

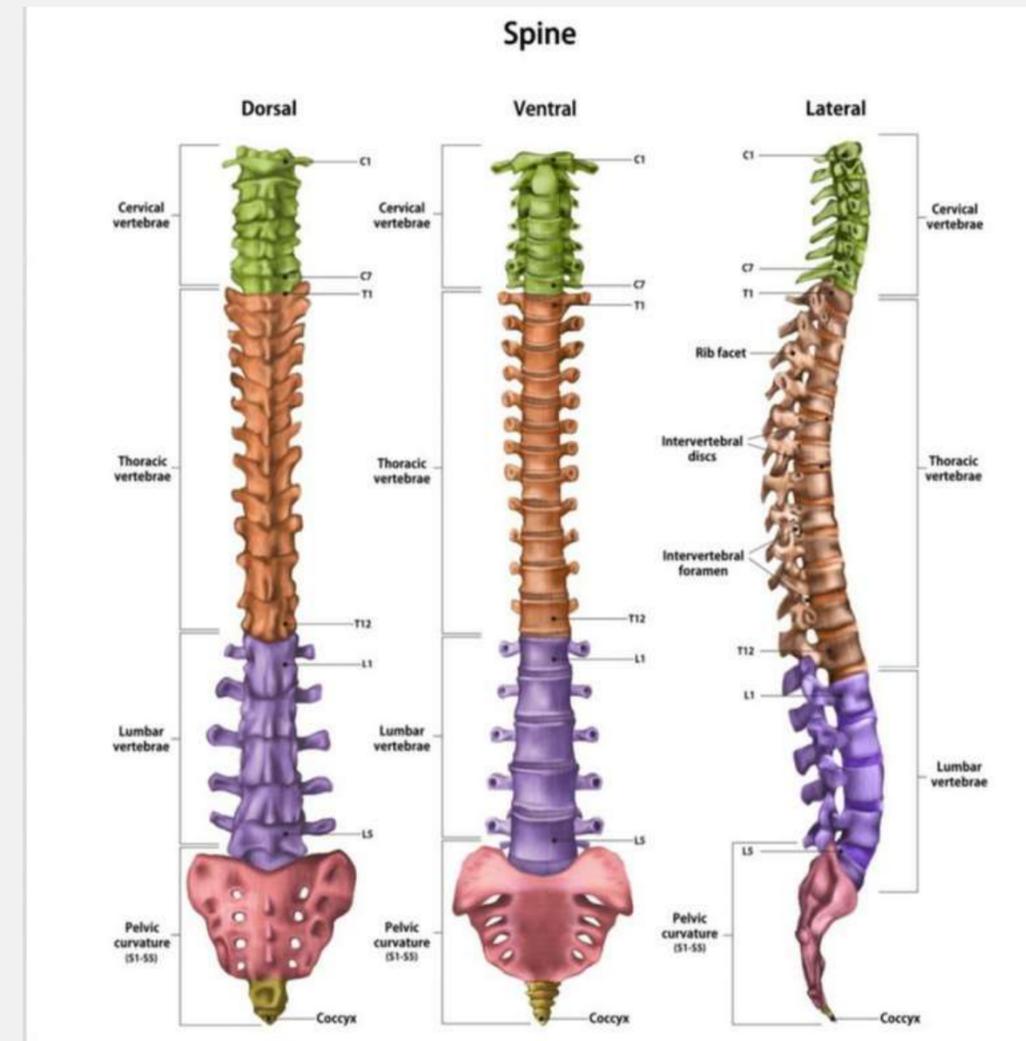
SPINAL DEGENERATIVE DISEASES

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• OVERVIEW

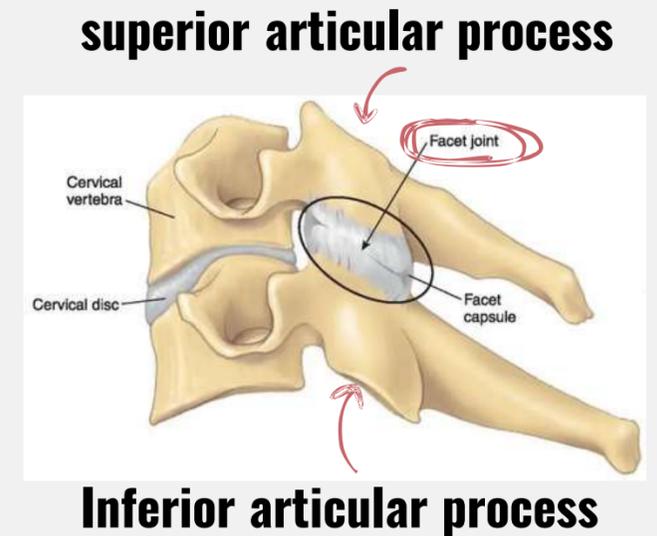
- The Vertebral column consists of 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral (fused to form the sacrum), and 4 coccygeal (the lower 3 are fused)
- Spinal cord proper ends at L1 in adult, and the remaining spinal nerves, seeking their intervertebral foramen of exit form the cauda equina.
- Subarachnoid space ends at S2.



• The vertebrae from C2 to S1 articulate with each other by two types of joints:

1) Facet joint:

Synovial joint between superior and inferior articular processes.



2) Intervertebral disc:

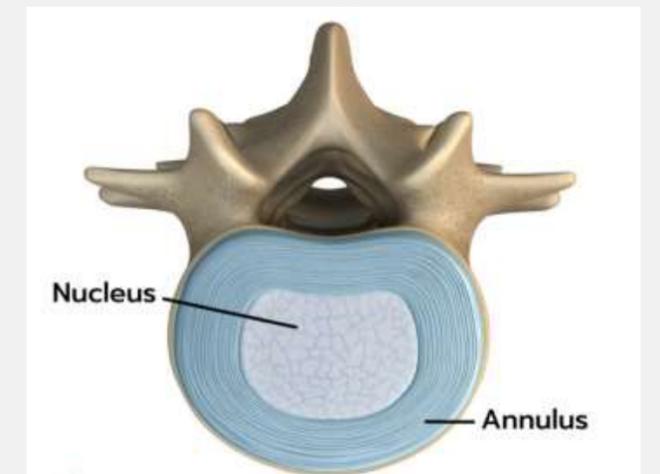
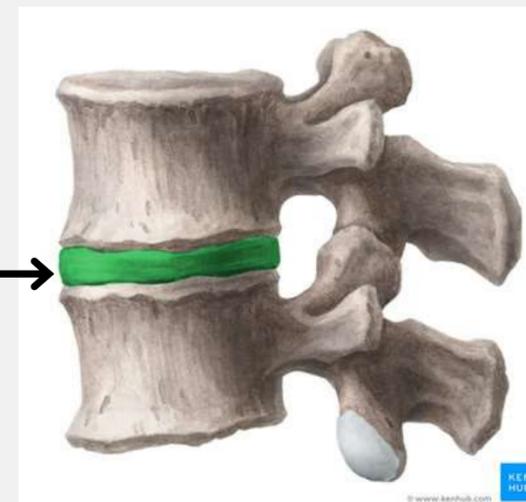
Cartilaginous joint between the vertebral bodies, it works as a shock absorber.

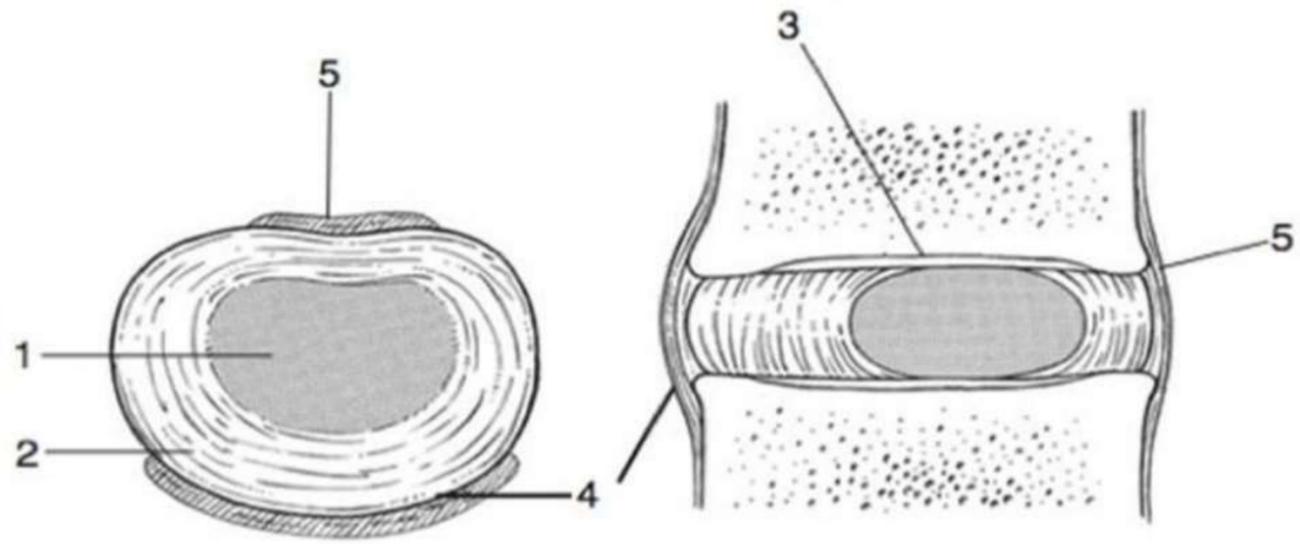
The disc consists of;

