Degenerative Spine Diseases

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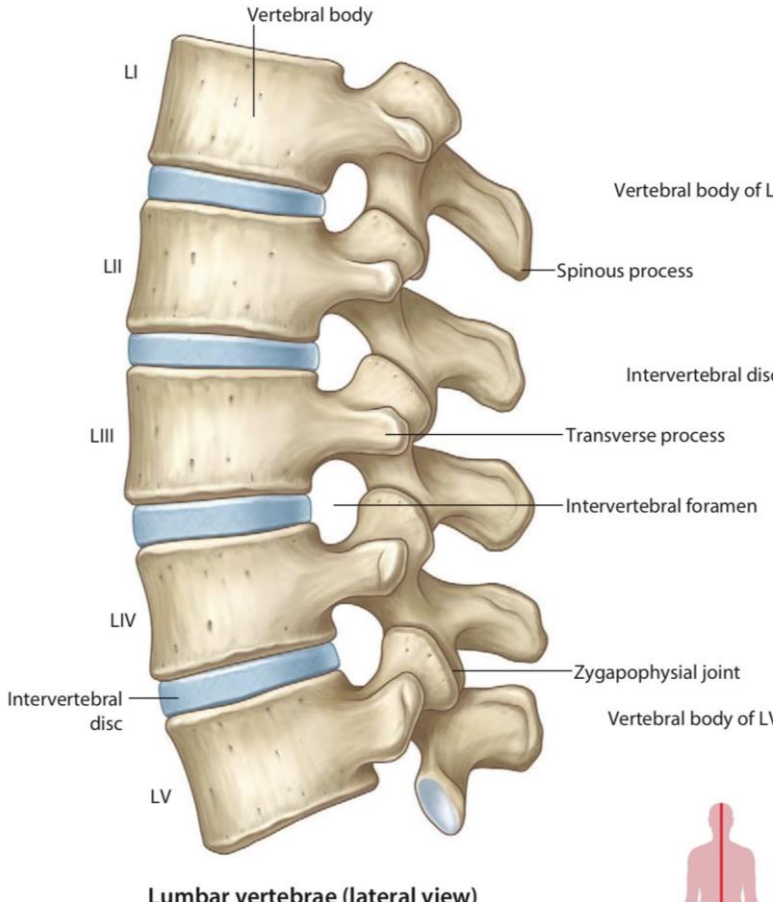
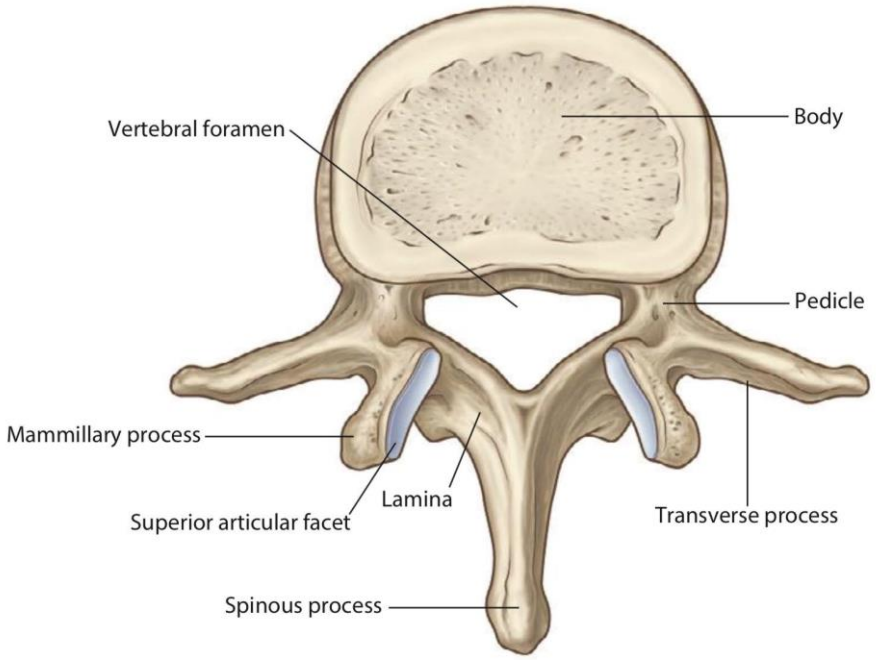
THE FOLLOWING TOPICS WILL BE COVERED IN THIS LECTURE

- Anatomy
- Glimpse of degenerative spinal diseases, clinical manifestations, diagnosis
- Emergencies (cauda equina and conus medullaris syndromes)
- Cervical disc prolapse
- Lumbar disc prolapse
- Spinal Stenosis
- Spondylosis
- Spondylolisthesis
- Differential Diagnoses

Anatomy

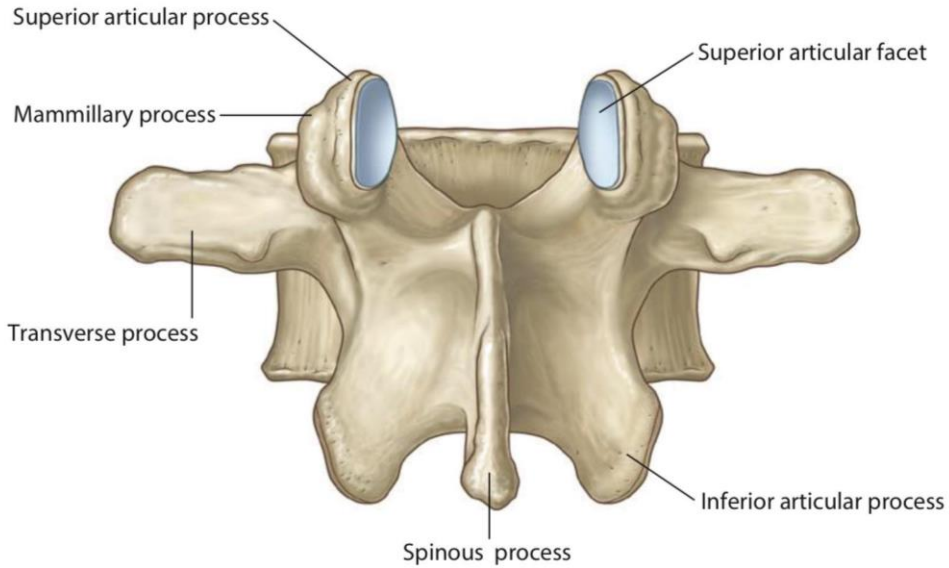


Lumbar vertebrae (lateral view)

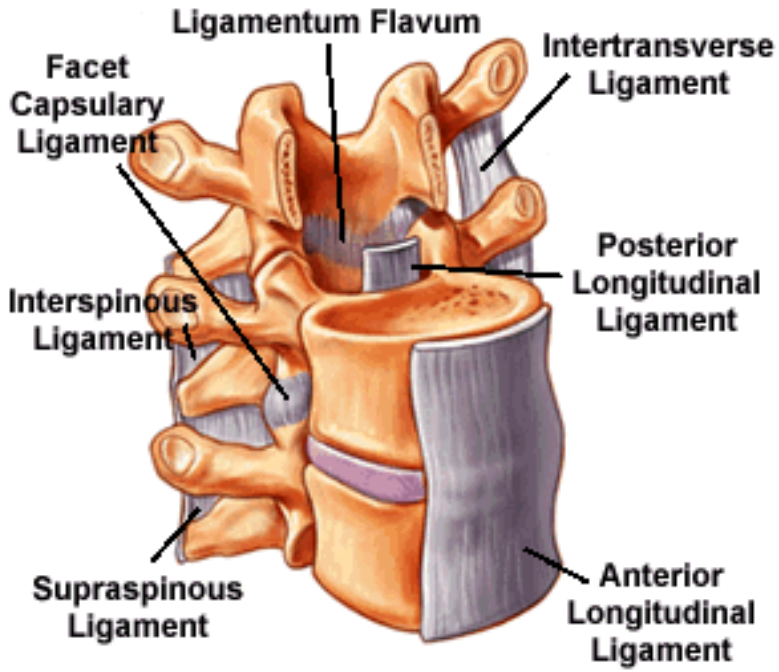


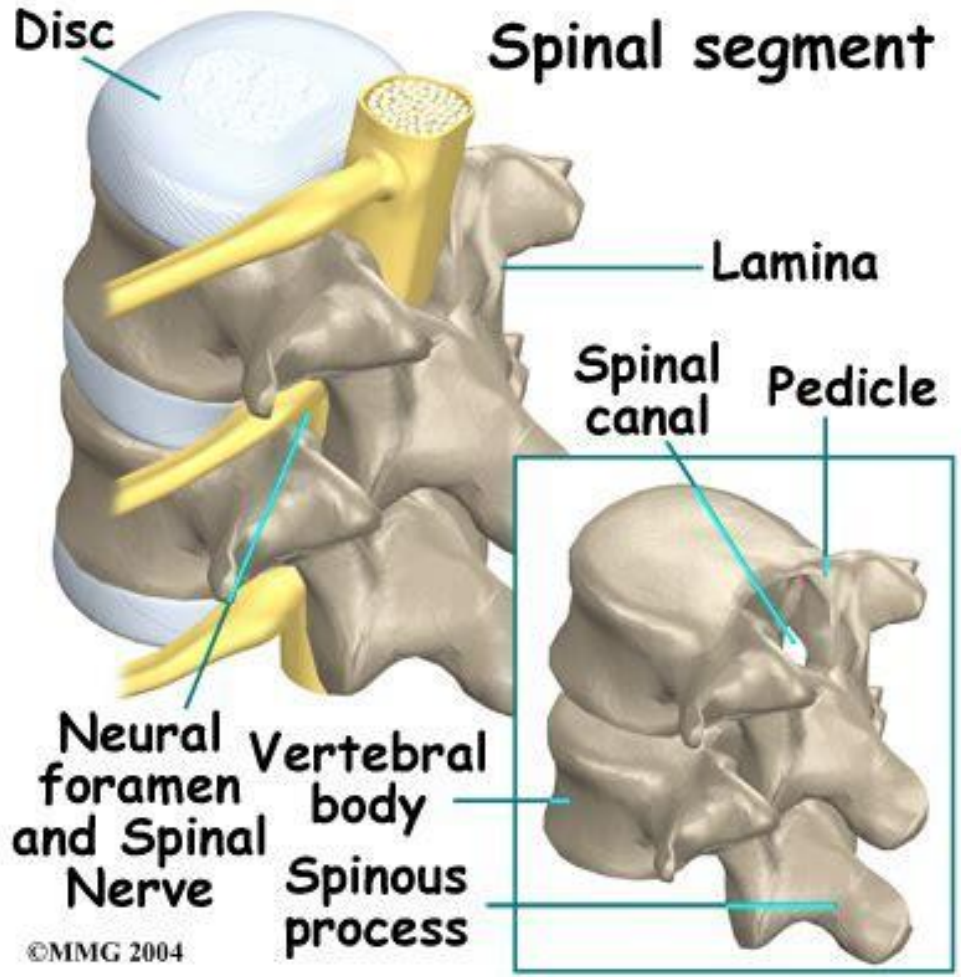
LIV vertebra (superior view)

