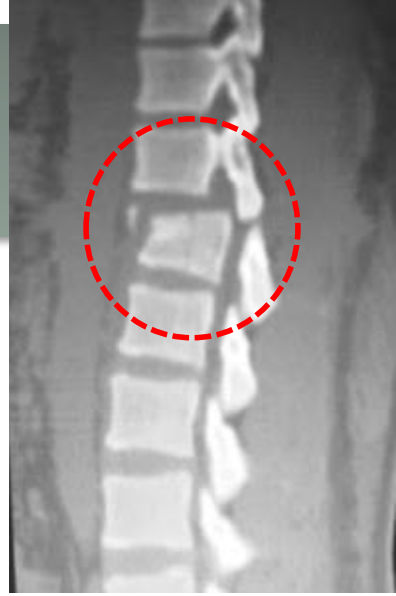
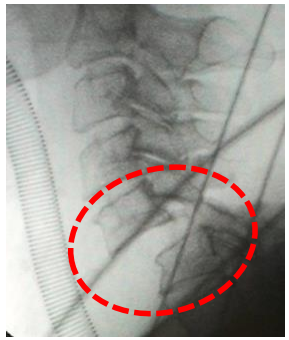
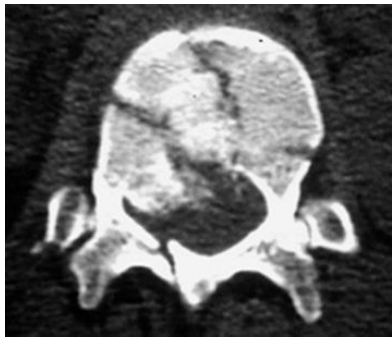


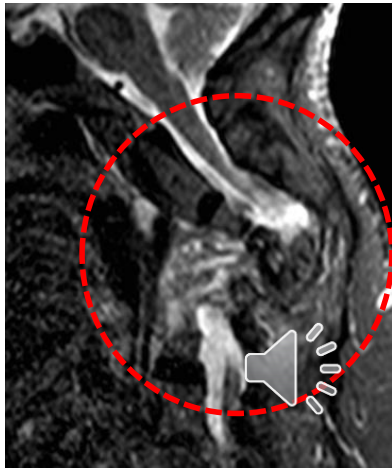
Vertebral body burst

Fracture-dislocation

Hospital treatment

- **Stabilisation**
  - Avoid movements until defining bone injury!
  - Orthosis/traction/reduction?
- **Evaluation**: radiological image
  - Plain x-ray flexion/extension?
  - Helical CT → 3D bone damages/hematoma
  - MRI → spinal cord/nerve root injury/hematoma
- **Treatment**
  - Urgent surgical decompression/fusion
  - Methyl-prednisolone (30 mg/kg in 15' + 45' pause + infusion 5'4 mg/kg/h) not recommended



ANY QUESTIONS?

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