I. Annulus fibrosus: fibrous, tough, outer layer.

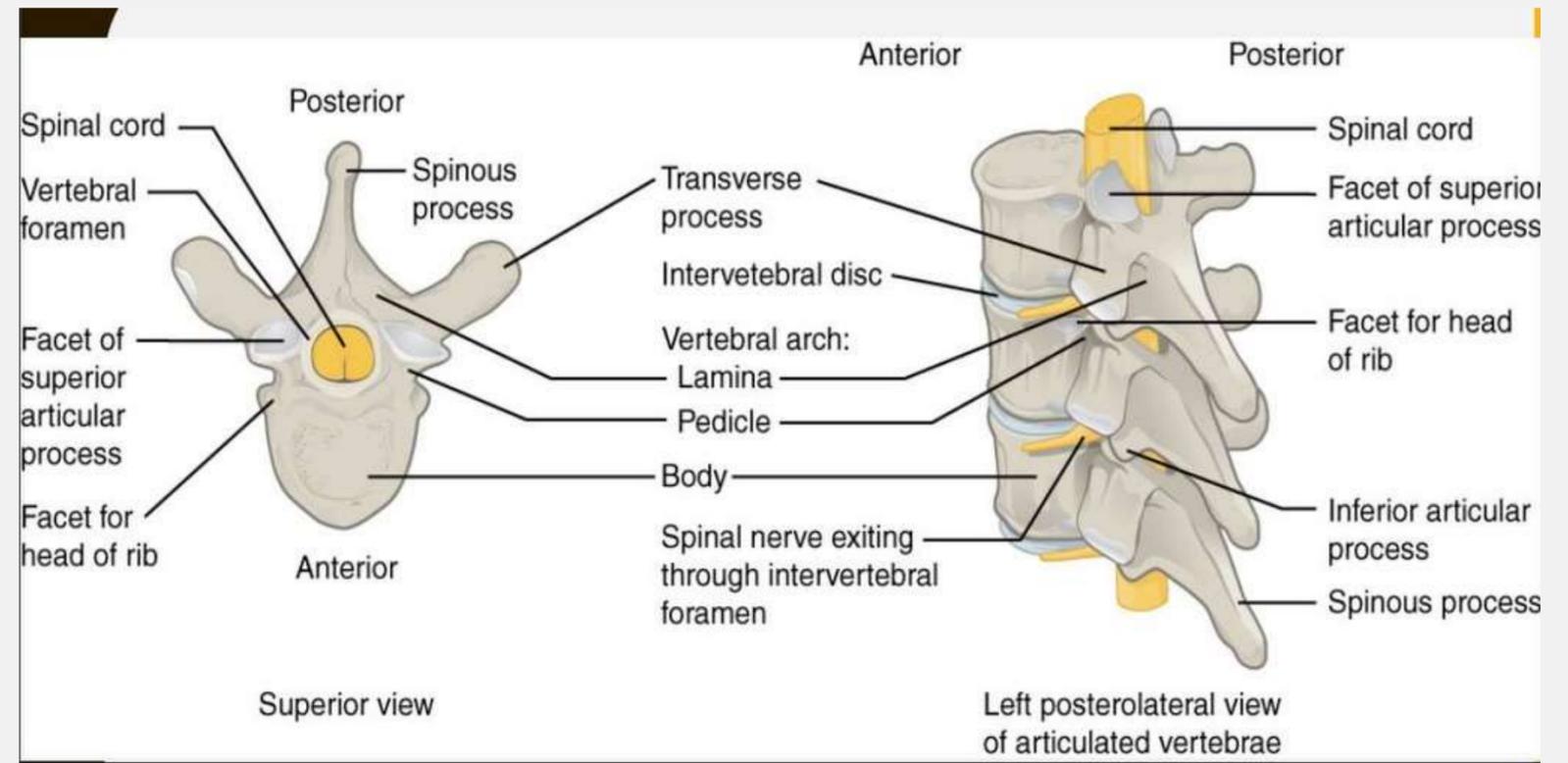
II. Nucleus pulposus: gelatinous part, with 80% water, which decreases with aging.

Intervertebral disc



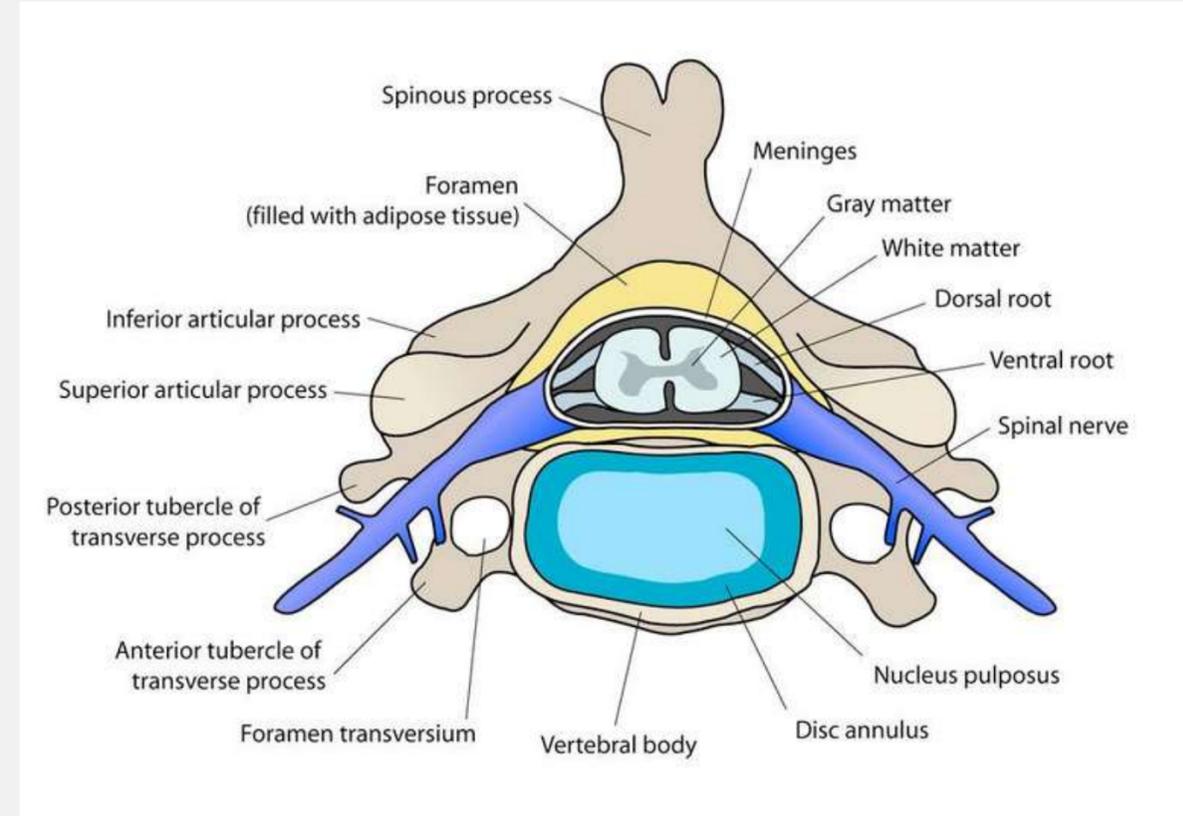


The intervertebral disc: 1, nucleus; 2, annulus; 3, cartilaginous endplate; 4, anterior longitudinal ligament; 5, posterior longitudinal ligament.



Superior view

Left posterolateral view of articulated vertebrae



- **Vertebrae are also stabilized by the following ligaments:**

- **Anterior longitudinal ligament**

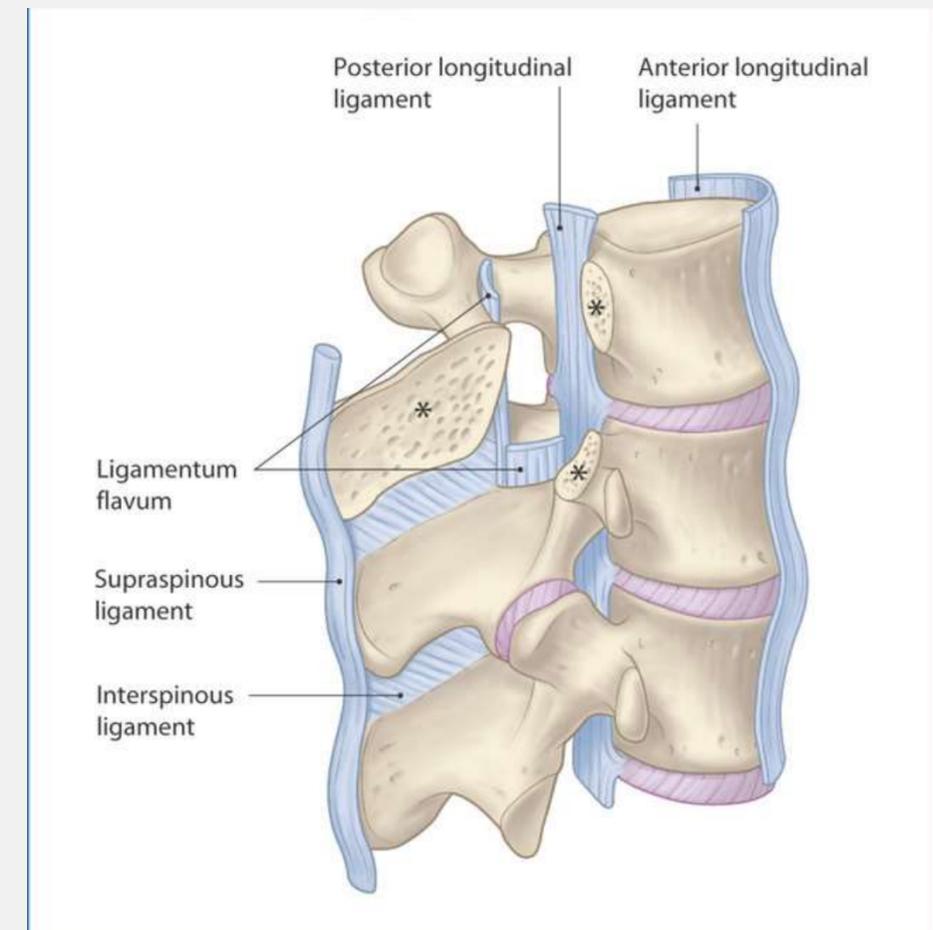
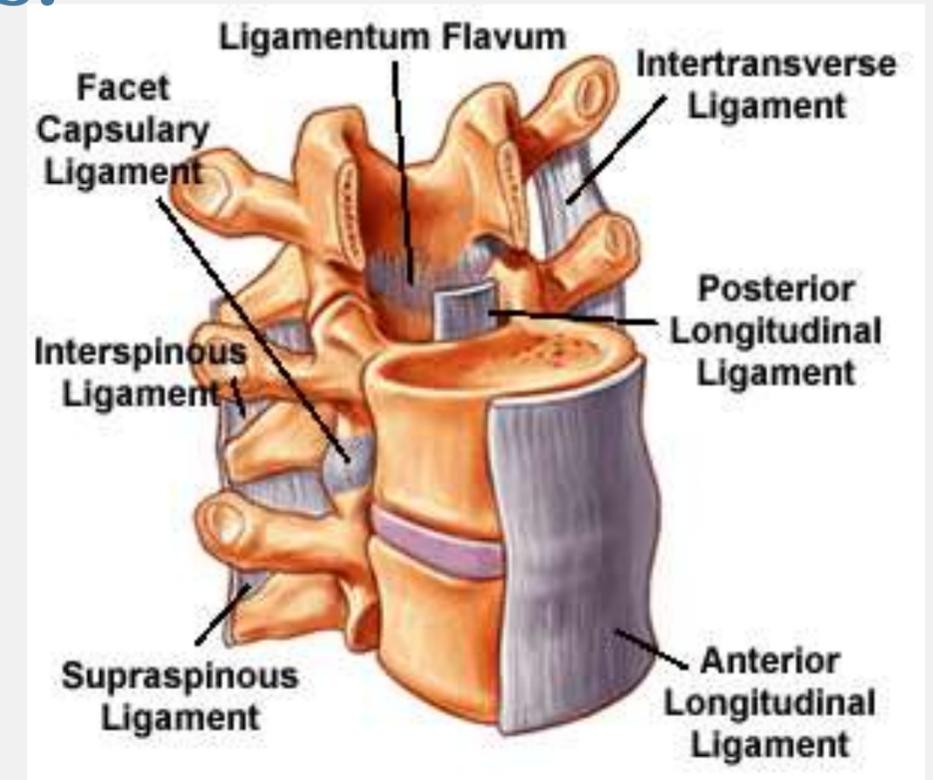
- **Posterior longitudinal ligament**