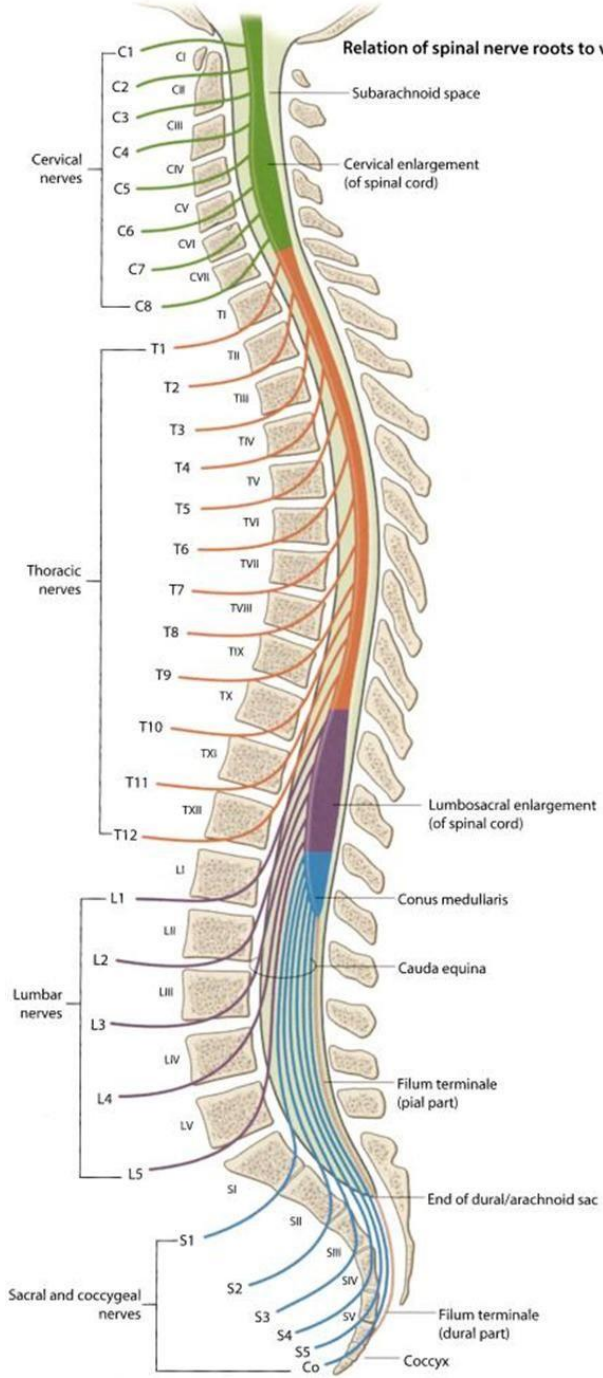
LIV vertebra (superior view)



LIV vertebra (posterior view)




Disc
Spinal segment
Lamina
Spinal canal
Pedicle
Neural foramen and Spinal Nerve
Vertebral body
Spinous process
©MMG 2004


Relation of spinal nerve roots to vertebrae
Subarachnoid space
Cervical enlargement (of spinal cord)
Lumbosacral enlargement (of spinal cord)
Conus medullaris
Cauda equina
Filum terminale (pial part)
End of dural/arachnoid sac
Filum terminale (dural part)
Coccyx
Cervical nerves
Thoracic nerves
Lumbar nerves
Sacral and coccygeal nerves
C1
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3
T4
T5
T6
T7
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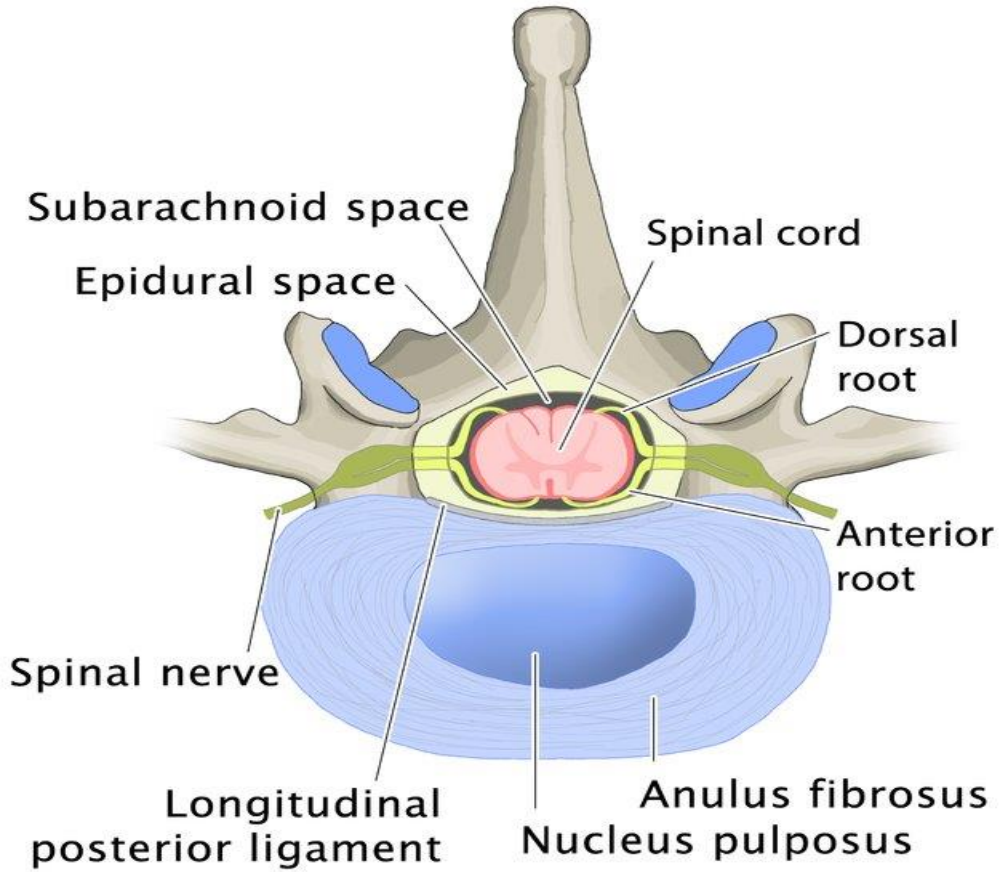
SV

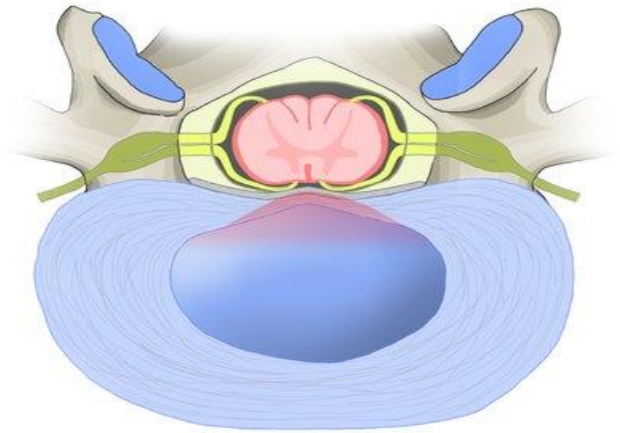
DEFINITION

- Degenerative spine conditions result from wear and tear, involve the gradual loss of normal structure and function of the spine over time.
- Compression, tension, shear, and torque stresses on the spinal disc → **degenerative changes** (e.g., dehydration, annular tear) → disc protrusion or herniation → adjacent **nerve root impingement** → **sensorimotoric deficits** in affected nerve root

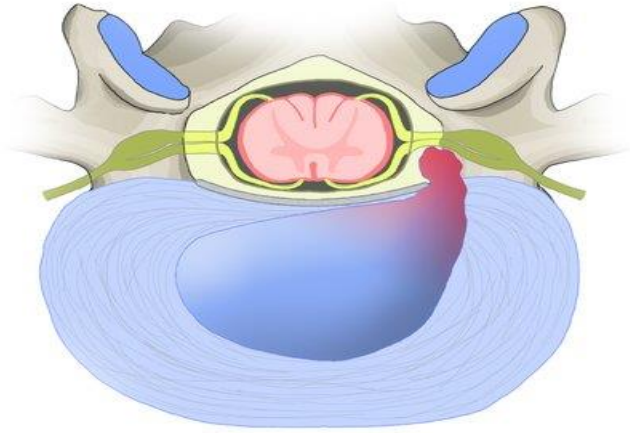
- Factors

1- Overweight
2- Aging (wear and tear)
3-Genetic Factors
4- Smoking (affection of disk vascularity)

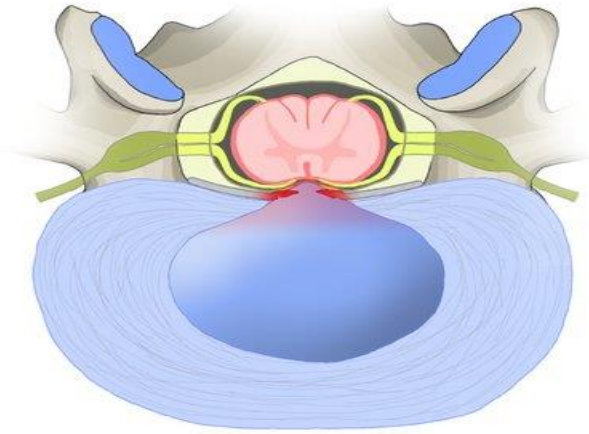




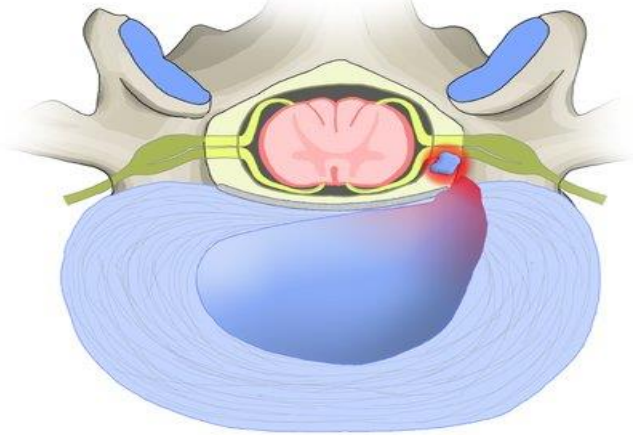
Disc protrusion



Lateral disc prolapse



Medial disc prolapse



Disc sequestration

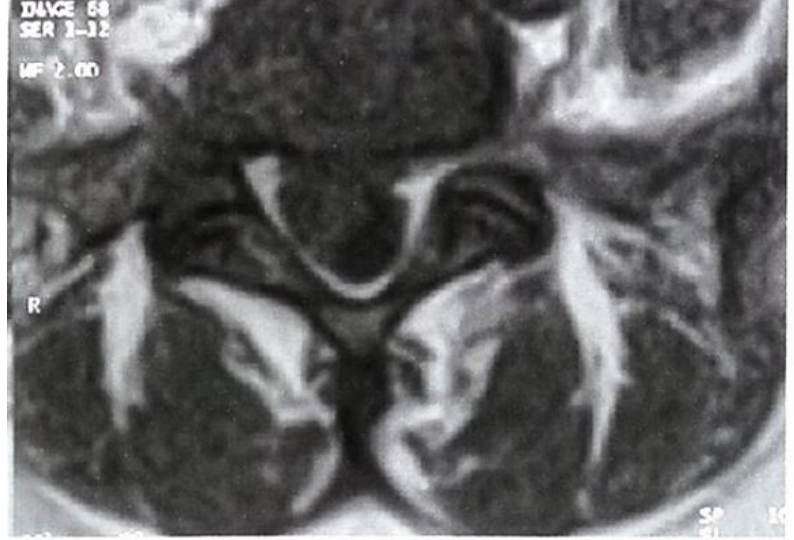
Disc protrusion (bulge): Pressure on the vertebra causes nucleus pulposus, to move and press against the annulus fibrosus. compressing a spinal nerve and thus causes pain.

Disc Prolapse: tear in annulus fibrosus results in the extrusion of nucleus pulposus and ..

- Lateral: compression of the spinal nerve in intervertebral foramen.
- Medial: rupture of the longitudinal posterior ligament.