- **Ligamentum flavum: between the laminae (The strongest lig.)**

- **Interspinous ligament: between the inner surface of the spinous processes.**

- **Supraspinous ligament: between the tips of the spinous processes.**

- **Intertransverse ligament: between the transverse processes**



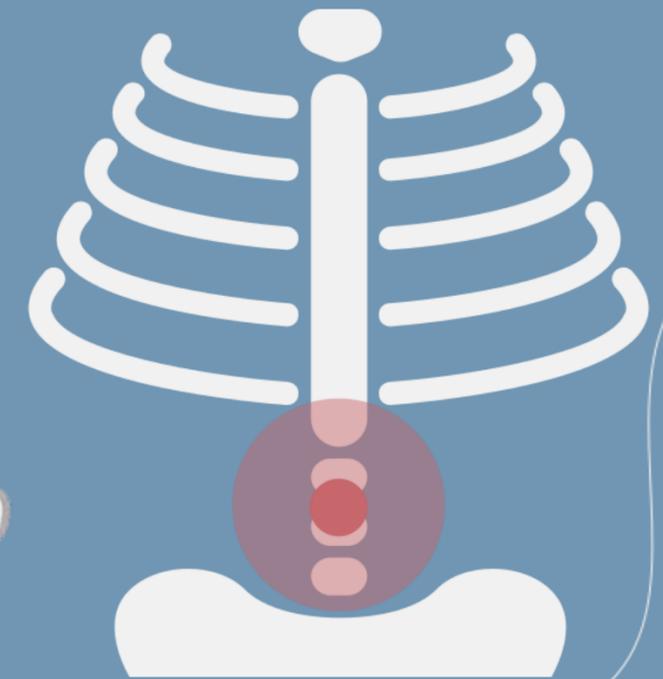
Degenerative Diseases of The Spine



- a general term that covers many types of conditions involve the gradual loss of normal structure and function of the spine over time. **This kind of spinal problems is usually a part of the normal aging process.**
- many people are more prone to spinal problems than others, like those who have: **infections, tumors, muscle strains, or arthritis**

1. Degeneration of the disc : (process of dehydration)

The intervertebral discs are composed of 90% water , with age the water content decreases thus the elasticity will decrease and this will increase the tendency for disc prolapse .



Degenerative Diseases of The Spine



2. Facet joint prolapsed :

they are synovial joints so they dehydrate with age .

3. Ligament degeneration :

the ligament become hypertrophied causing pressure on spinal cord and nerve root or thecal sac .

4. Bone degeneration :

osteophyte formation , when they present on the posterior side they cause more symptoms than anterior .



Degenerative Diseases of The Spine



5. Spondylolysis :

associated with pars interarticularis fracture.

6. Spondylolithiasis :

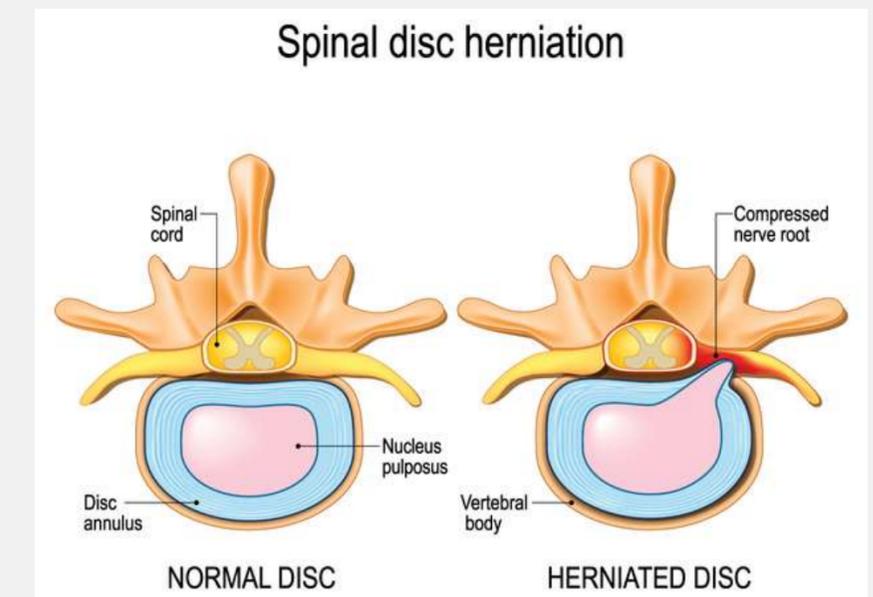
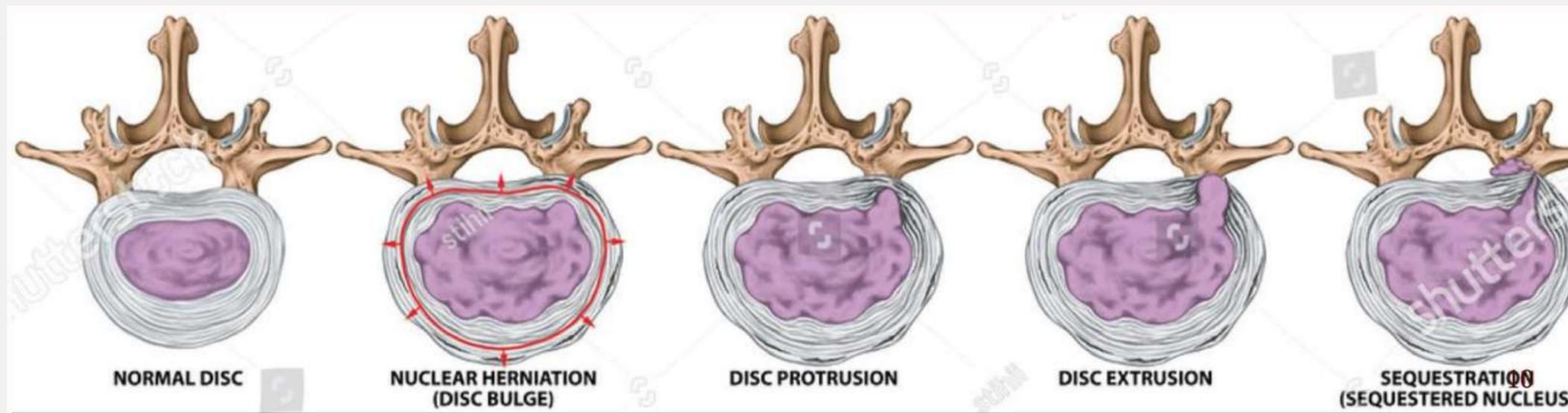
appears on oblique view X-ray as (decapitated scoty dog appearance).





Intervertebral Disc degeneration

- Many factors including aging, induce changes in the biochemical and structural formation of the intervertebral discs, such as decreasing its water-binding capacity. The water content decreases down to 70%.
- Development of annular tears in the annulus fibrosus due to weakness allows nucleus pulposus to prolapse into the defects.



Intervertebral Disc degeneration

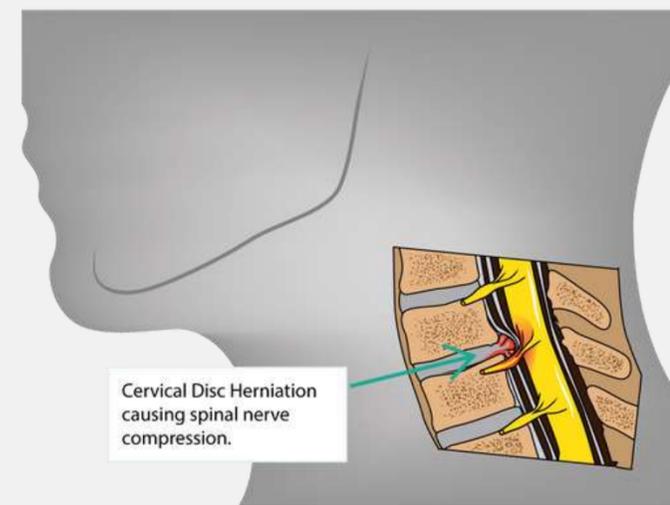
- *Types:*

1. Cervical Disc Prolapse
2. Cervical Spondylosis
3. Thoracic Disc Herniation
4. Lumbar Disc Prolapse most common
5. Lumbar Stenosis
6. Lumbar Spondylolisthesis