Disc herniation: (= disc extrusion or disc prolapse): A tear in the anulus fibrosis results in extrusion of the nucleus pulposus and potential compression of the spinal nerve

Disc sequestration: Extrusion of the nucleus pulposus and separation of a fragment that enters the spinal canal and may cause compression of the spinal nerve.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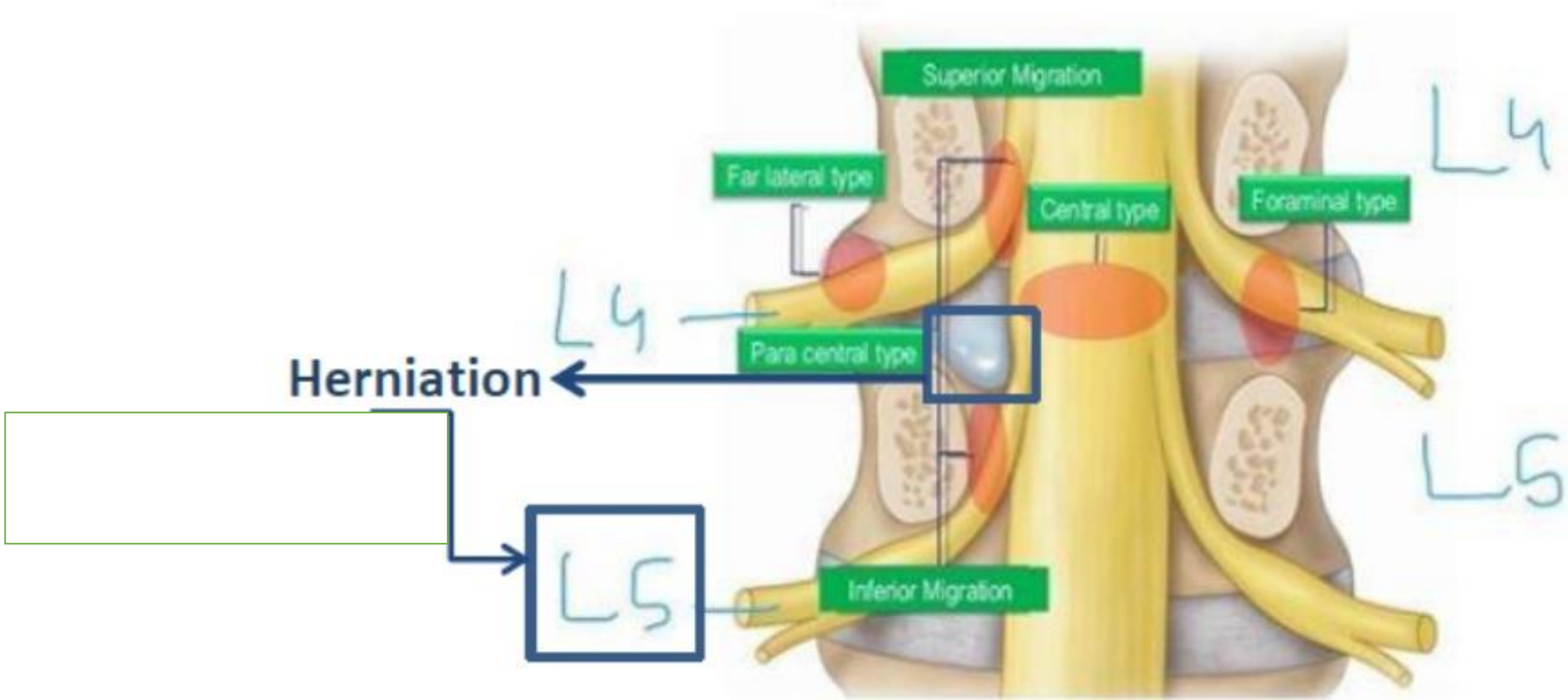
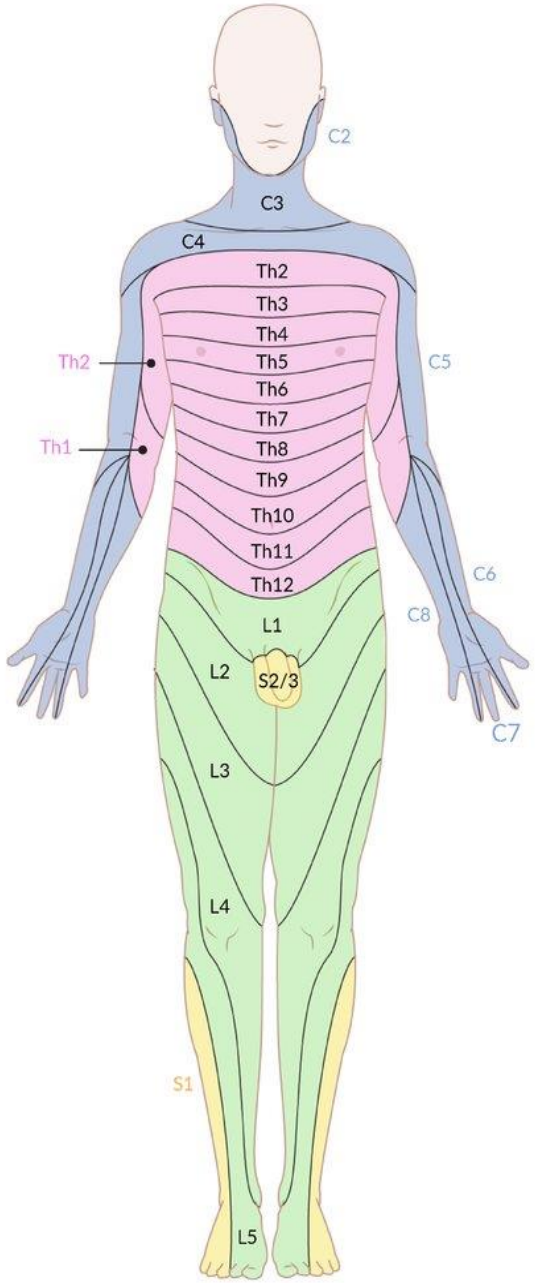
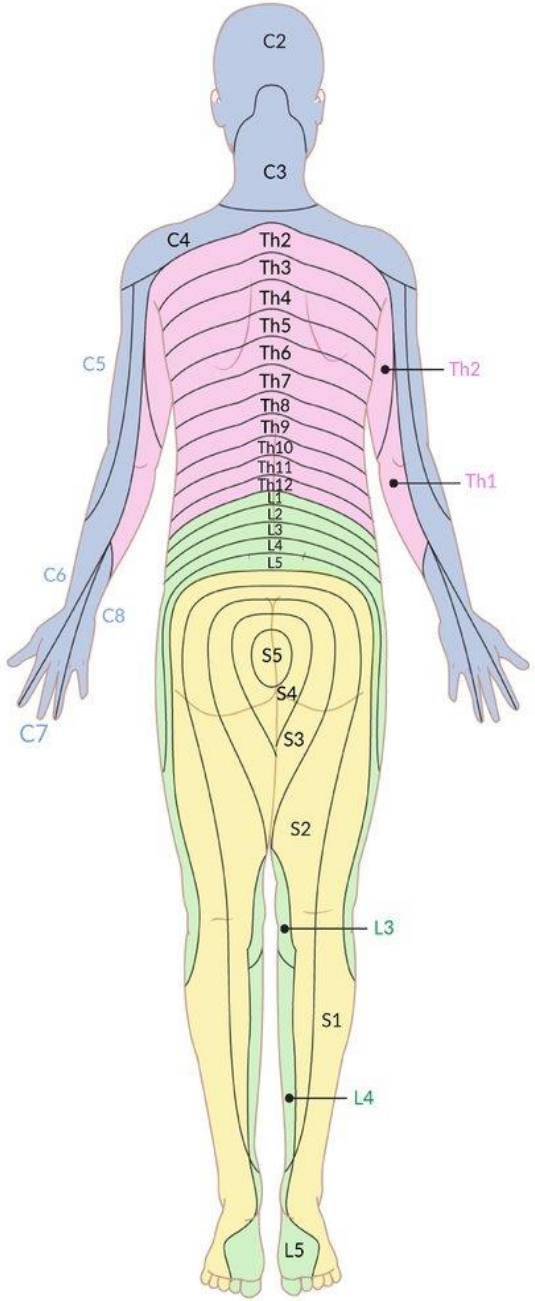
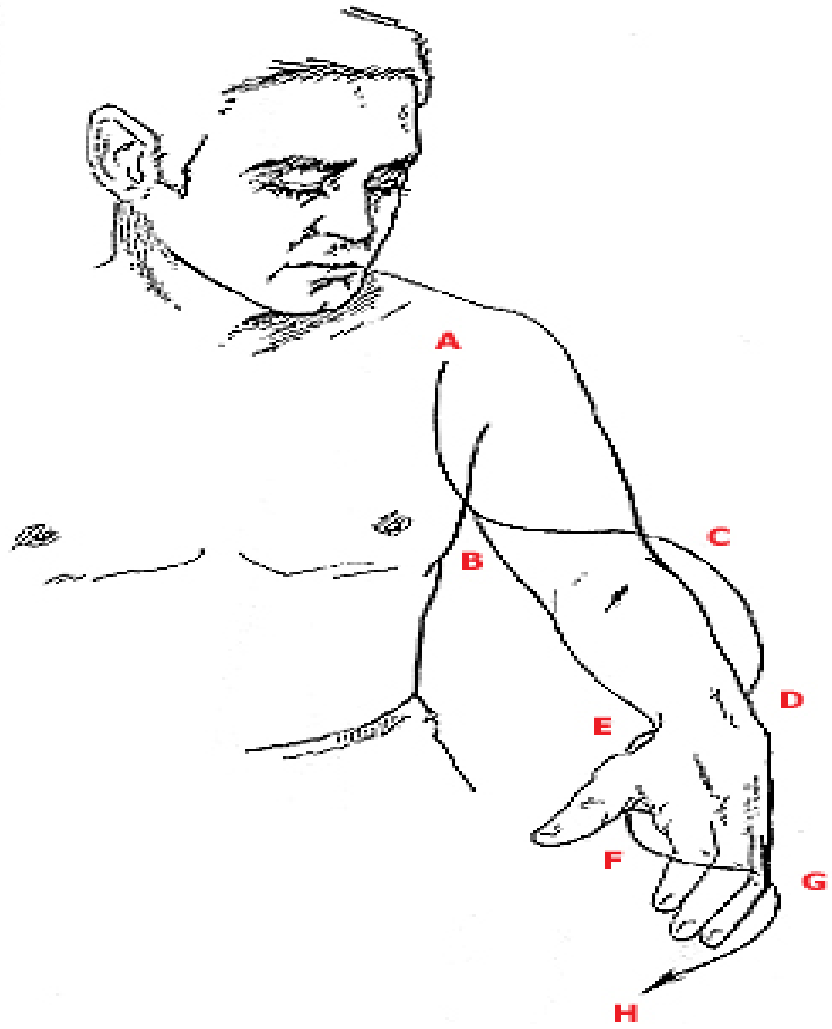

Superior Migration
Far lateral type
Central type
Foraminal type
L4
L4
Herniation
Para central type
L5
L5
Inferior Migration

Clinical manifestations

- General manifestations:
- neck/ thoracic/ lumbar pain
- Morning stiffness
- Inability to perform daily tasks
- Radiculopathies (root pain/ paresthesia/ anaesthesia or Muscle Weakness or Urinary complaints or intermittent claudication)
- myelopathies (below the area of affection paresthesia/ anesthesia, spasticity during walking and bladder symptoms)