1. Cervical Disc Prolapse:

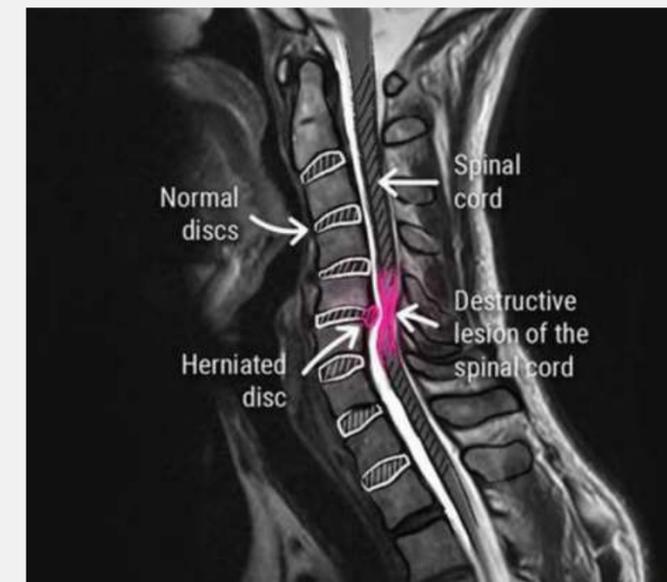
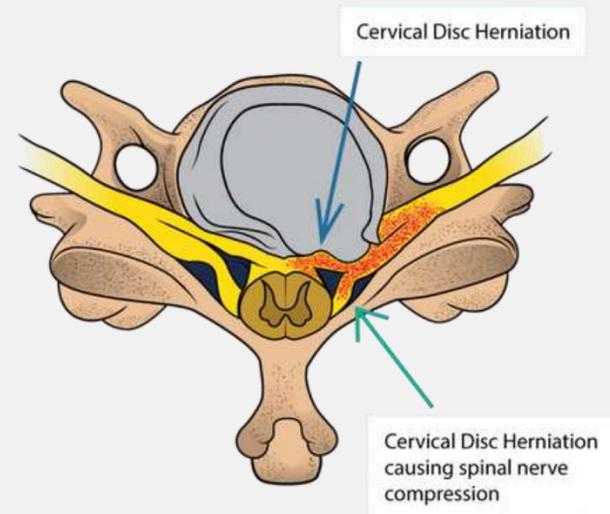
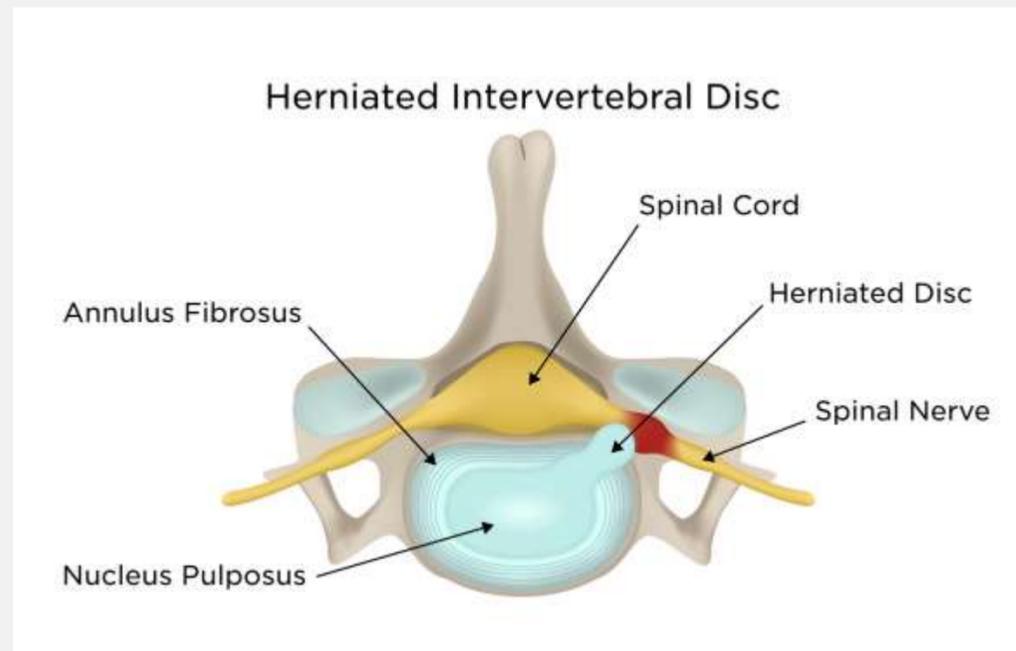
- Cervical disc herniation is a condition in which the inner gelatinous substance of the disc escapes through a tear in the outer, fibrous ring causing a compression of the spinal cord or the surrounding nerves, resulting in neck or arm pain.
- **Less common than disc prolapse in the lumbar area.**
- The disc prolapse occurs most frequently at the C6/7 (70%) level because they are most mobile and at the C5/6 level (20%).
- Disc prolapse above these levels and at the C7/T1 level is much less common.
- **Physical exam leads you to the level of the disc .**



1. Cervical Disc Prolapse:



- The cervical disc prolapse is usually in the **posterolateral direction**, because the strong posterior longitudinal ligament prevents direct posterior herniation.
- The posterolateral disc herniation will cause compression of the adjacent nerve root as it enters and passes through the intervertebral neural foramen causing “Radiculopathy” .
- If the cervical disc herniates posteriorly, causing compression on the adjacent cervical spinal cord, It’s a neurosurgical emergency.



1. Cervical Disc Prolapse:



- CAUSES:

- Repetitive cervical stress .
- Trauma.
- Heavy lifting.
- Prolonged sedentary position.
- Whiplash accidents (Neck strain).
- Frequent acceleration/deceleration.

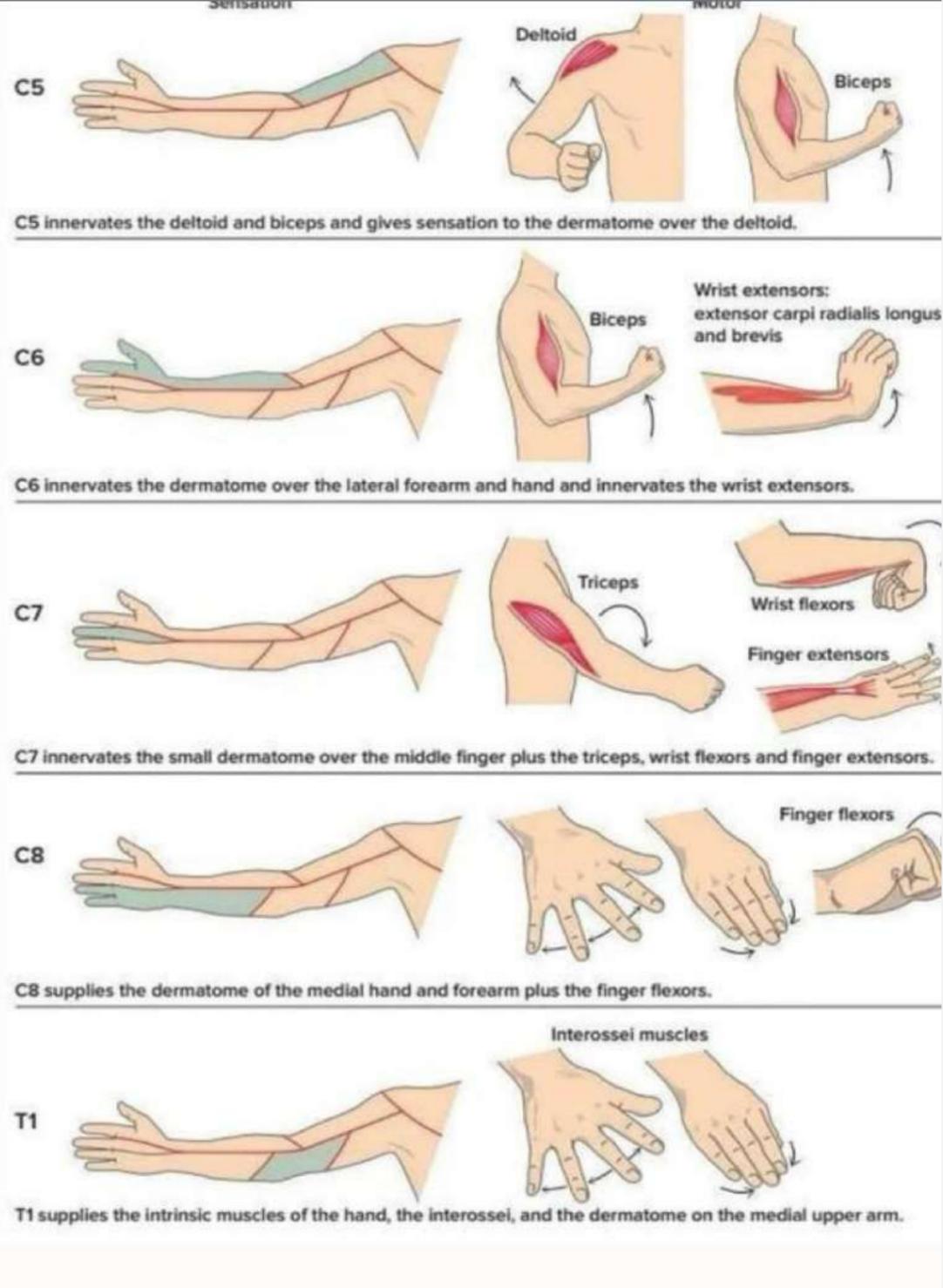
Whiplash Injury Caused by
Hyperextension and Hyperflexion of Cervical Spine



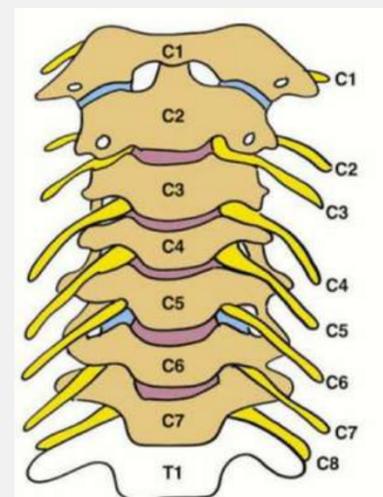
Hyperextension



Hyperflexion



	Level of herniated cervical disc			
	C4-5	C5-6	C6-7	C7-1
% of cervical discs	2%	19%	69%	10%
compressed root	C5	C6	C7	C8
reflex diminished	deltoid & pectoralis	biceps & brachioradialis	triceps	finger-jerk ^a
motor weakness	deltoid	forearm flexion	forearm ext (wrist drop)	hand intrinsic
paresthesia & hypesthesia	shoulder	upper arm, thumb, radial forearm	fingers 2 & 3, all fingertips	fingers 4 & 5



Cervical Nerve Root
 Exiting Above the
 Pedicle

Overview of cervical radiculopathies ^[9]