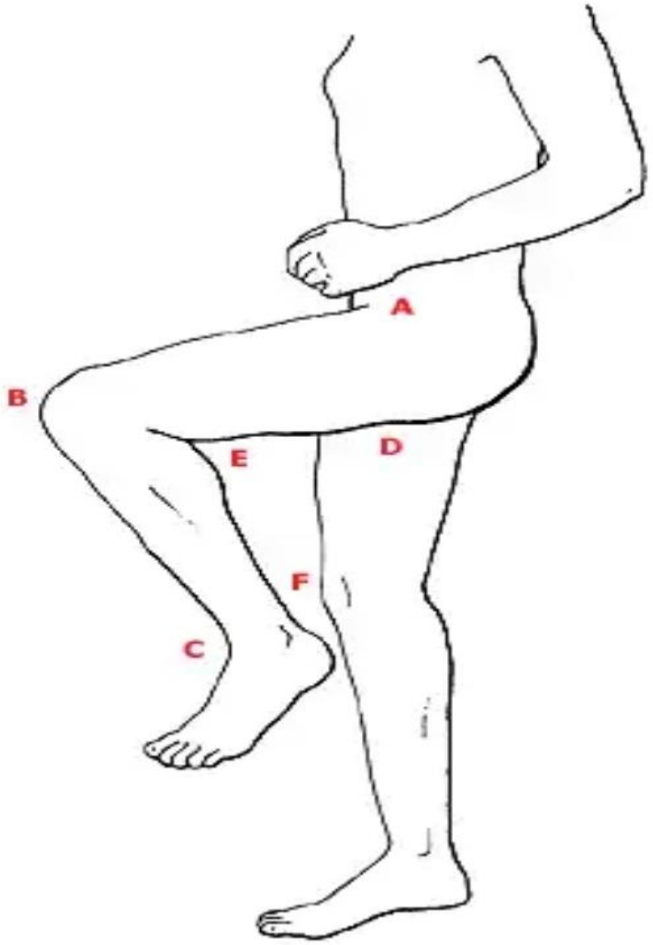






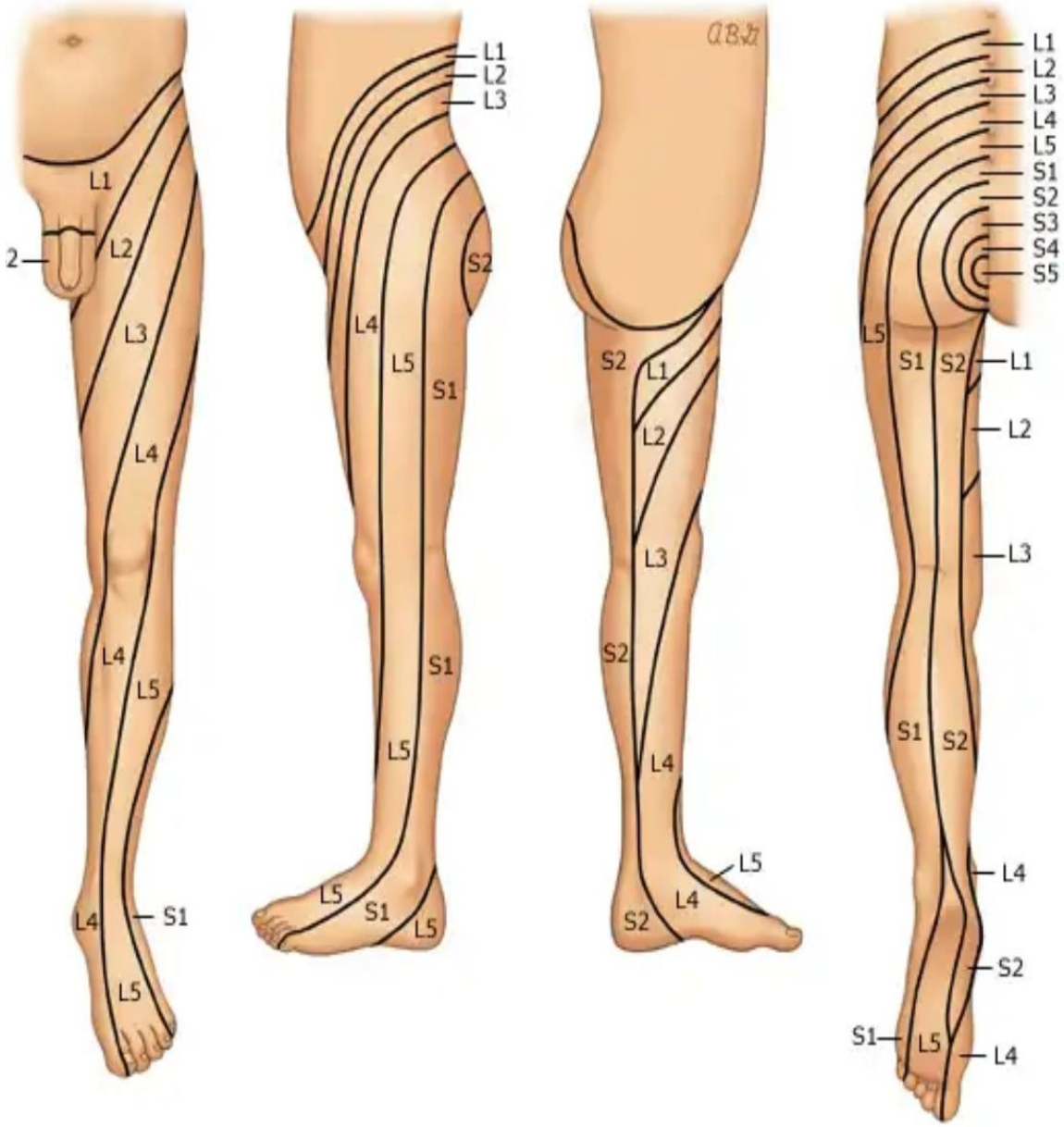
Movement	Nerve root	Peripheral nerve
A. Shoulder abduction	C5	Axillary
B. Elbow flexion	C5-6	Musculocutaneous
C. Elbow extension	C6-7	Radial
D. Wrist extension	C6-7	Radial
E. Wrist flexion	C7-8	Median
F. Finger flexion	C8	Median
G. Finger extension	C8	Radial
H. Finger abduction	T1	Ulnar

Nerve roots and peripheral nerves corresponding to the principa movements of the lower extremity



Movement	Nerve roots	Peripheral nerve
A. Hip flexion	L2-3	Femoral ("nerve to iliopsoas")
B. Knee extension	L3-4	Femoral
C. Ankle dorsiflexion	L4-5	Peroneal
D. Hip extension	L4-5	Gluteal
E. Knee flexion	L5-S1	Sciatic
F. Ankle plantar flexion	S1-2	Tibial

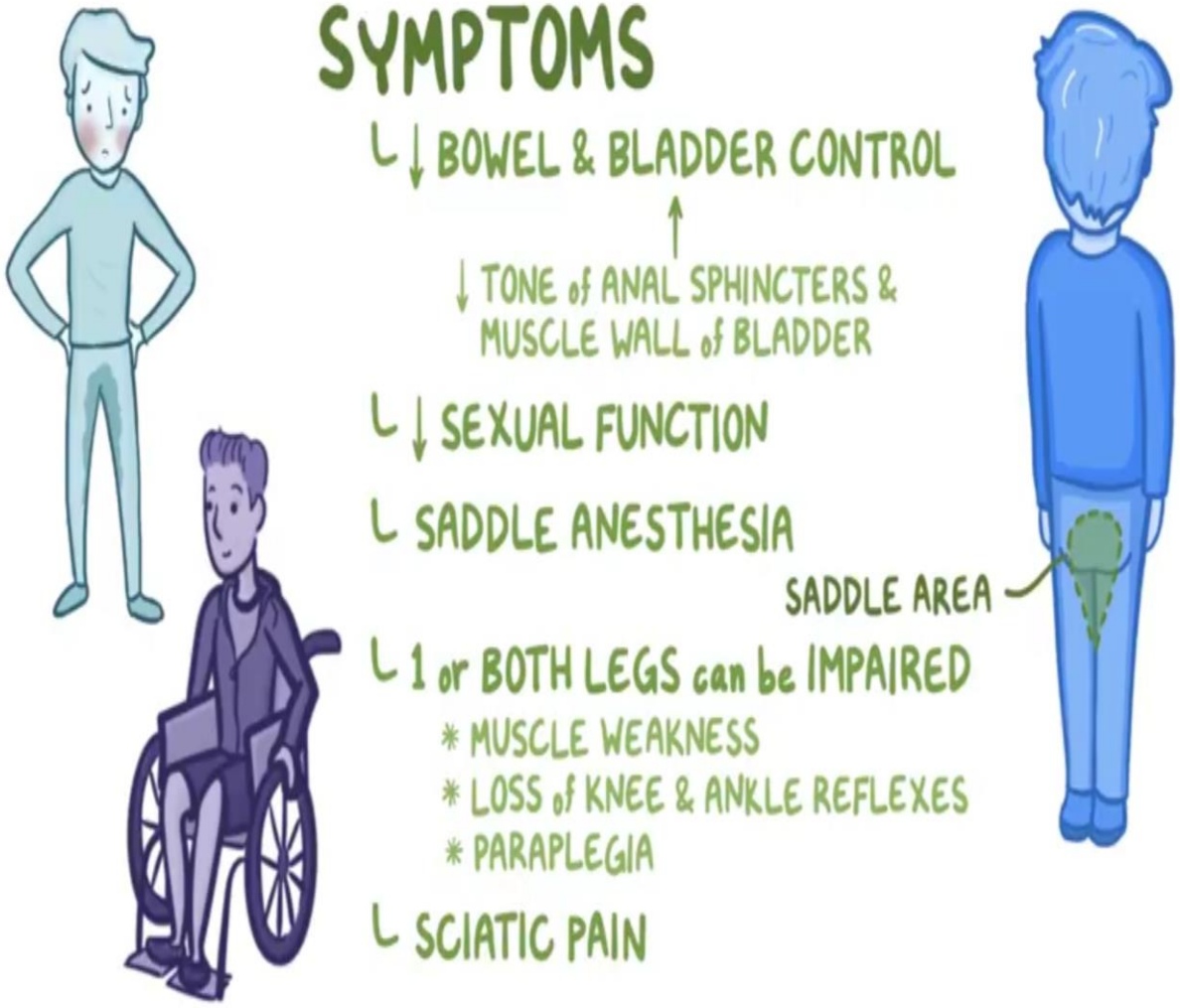
mbosacral dermatomes



diagnosis

- History
- Physical Examination
- We know the importance of MRI
- What about X-rays (plain radio)?
- Widened bony canals
- Straightening of spine due to muscular spasm
- Spinal tumors??
- Congenital anomalies
- Other spine instabilities

Cauda Equina is caused by the loss of functions of two or more of the 18 or 19 nerve roots



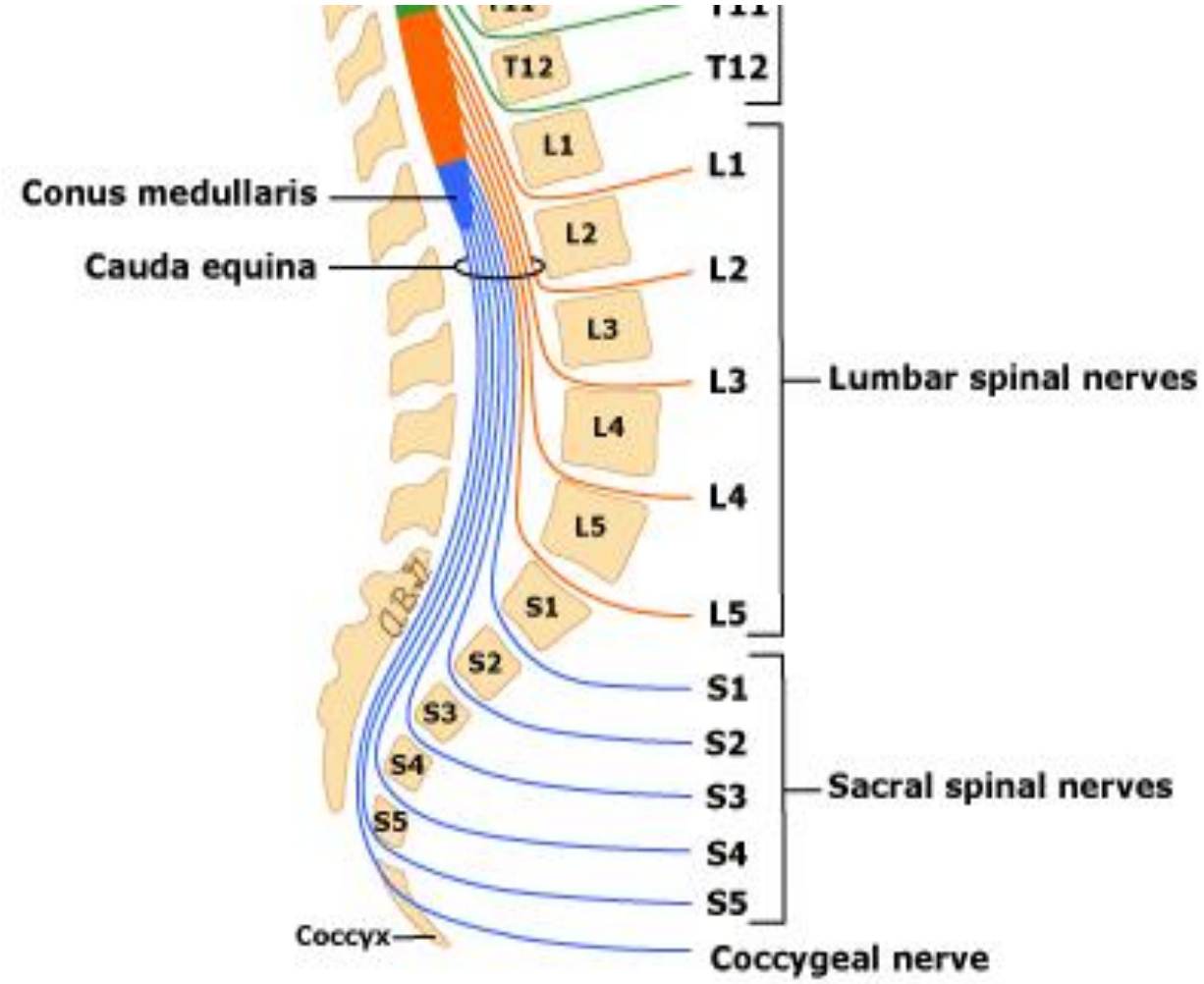
Lumbar disc herniation is most common cause (large posteromedial)

Other causes: spinal stenosis and spondylothesis

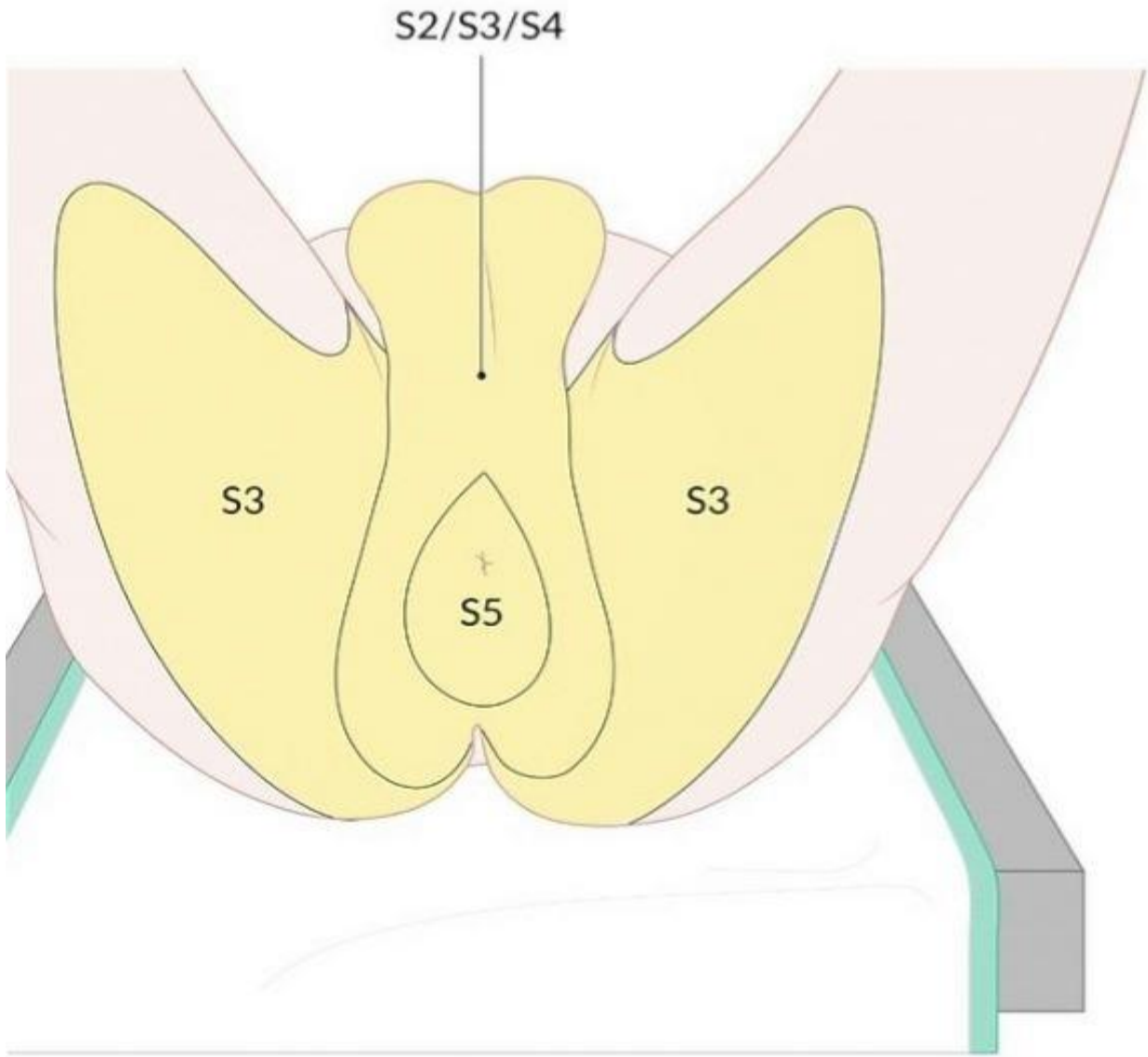
Injuries to L2 frequently damage the conus medullaris. Injuries below L2 usually involve the cauda equina

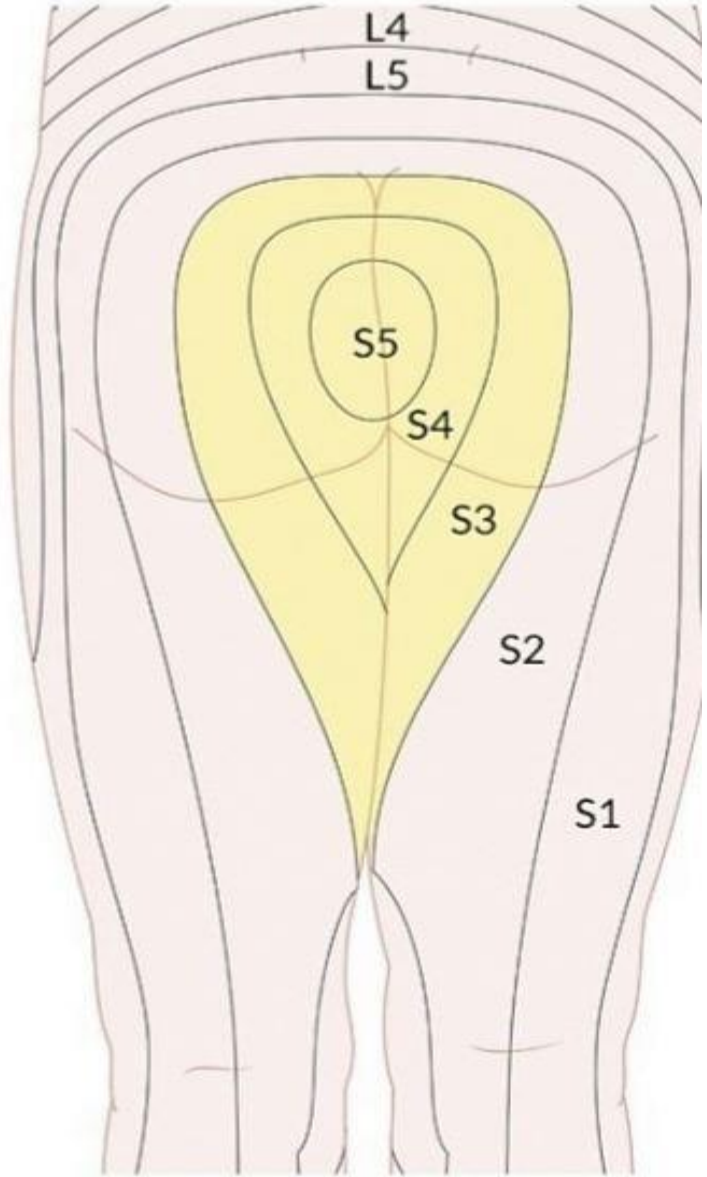
Patients can present with symptoms of isolated cauda equina syndrome, isolated conus medullaris syndrome, or a combination.

LMN vs UMN



	CONUS MEDULLARIS UMN	CAUDA EQUINA LMN
PRESENTATION	Sudden, Bilateral	Gradual, unilateral
REFLEXES	Only ankle jerks are affected	Both ankle and knee
RADICULAR PAIN	Less severe (cord)	More severe (root)
LOW BACK PAIN	More	less
SENSORY	Numbness more localized to perianal area Sensory dissociation?	Numbness more localized to saddle (S3-S5) anesthesia.
MOTOR STRENGTH	symmetric, hyperreflexia	Asymmetric, arrefexia
IMPOTENCE	Erectile dyfunction	Erectile dysfunction
SPHINCTER	early	late


S2/S3/S4
S3
S3
S5


L4
L5
S5
S4
S3
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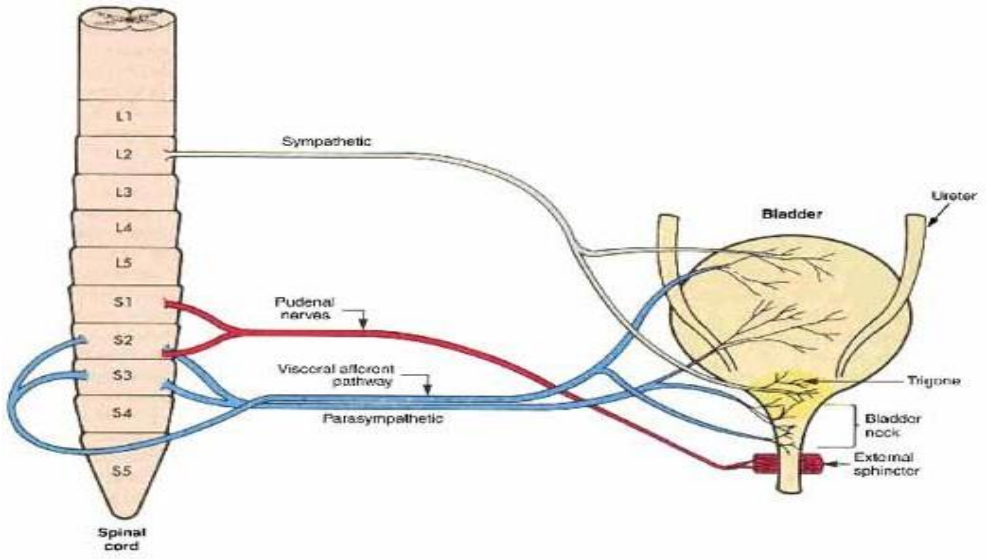
S1

- **Conus medullaris syndrome** —

1. early and prominent sphincter dysfunction with flaccid paralysis of the bladder and rectum, impotence
2. Leg muscle weakness may be mild if the lesion is very restricted and spares both the lumbar cord and the adjacent sacral and lumbar nerve roots.
3. Causes include disc herniation, spinal fracture, and tumors [11,27].



Cervical disc prolapse

- 7 cervical vetebrae
- 8 cervical nerve roots.
- First cervical root exists between occiput and C1
- 6th cervical root exists between C5 and C6
- 8th cervical root exists between C7 and T1