Radiculopathy	Causative disk	Sensory deficits 	Motor deficits	Reduction of reflexes
C3/4 radiculopathy	<ul style="list-style-type: none"> • C2-C4 	<ul style="list-style-type: none"> • Shoulder and neck area 	<ul style="list-style-type: none"> • Scapular winging 	<ul style="list-style-type: none"> • None
C5 radiculopathy	<ul style="list-style-type: none"> • C4-C5 	<ul style="list-style-type: none"> • Anterior shoulder 	<ul style="list-style-type: none"> • Biceps and deltoid 	<ul style="list-style-type: none"> • Biceps reflex
C6 radiculopathy	<ul style="list-style-type: none"> • C5-C6 	<ul style="list-style-type: none"> • From the upper lateral elbow over the radial forearm up to the thumb and radial side of index finger 	<ul style="list-style-type: none"> • Biceps and wrist extensors 	<ul style="list-style-type: none"> • Biceps reflex • Brachioradialis reflex
C7 radiculopathy	<ul style="list-style-type: none"> • C6-C7 	<ul style="list-style-type: none"> • Palmar: fingers II-IV (II ulnar half, III entirely, IV radial half) • Dorsal: medial forearm up to fingers II-IV 	<ul style="list-style-type: none"> • Triceps, wrist flexors, and finger extensors 	<ul style="list-style-type: none"> • Triceps reflex
C8 radiculopathy	<ul style="list-style-type: none"> • C7-T1 	<ul style="list-style-type: none"> • Fingers IV (ulnar half) and V, hypothenar eminence, and ulnar aspect of the distal forearm 	<ul style="list-style-type: none"> • Finger flexors 	<ul style="list-style-type: none"> • None

Overview of lumbosacral radiculopathies ^[9]

Radiculopathy	Causative disk	Sensory deficits 	Motor deficits	Reduction of reflexes
L3 radiculopathy	<ul style="list-style-type: none"> L2-L3 	<ul style="list-style-type: none"> Anterolateral area of the thigh  	<ul style="list-style-type: none"> Hip flexion Knee extension Hip adduction 	<ul style="list-style-type: none"> Adductor reflex Patellar reflex
L4 radiculopathy	<ul style="list-style-type: none"> L3-L4 	<ul style="list-style-type: none"> Anterolateral thigh, area over the patella, medial aspect of the leg, medial malleolus 	<ul style="list-style-type: none"> Knee extension Hip adduction 	<ul style="list-style-type: none"> Patellar reflex
L5 radiculopathy	<ul style="list-style-type: none"> L4-L5 	<ul style="list-style-type: none"> Lateral aspect of the thigh and knee, anterolateral aspect of the leg, dorsum of the foot, and the big toe 	<ul style="list-style-type: none"> Tibialis anterior muscle (foot dorsiflexion): difficulty heel walking (foot drop) Extensor hallucis longus muscle (first toe dorsiflexion) 	<ul style="list-style-type: none"> Posterior tibial reflex (medial hamstring)
S1 radiculopathy	<ul style="list-style-type: none"> L5-S1 	<ul style="list-style-type: none"> Dorsolateral aspect of thigh and leg, and the lateral aspect of the foot 	<ul style="list-style-type: none"> Peroneus longus and brevis muscle (foot eversion) and gastrocnemius muscle (foot plantarflexion): difficulty toe walking 	<ul style="list-style-type: none"> Achilles reflex  Lateral hamstring reflex
S2 radiculopathy, S3 radiculopathy, S4 radiculopathy	<ul style="list-style-type: none"> S1-S4 	<ul style="list-style-type: none"> Posterior aspect of the thigh and leg (S2), perineum (S3-S4), perianal (S4) 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Bulbocavernosus reflex Perineal reflex

Management

- Conservative treatment

Patients may find relief by:

- Applying ice or heat.
- Using medications to control pain and inflammation (NSAIDs).
- Exercising the neck and shoulder areas (alone or with the help of a professional familiar with neck conditions) to relieve stiffness and maintain flexibility.
- Use of a cervical collar, cervical pillows or neck traction may also be recommended to stabilize the neck and improve neck alignment.

Conservative treatment is the 1st choice, except in two cases we do surgery :

1. Myelopathy
2. If red flags are present

If conservative treatment fails we go for surgery



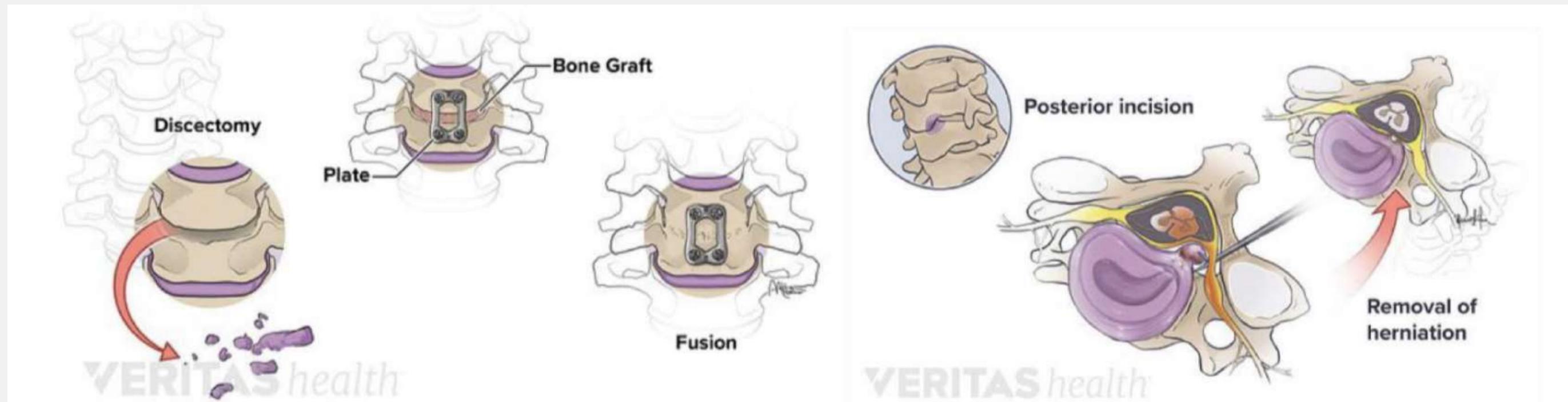
Management



- **OPERATIVE PROCEDURES**

- **The two most commonly performed operations for cervical disc prolapse are:**

- 1) Cervical foraminotomy with excision of the disc prolapse.
- 2) Anterior cervical discectomy, with subsequent fusion.





• Case:

A male patient complaining of neck pain radiating to the right shoulder, lateral arm, and thumb. The pain is associated with numbness and tingling in the thumb.

On examination:

Sensory: decreased sensation over the thumb.

Motor: weakness of biceps.



Q1: What is the dermatomal distribution of pain?

Q2: What is the level, site & diagnosis of the lesion?

Q3: Is the pain due to radiculopathy or myelopathy?

Q4: Which reflex is affected?



2. CERVICAL SPONDYLOSIS

- Cervical spondylosis is a degenerative arthritic process involving the cervical spine and affecting the intervertebral disc, facet joints and vertebral bodies.
- **PATHOLOGIC CHANGES**
- The degenerative process occurs in most cases largely as a result of the inevitable stresses and traumas that occur to the cervical spine as a result of the normal activities of daily living.
- The spondylitic process may cause narrowing of the spinal canal as a result of osteophyte formation, particularly the formation of hypertrophic bony ridges at the anterior intervertebral spaces of the spinal canal and hypertrophy of the ligamentum flavum. This may result in compression of the spinal cord. Such compression is maximal during hyperextension of the neck and may cause “cervical myelopathy”, here it can affect not only the arms, but the legs as well.



2. CERVICAL SPONDYLOSIS

- RISK FACTORS

- Major: Aging, By age 60, most women and men show signs of cervical spondylosis on x-ray without symptoms.

- Other factors:

- ✓ Past neck injury (often several years ago).
- ✓ Severe arthritis.
- ✓ Past spine surgery.



2. CERVICAL SPONDYLOSIS

- CLINICAL MANIFESTATIONS

- Symptoms often develop slowly over time, but may start suddenly

- Common symptoms are:

1. Neck pain (may radiate to the arms or shoulder).
2. Neck stiffness that gets worse over time.
3. Loss of sensation or abnormal sensations in the shoulders, arms, or (rarely) legs.
4. Weakness of the arms or (rarely) legs.
5. Headaches, particularly in the back of the head.

- Less common symptoms are:

1. Loss of balance
2. Loss of control over the bladder or bowels (if spinal cord is compressed).



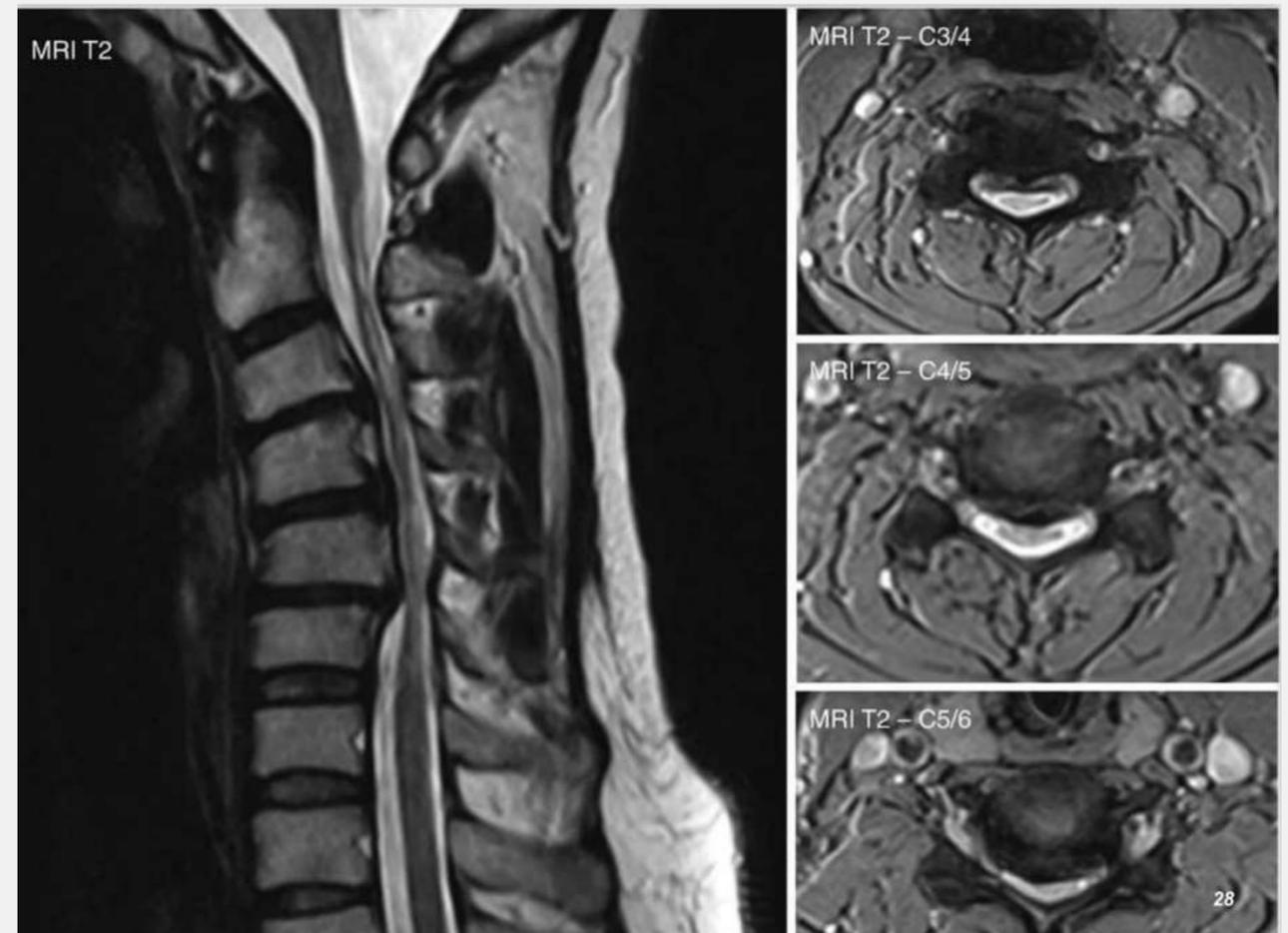
2. CERVICAL SPONDYLOSIS

- The clinical features are similar to the neuralgia caused by an acute soft disc prolapse, in that the pain radiates diffusely into the periscapular area and shoulder, numbness and tingling in the appropriate dermatome distribution, and weakness of the arm are present also.
- Although the clinical features may be almost indistinguishable from those due to an acute soft disc prolapse, the process is usually not as acute and the patient often has a history of intermittent or chronic pain.
- Wasting of a muscle group in the appropriate nerve root distribution is more common because of the longer history, but the examination findings will otherwise be similar to those seen with an acute soft disc protrusion.



3. CERVICAL SPONDYLOTIC MYELOPATHY (CSM)

- Cervical spondylosis is the most common cause of myelopathy in patients > 55 yrs of age.
- Cervical spondylotic myelopathy (CSM) develops in almost all patients with < 30% narrowing of the cross-sectional area of the cervical spinal canal (although some patients with severe cord compression do not have myelopathy).



3. CERVICAL SPONDYLOTIC MYELOPATHY (CSM)

- **TREATMENT:**

Several medications may be used together during the first phase of treatment to address both pain and inflammation.

- Acetaminophen : Mild pain.
- Non-steroidal anti-inflammatory drugs (NSAIDs).
- Muscle relaxants: Medications such as cyclobenzaprine or carisoprodol can also be used in the case of painful muscle spasms.
- Cortisone injections to specific areas of the spine.

Collars



3. CERVICAL SPONDYLOTIC MYELOPATHY (CSM)

- **TREATMENT:**

PHYSICAL THERAPY

Heat Superficial heat modalities:

1)Infrared :

The patient should be positioned 20 inches from the source.
Treatment time should be 15-20 minutes.



2)Hot packs:

Treatment time should be 20-30 min.



3. CERVICAL SPONDYLOTIC MYELOPATHY (CSM)

• TREATMENT:

• LIFE STYLE

- Don't maintain the position of the neck for long periods so TAKE BREAKS when driving, watching TV or working on a computer .
- Avoid watching TV from one side.
- Exercise regularly.

• INDICATIONS FOR SURGERY

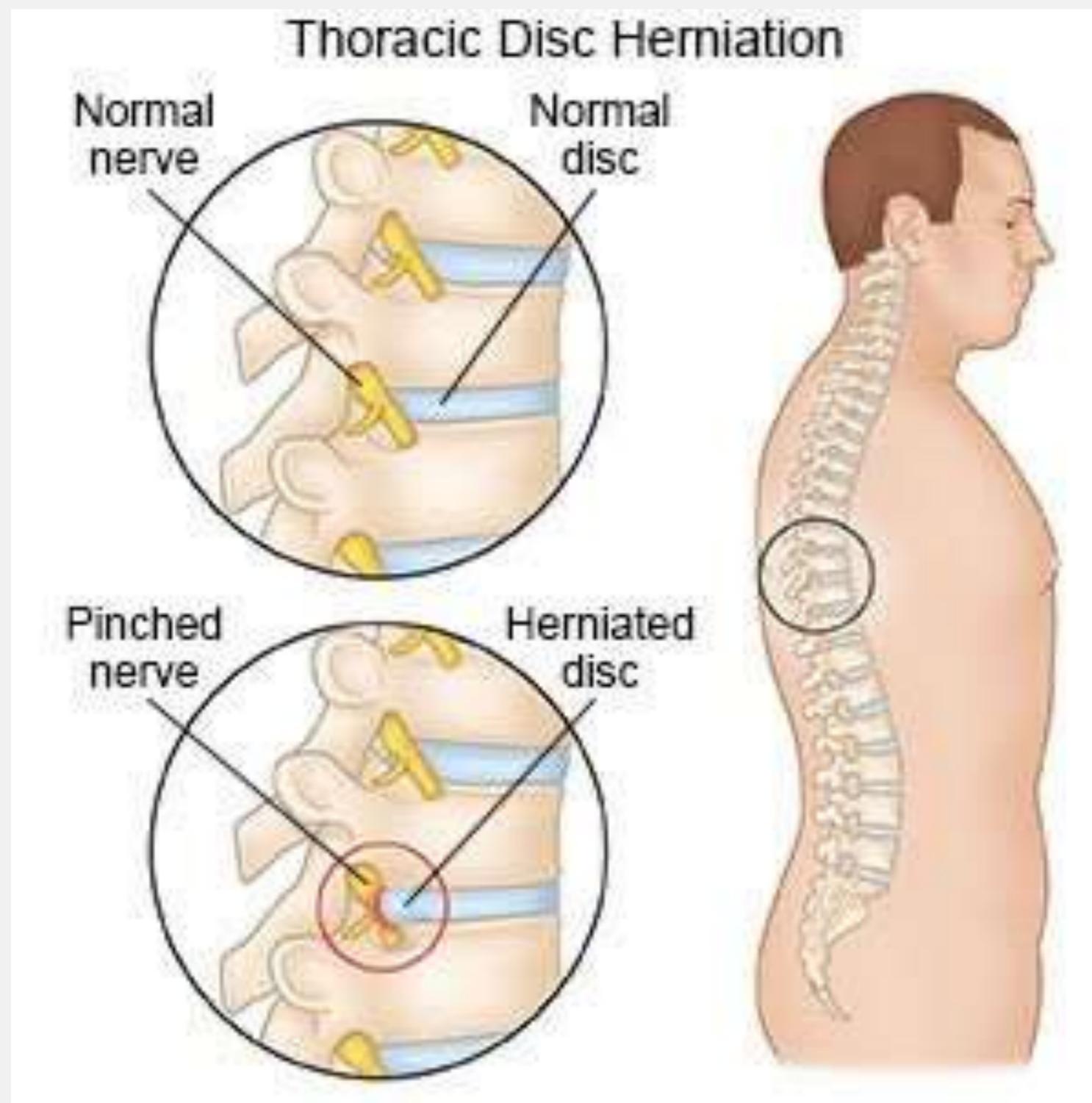
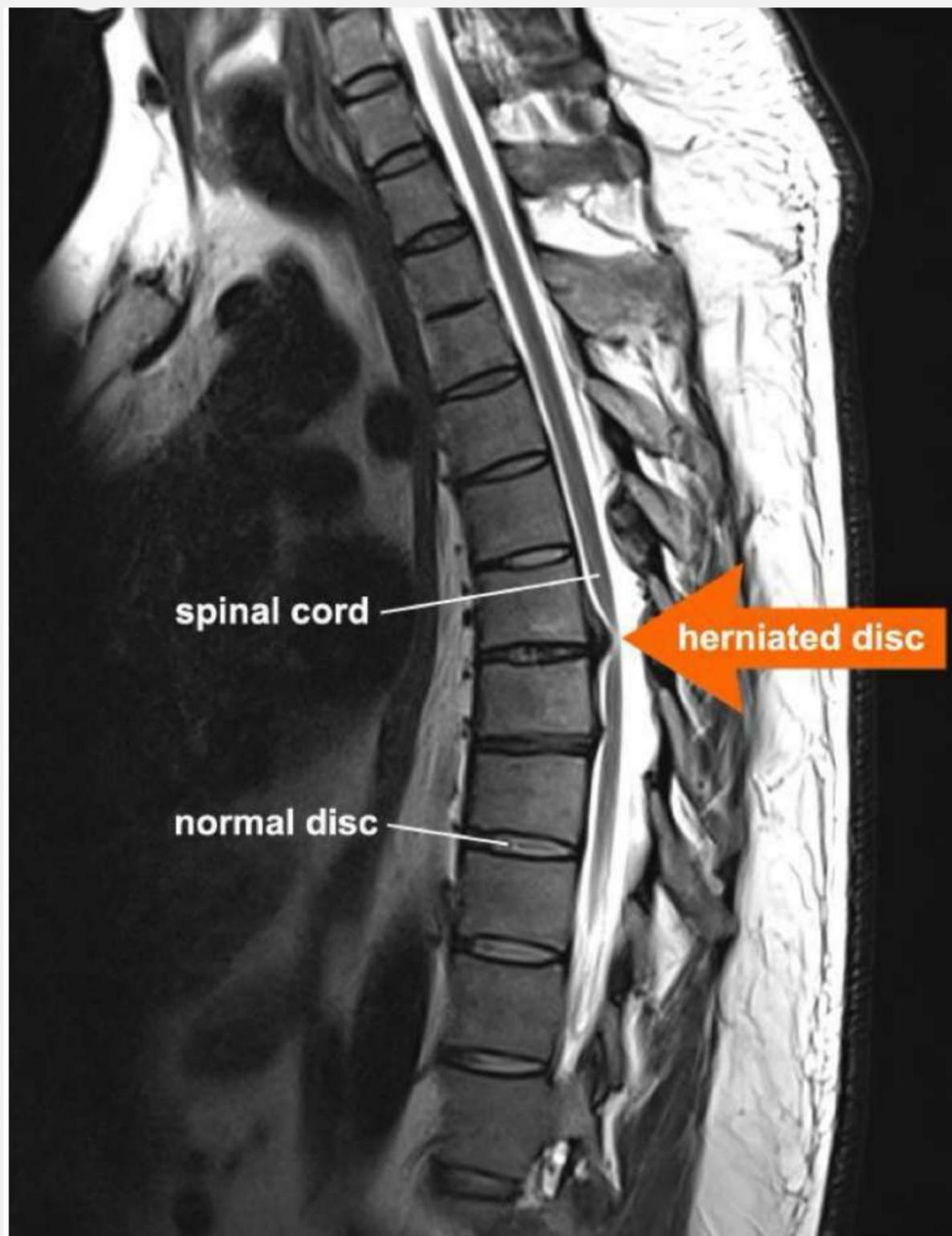
1. Severe pain that does not settle with conservative treatment over 2–3 weeks.
2. Chronic or recurrent pain.
3. Progressive weakness in the arm which causes functional disability.