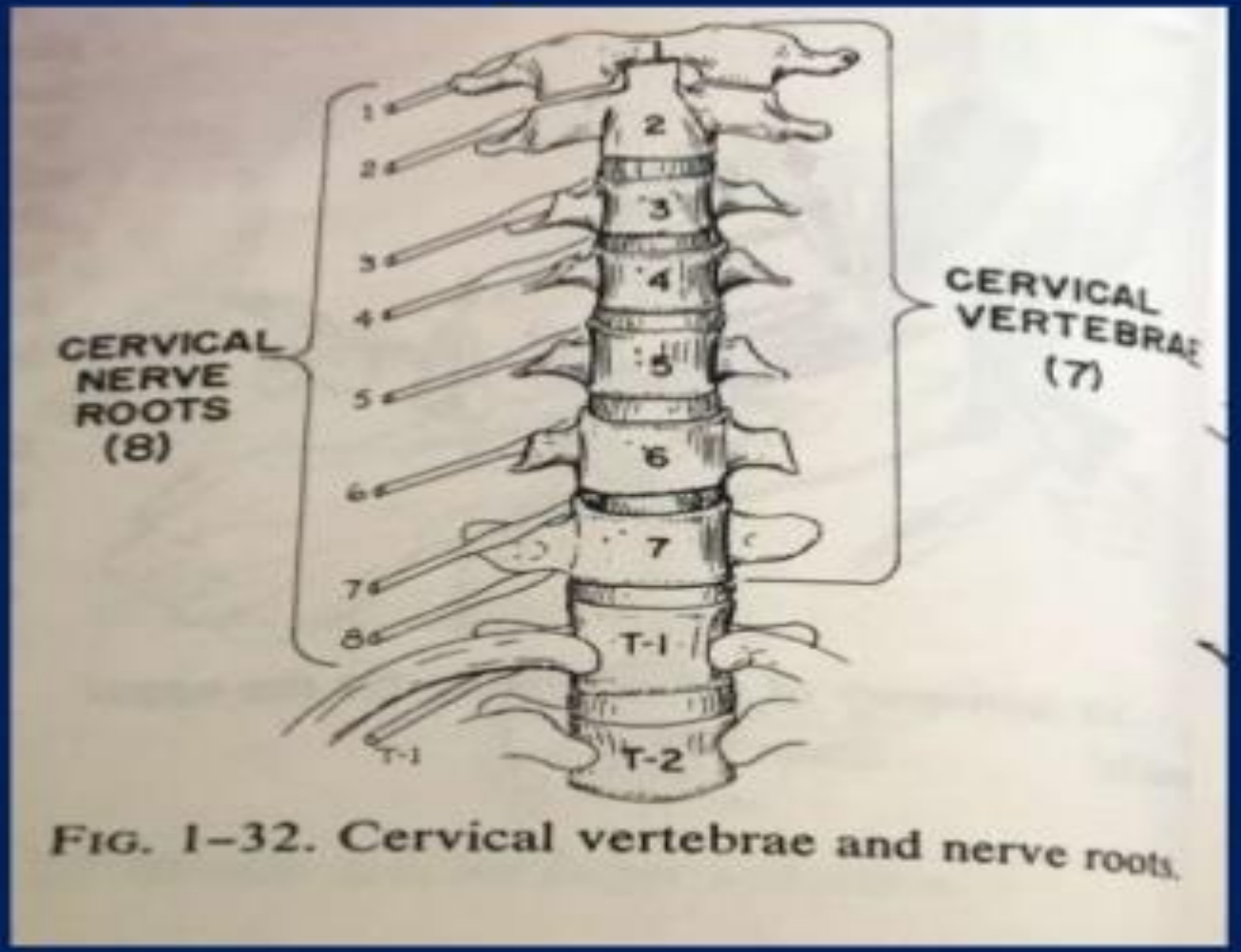
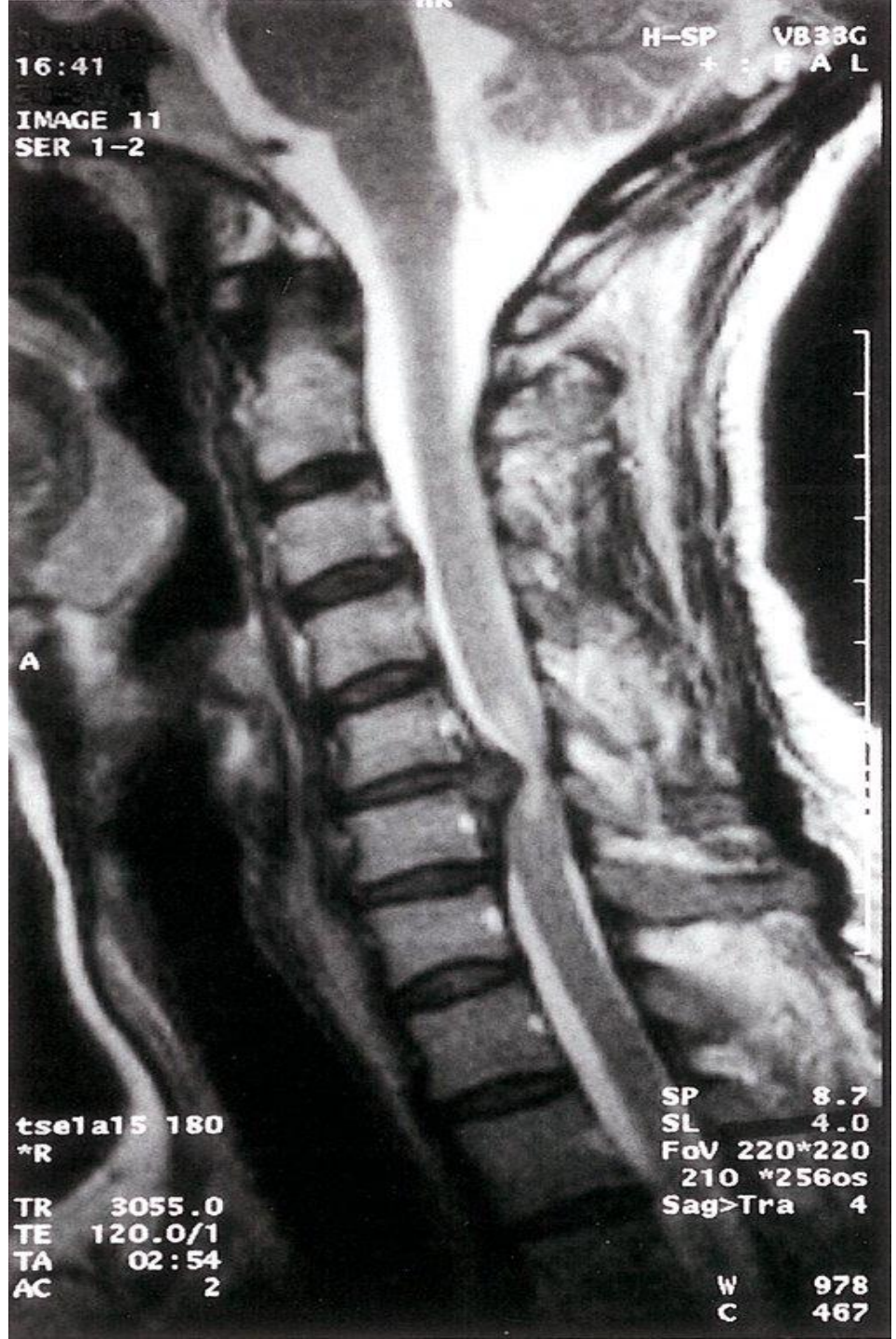


FIG. 1–32. Cervical vertebrae and nerve roots.

- Nerves in the Cervical region, unlike the lumbar region, directly passes laterally.
- **Spurling's maneuver** (neck compression test) Used for diagnosis of cervical spine radiculopathy.. Forward flexion , tilting, and rotation of the neck towards the affected side and application of downward pressure to the head → reproduction of pain or paresthesia with radiation to the motor/sensory area of the affected nerve root
  - Highly specific, but not negative (absence of pain doesn't mean negative)
- Lhermittes (Barber Chair) electrical shock reaching the limb due to flexion or extension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Non operative Management

- Weight loss
- Painkillers
- Physiotherapy
- Rest

Cervical myelopathy
Failure of nonoperative
Neurological deficits

Operative Management

Lumbar prolapse disc :

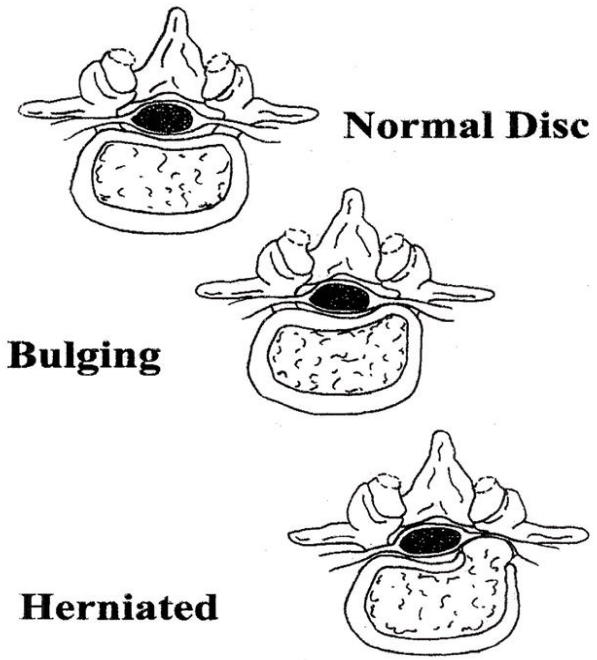
disk herniation results in a definite mechanical neural compression that is responsible for dysfunction of the compressed nerve root.

Symptoms may be motor (weakness along a myotome) or sensory (numbness/paraethesias across a dermatome). In severe cases, loss of bladder or bowel control may ensue; this is known as the cauda equina syndrome.

https://emedicine.medscape.com/article/1263961-overview

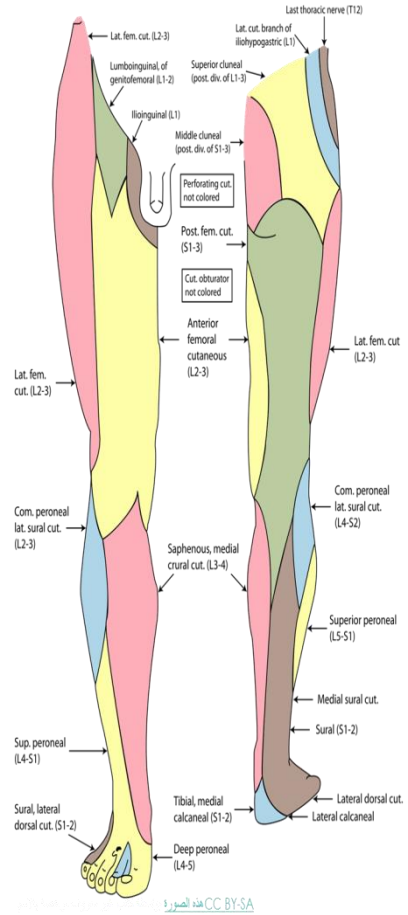
Nuclear material is normally contained within anulus, but it may cause bulging of anulus or may herniate through anulus into spinal canal. This commonly occurs in posterolateral location of intervertebral disk.

https://emedicine.medscape.com/article/1263961-overview#a1



A dermatome is an area of skin that is mainly supplied by a single spinal nerve, while a myotome is the group of muscles that a single spinal nerve innervates).

we expect to find specific symptoms (abnormal muscle reflex in a certain myotome and pain sensation in a certain dermatome)
according to the affected nerve.



1- L3-L4, IVD herniation(3-10)%:

Now, what are the symptoms of such a herniation?

The patient will manifest a weakness in muscle reflexes in those muscles that are innervated via L4 spinal nerve (myotome), and they will feel numbness in the skin that is innervated via this nerve(dermatome).

The patient will manifest a weakness in the muscles, mainly the quadriceps muscle which extends the knee joint. The Quadriceps Femoris muscle is innervated by the femoral nerve which originates from the L2, L3 and L4 roots of spinal cord. And we can test the myotome by a test called "Knee Jerk" .

The patient will suffer from abnormal sensation in the anteromedial side of the leg (L4 root dermatome) which is innervated by the saphenous nerve, which is a branch of the femoral nerve (L2,L3,L4).

2- L4-L5 IVD herniation (40-45)% very common:

And such a herniation will press the root of L5 causing muscle weakness, mainly in Extensor Hallucis longus and Tibialis Anterior muscles, both are found in anterior compartment of the leg (dorsiflexion of the foot).

The patient will suffer from abnormal sensation in the anterolateral side of the leg and big toe (L5 root dermatome, which is innervated by the superficial peroneal (or the common Peroneal),which is the son of the sciatic nerve that has the root value of L4-S3.

3- L5-S1 IVD herniation (45-50)%, the commonest:

And such a herniation will press the root of S1 causing muscle weakness, mainly in the Gastrocnemius, which is found in posterior compartment of the leg (Plantar flexion) . And it is common to ask your patient to stand on his tiptoes (plantar flex his foot) upon testing this root (S1). If the patient could, then the root is not pressed. But if they found a difficulty to do so, then we expect the herniation.

The ankle jerk reflex .

The patient will suffer from abnormal sensation in the lateral aspect of the foot (S1 root dermatome) innervated by the Sural nerve, a branch of Tibial nerve.