4. THORACIC DISC HERNIATION

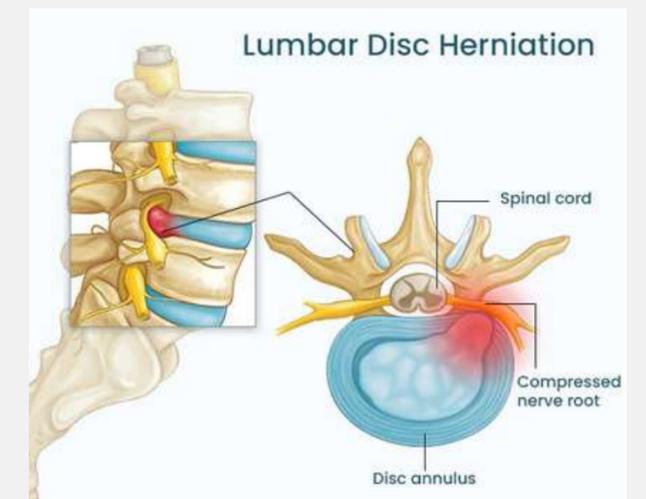
- The majority of the thoracic disc herniation is asymptomatic, or the patient presents with nonspecific symptoms like chest wall pain, epigastric pain, upper extremity pain, and sometimes, a pain in the groin or the lower extremity.
- Usually occur at or below **T8** (the more mobile portion of the thoracic spine)
- Frequently calcified ∴ get CT through disc (may affect choice of surgical approach)
- Primary indications for surgery: refractory pain, progressive myelopathy.
- **80%** occur between the 3rd and 5th decades.
- A history of trauma may be elicited in 25% of cases.
- Most common symptoms: pain (60%), sensory changes (23%), motor changes (18%).
- With thoracic radiculopathy, pain and sensory disturbance is in a band-like distribution radiating anteriorly and inferiorly along the involved root's dermatome.
- Motor involvement is difficult to document.

4. THORACIC DISC HERNIATION



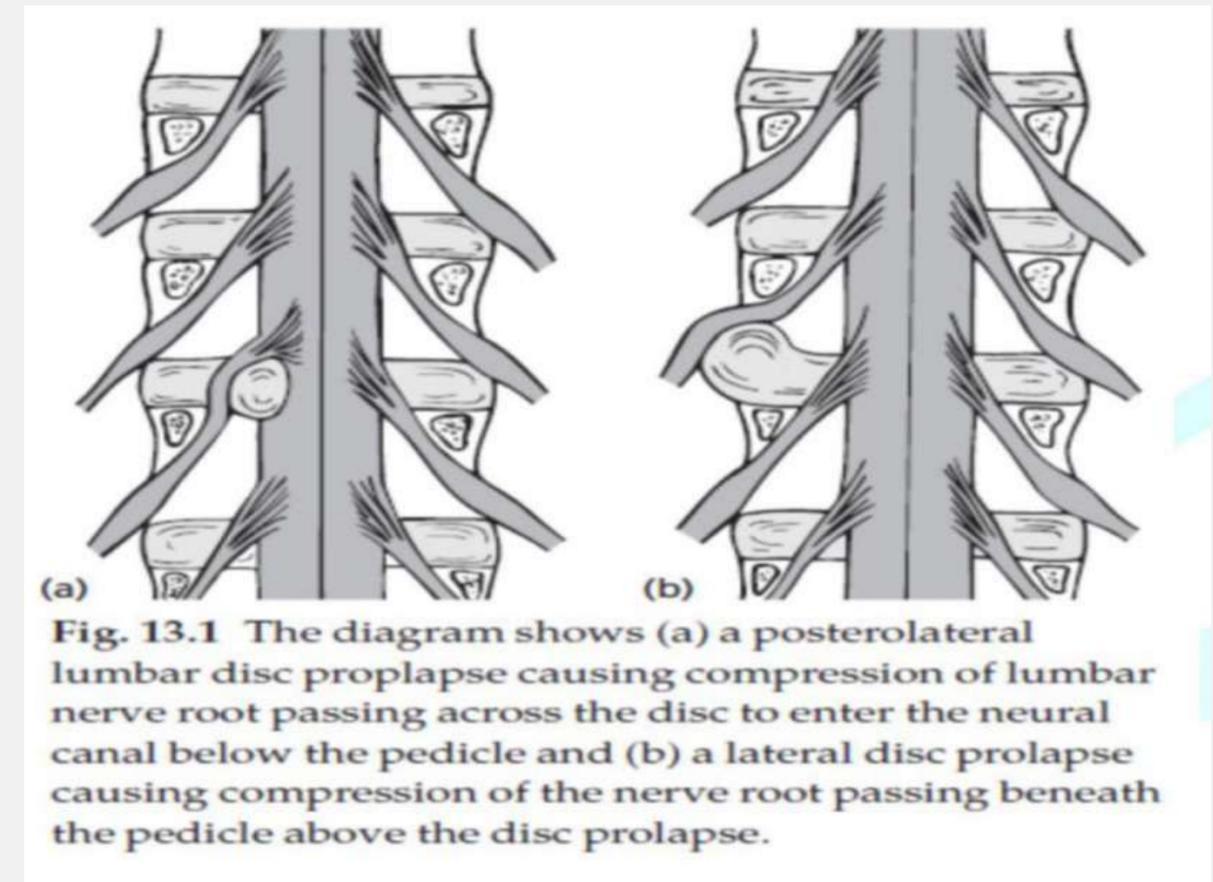
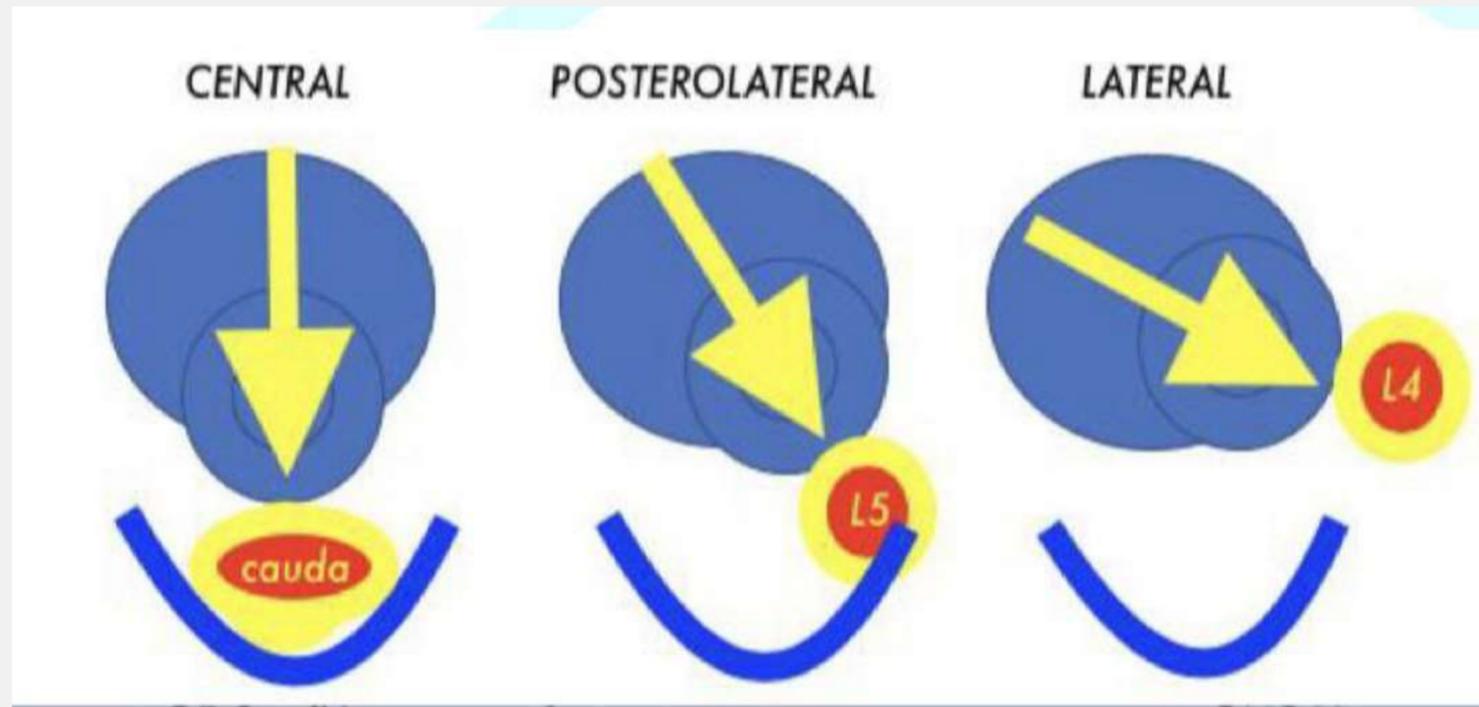
5. Lumbar Disc Prolapse

- NO Myelopathy here
- About 75% of total spinal movement & of lumbar flexion– extension occurs at the lumbosacral junction (L5/S1), 20% at (L4/L5) level and 5% at upper lumbar levels.
- Consequently, about 90% of lumbar disc prolapses occur at the lower two lumbar levels; -The most frequently affected disc is at L5/S1 level.
- Disc prolapse is usually in a posterolateral direction, as the posterior longitudinal ligament prevents direct posterior herniation.
- Less frequently the disc herniates laterally.
- Posterolateral prolapsed disc causes compression of the nerve which runs along the posterior aspect of the disc and down in the neural foramen under the pedicle of the vertebra below



5. Lumbar Disc Prolapse

- Lateral disc prolapse will cause compression of the nerve root passing below the pedicle of the vertebra above the disc prolapse.
- Central prolapse compresses the Cauda equina.
- (remember the spinal cord ends at L1/L2)