Imaging :

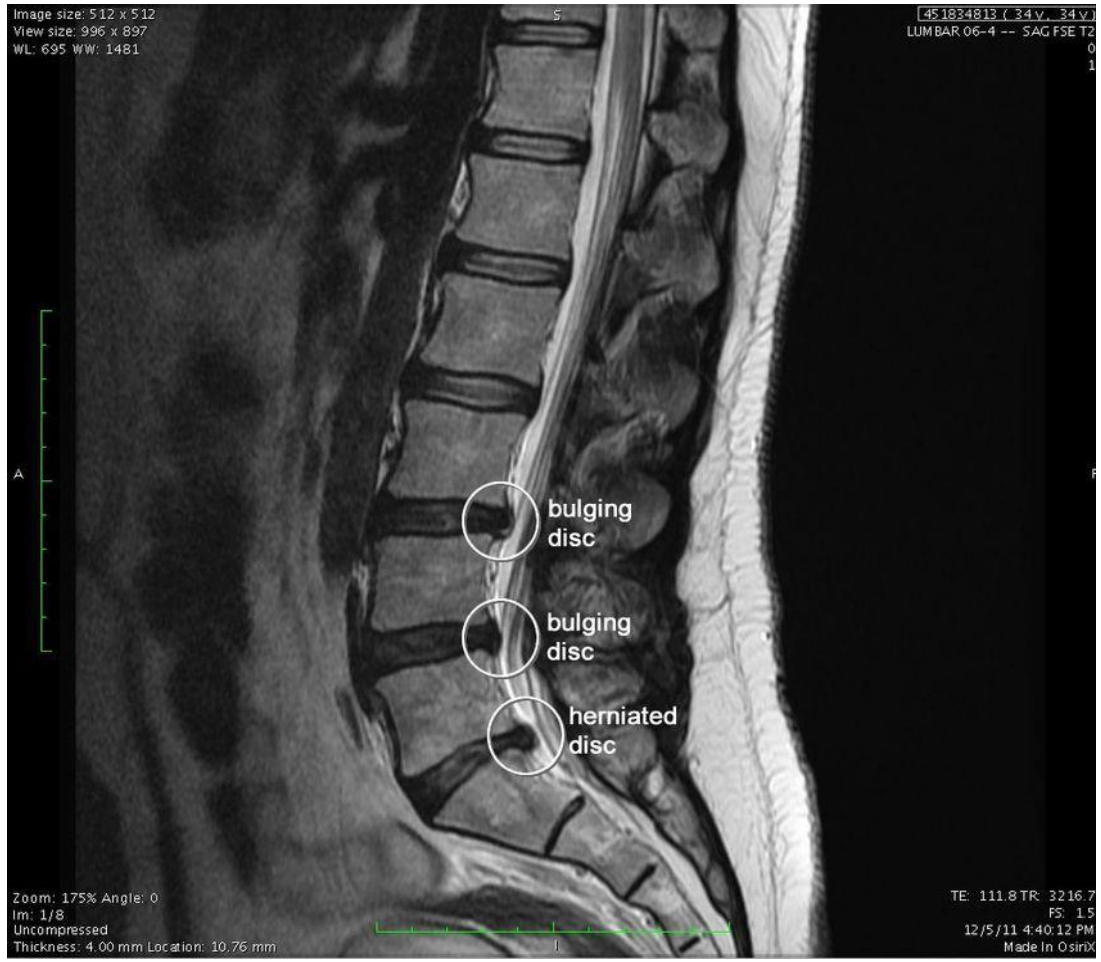
plain X-ray for lumbar spine :
- loss of loridosis
- loss of height in involved disc spaces

MRI T1,T2 sagittal and axial (transverse) cuts :
the best to diagnose .

CT scan :
when more information is needed about vertebrae .

Stenosis:

characterized by narrowing of central spinal canal, intervertebral foramen and/ or lateral recess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- Management :

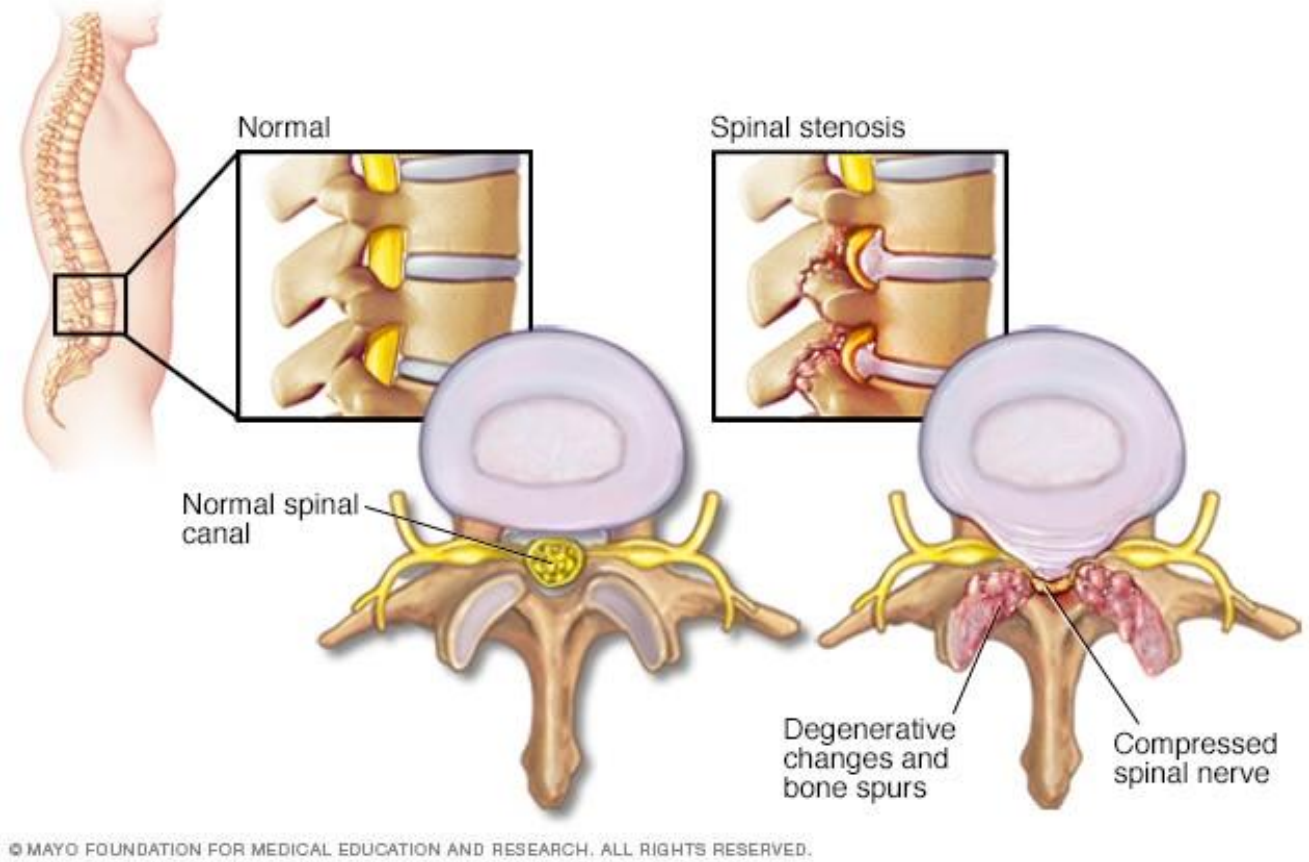
conservative :
  Bed rest
  Physio therapy
Nerve root block :
  Injections of local anesthetics and steroids. .

Spinal Stenosis

- What is Spinal Stenosis?
- What causes Spinal Stenosis?
- What are the symptoms of Spinal Stenosis?

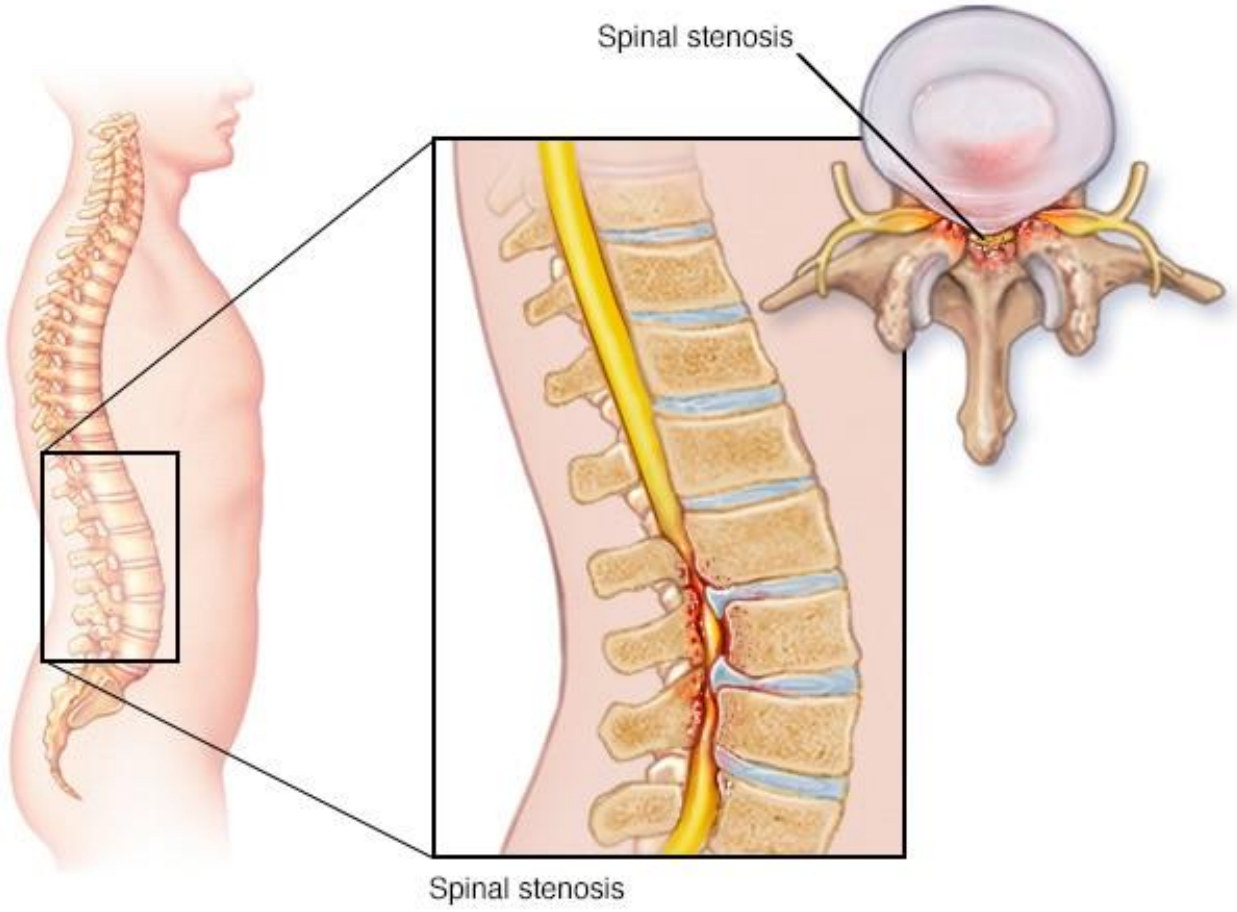
Spinal Stenosis/What is Spinal Stenosis?

- "Spinal Stenosis" is narrowing of the space within the spinal canal, which puts pressure on the nerves that travel within the spinal cord, it most often occurs in the lumbar and cervical areas of the spine.



Spinal Stenosis/Symptoms of Spinal Stenosis

- As in last said definition, there are two common types of spinal stenosis; ***one that occurs in the cervical region*** of the spine and one that ***occurs in the lumbar region***.



Spinal Stenosis/Symptoms of Spinal Stenosis

a. Cervical Stenosis:

- Causes numbness and weakness in a hand, arm, foot or leg.
- Causes Problems with walking and balance
- Neck Pain
- In severe cases: bowel or bladder dysfunction (urinary urgency and incontinence)

Spinal Stenosis/Symptoms of Spinal Stenosis

b. Lumbar Stenosis:

- Causes numbness/tingling or weakness in a foot or leg
- Pain or cramping in one or both legs when standing or walking for long periods of time which eases with sitting or bending forward.
- Back pain

Spinal Stenosis/Causes of Spinal Stenosis

There are many reason to why stenosis occurs in the spinal canal, some people are born with a small spinal canal, but most causes are acquired and include:

a. ***Overgrowth of bone***: osteoarthritis causes spurs of bone and narrows the spinal canal, also Paget's disease causes spinal canal stenosis

b. ***Herniated discs***: they can press on the spinal cord

c. ***Thickened ligaments*** can bulge into the spinal canal

d. ***Tumours*** can either growth within the membranes that cover the spinal cord or in the space between the spinal cord and the vertebrae

e. ***Spinal injuries***: trauma and swelling immediately after a back surgery.

Spondylosis

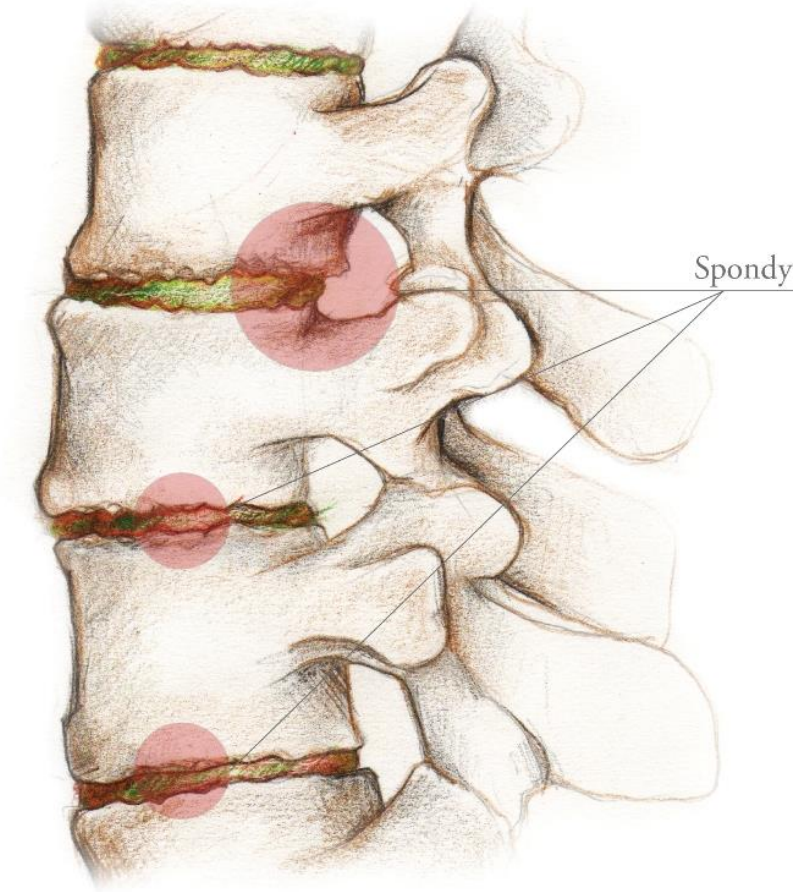
- What is Spondylosis?
- What causes Spondylosis?
- What are the symptoms of Spondylosis?

Spondylosis/Definition of Spondylosis

- "Spondylosis" refers to degenerative changes in the spine such as bone spurs and degenerating intervertebral discs between the vertebrae.
- It is commonly referred to as osteoarthritis, because it is the most common form of it

Cervical Spondylosis

Spondylosis/Signs and Symptoms



- Many people with spondylosis on X-Ray do not have symptoms, in fact, lumbar spondylosis is present in 27%-37% of people without symptoms.

- Symptoms of spondylosis are localized to the area affected, the symptoms are mainly pain but can also include headache if spondylosis affects cervical spine.

- If a herniated disc of spondylosis is compressing on a nerve root, the pain could shoot to a limb, this is called radiculopathy.

Spondylosis/Causes of Spondylosis

There are three main causes of spondylosis:

a. “Spndylosis is a normal aging process”, most patients present at an age between 20-80 years, with many 40-year olds showing X-Ray spondylosis

b. Genetic is another risk factor for spondylosis: if many people in a family have spondylosis, there’s chance that there will be stronger predisposition to spondylosis

c. Spinal Injuries can cause intervertebral discs to herniate. Also osteoarthritis is more likely to occur in joints that are injured

Spondylolisthesis

Spondylolisthesis/Definition of Spondylolisthesis

- "Spondylolisthesis" is forward or backward displacement of the body of one vertebrae in relation to an adjacent vertebra. For example, anterior spondylolisthesis of L4 on L5 means that the fourth lumbar vertebra has slipped forward on the fifth lumbar vertebra.

- As a result, the spine is not normally aligned. If the displaced vertebrae shift with movement of the spine, this is referred to as dynamic spondylolisthesis.

Spondylolisthesis/Causes of Spondylolisthesis

- Congenital Spondylolisthesis: abnormal bone formation that puts the spinal vertebrae at a greater risk for slipping

- Isthmic spondylolisthesis: occurs as a result of spondylolysis, a condition that leads to small stress fractures in the vertebra, in some cases the fractures weaken the bone so much that it slips out of place

- Degenerative spondylolisthesis: the most common form of the disorder, with aging the intervertebral discs lose water become less spongy and are less able to resist the movement in the vertebrae

Spondylolisthesis/Signs and Symptoms

- Many people with spondylolisthesis have no symptoms and don't even know they have the condition. When symptoms do occur, low back pain is the most common. The pain usually spreads across the lower back, and might feel like a muscle strain

- Spondylolisthesis can also cause muscle spasms in the hamstring muscles in the back of the thighs. Tight hamstrings can cause the person to walk with short strides and with the knees slightly bent. If the slipped vertebra is pressing on a nerve, pain might spread down the leg to the foot. The foot might also tingle and/or feel numb.

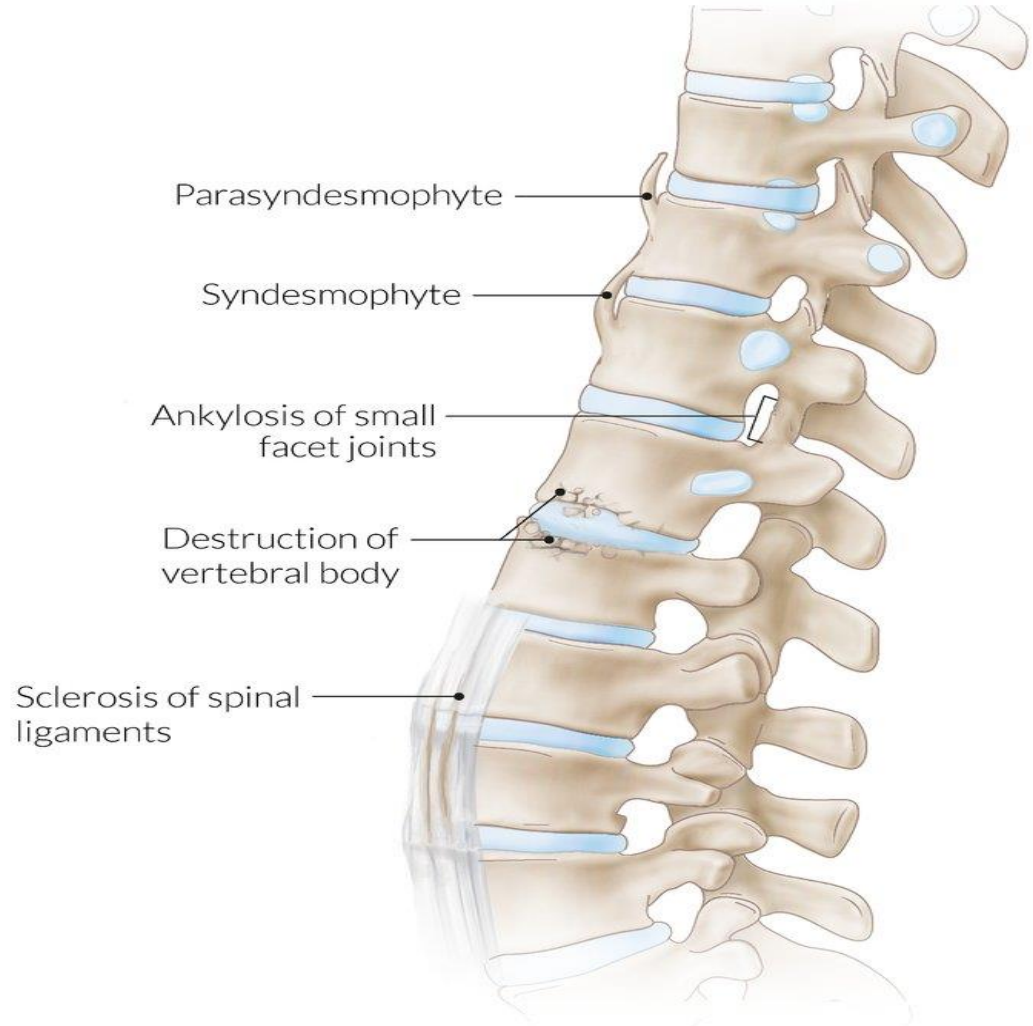
Spondylolisthesis/ How is spondylolisthesis graded?

- radiologist determines the degree of slippage upon reviewing spinal X-rays. Slippage is graded I through IV:
- Grade I: 1% to 25% slip
- Grade II: 26% to 50% slip
- Grade III: 51% to 75% slip
- Grade IV: 76% to 100% slip

- Generally, Grade I and Grade II slips do not require surgery and are treated medically. Grade III and Grade IV slips might require surgery if persistent, painful, slips are present.

Common etiologies		Typical features	Diagnostics	Therapy
Musculoskeletal	Muscle strain (most common cause of lower back pain)	•Acute back pain and paravertebral stiffness and difficulty bending after physical exertion (e.g., heavy lifting) •No loss of sensory or motor function •Straight leg raise test negative	•Percussion: tenderness over lumbar spine •Negative straight leg-raising maneuvers	•Early mobilization •NSAIDs and muscle relaxants •Prevention: correct lifting of heavy items
	Spinal stenosis	•In older patients •Pain in buttocks and legs (neuropathic claudication; improves with bending forward)	•X-ray: degenerative spine changes •MRI: confirmatory test (nerve compression)	•Conservative • NSAIDs • Physiotherapy • Epidural steroid injections •Surgery if conservative therapy fails
	Spinal disc herniation	•Unilateral radicular pain, dermatome referred (usually L5/S1 with positive straight-leg raise test) •Paresthesia and muscle weakness	•MRI: shows disc herniation	•Conservative • Activity continuation, no bed rest • NSAIDs •Surgical decompression: in case of severe/progressive neurologic deficits
	Degenerative spondylolisthesis	•Older age •Possibly radicular syndromes, spinal claudication	•Lateral x-ray of the spine	•Conservative • Physiotherapy • Orthotic braces • Steroid/anesthetic injections for radicular pain •Surgery if conservative treatment not efficient • Vertebral fusion • Decompression of the spine
Malignancy	Vertebral fractures	•History of injury •Local pain on pressure, percussion, and compression •History of cancer (e.g., lung cancer, breast cancer, prostate cancer, melanoma)	•X-ray,CT •MRI for detecting spinal cord lesions	•Surgical stabilization of the spine (e.g., kyphoplasty) •Cord decompression
	Bone metastases (extradural metastatic lesions) Less commonly: intramedullary tumors (e.g., multiple myeloma, ependymomas, astrocytomas, metastases) and intradural-extramedullary (e.g., meningiomas, nerve sheath tumors)	•Advanced age •Pain worse at night •Spinal cord compression •Local spinal pain, may radiate to the shoulder and neck (common in spinal metastases) •Brown-Séquard syndrome is a common initial finding in patients with spinal metastatic lesions. •Point tenderness	•MRI (urgent if spinal compression is suspected)	•Surgery •Radiation therapy •In case of spinal cord compression: high-dose corticosteroids as soon as possible followed by definitive management
Infectious	Spinal epidural abscess	•Fever and chills •Spinal cord compression •Risk factors: • IV drug use • Diabetes • Invasive procedures (e.g., removal of an epidural catheter) • Alcohol use disorder • Immunosuppression	•Urgent MRI •Culture of blood, CSF, abscess contents (gained through aspiration) to identify the causative pathogen (Staphylococcus aureus (~ 65% of cases)	•Empiric antibiotic therapy •Surgical drainage and decompression
Inflammatory	Ankylosing spondylitis Reactive arthritis Psoriatic arthritis	•Pain mostly at rest •Improves with activity	•HLA-B27 present	•Physical therapy •NSAIDs •DMARDs in chronic cases •In severe cases surgery
Others	Abdominal aortic aneurysm	•Pulsatile abdominal mass •Bruit on auscultation	•Ultrasound (also for follow-up) •CT (in case of rupture)	•Open or endoscopic grafting (tube or Y-prosthesis)
	Cauda equina syndrome	•Asymmetric, areflexic, flaccid paresis of the legs •Bladder, bowel incontinence, saddle anesthesia	•MRI	•Surgical decompression
	Spinal epidural hematoma	•♂ > ♀ (4:1) •Bimodal distribution (peaks during childhood and between age 40–50 years) •Spontaneous or traumatic (e.g., following lumbar puncture, pulling epidural catheter) bleeding •Risk factors • Thrombocytopenia, Bleeding diathesis, Anticoagulation, Vascular malformations •Acute spinal cord compression •Back pain, lower extremity weakness and numbness, hyporeflexia	•MRI with and without gadolinium : to demonstrate hematoma and underlying pathology	•Surgical decompression to avoid permanent neurologic dysfunction (laminectomy and evacuation of blood)

Degenerative lesions of the spine



Inflammatory lesions of the spine

THANK YOU