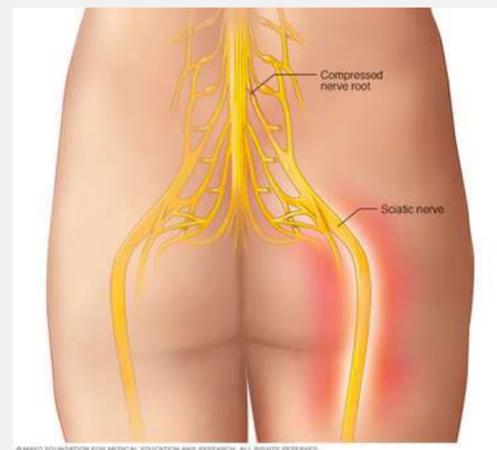
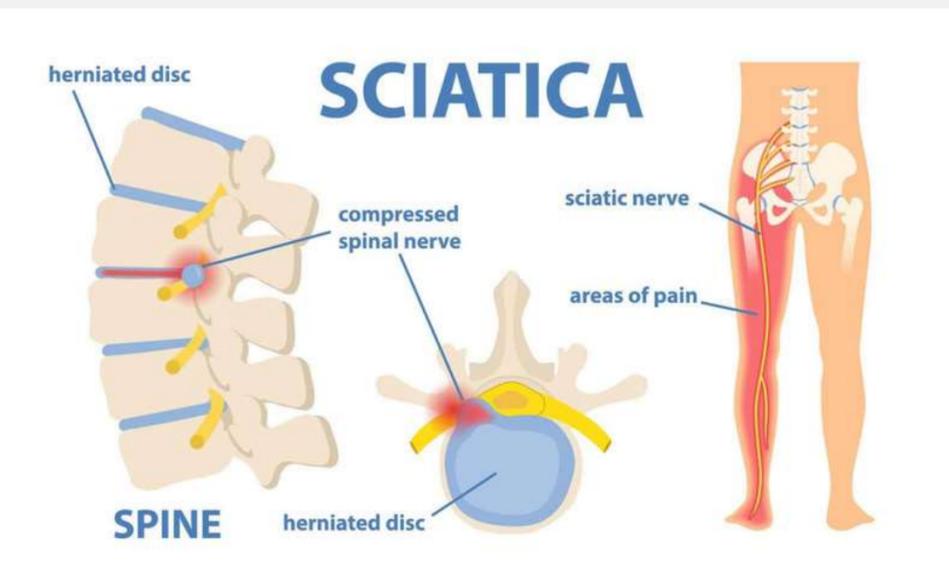
CLINICAL FEATURES OF DISC PROLAPSE

- This type of pain is called **sciatica**, which is the clinical description of pain in the leg due to **lumbosacral nerve root compression** which is usually in the distribution of the sciatic nerve.

Causes of sciatica.

- Prolapsed lumbar disc
- Lumbar spondylosis (osteophyte)
- Lumbar canal stenosis (lateral recess)
- Lumbar spondylolisthesis
- Cauda equina tumours (e.g. ependymoma)
- Pelvic tumours (e.g. rectal carcinoma)
- Spinal arteriovenous malformation (rare)

- The patient suffering from sciatica will be in obvious discomfort, which will be reflected by movements and posture when lying supine.
- The patient lies tilted, usually to the side opposite to the sciatica, with the affected hip and knee slightly flexed taking pressure off the stretched nerve.
- The pain is worse on movement, coughing, sneezing or straining. Although back pain may be present, the important feature is the pain which radiates down the leg in the distribution of the affected



PHYSICAL EXAMINATION

- Inspection:

- a. Scoliosis with the concavity to the side of the herniation.
- b. Loss of lumbar lordosis
- c. Muscle spasm
- d. Dystrophic skin changes.

- Special Tests:

- 1) Straight leg raising (Lasegue's test) :Raising the leg (30- 70degrees) will cause pain.
- 2) Then Bowstring sign (perform SLR) then flex knee and squeeze Popliteal fossa
- 3) Valex Test: Pain increases on pressing the buttocks or the sciatic nerve
- 4) Femoral Nerve Stretch Test:
The knee is passively flexed to the thigh and the hip is passively extended; the test is positive if the patient experiences anterior thigh pain.

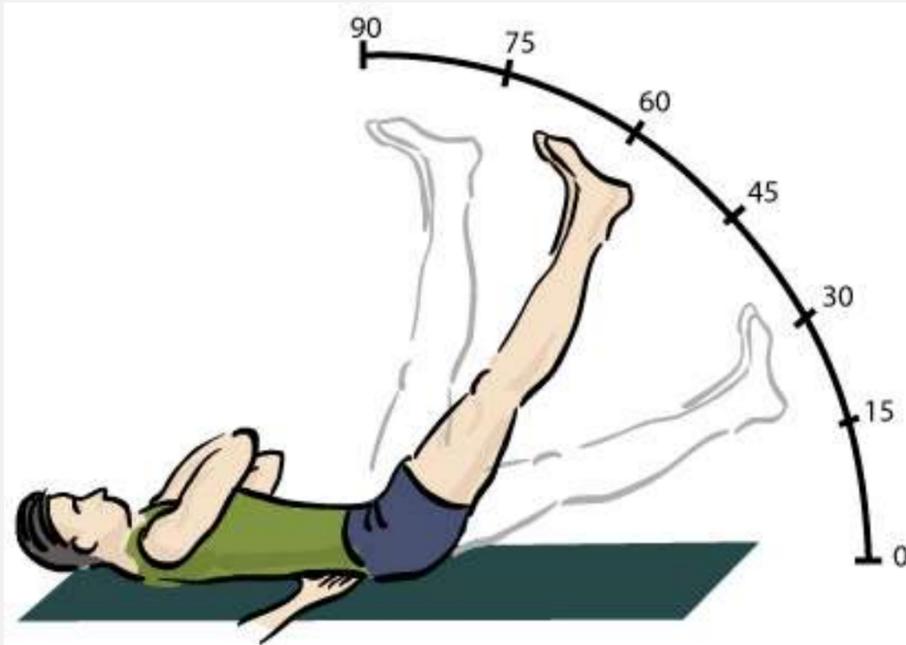
- Palpation :

- Local tenderness
- **Lumbar movement restriction**

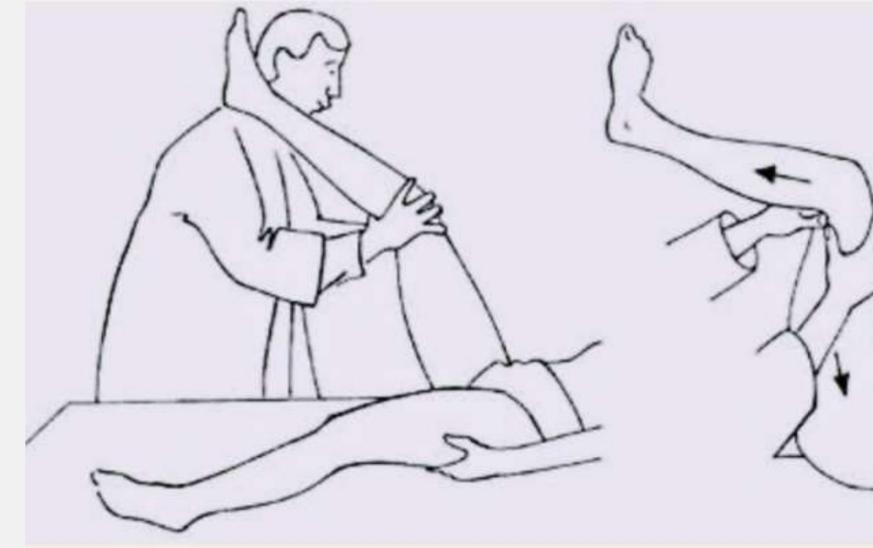


PHYSICAL EXAMINATION

- Lasegue's test



- Bowstring sign (perform SLR)



- Femoral Nerve Stretch Test:

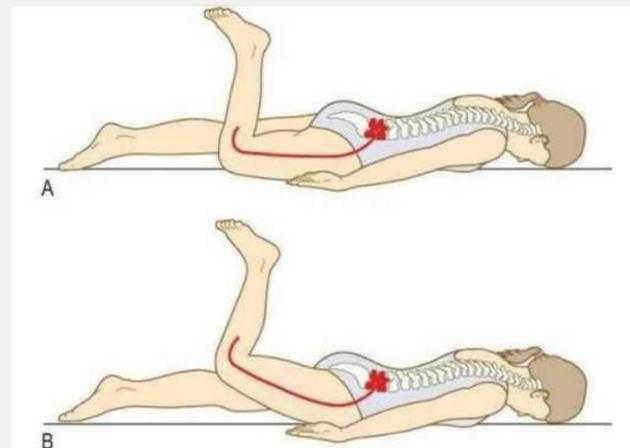
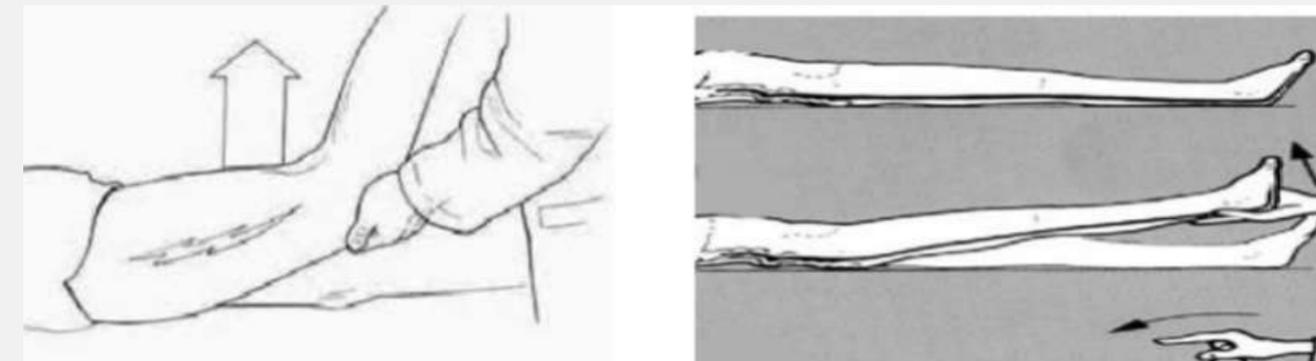


Fig. 14.26 Stretch test: femoral nerve. (A) Pain may be triggered by knee flexion alone. (B) Pain may be triggered by knee flexion in combination with hip extension.



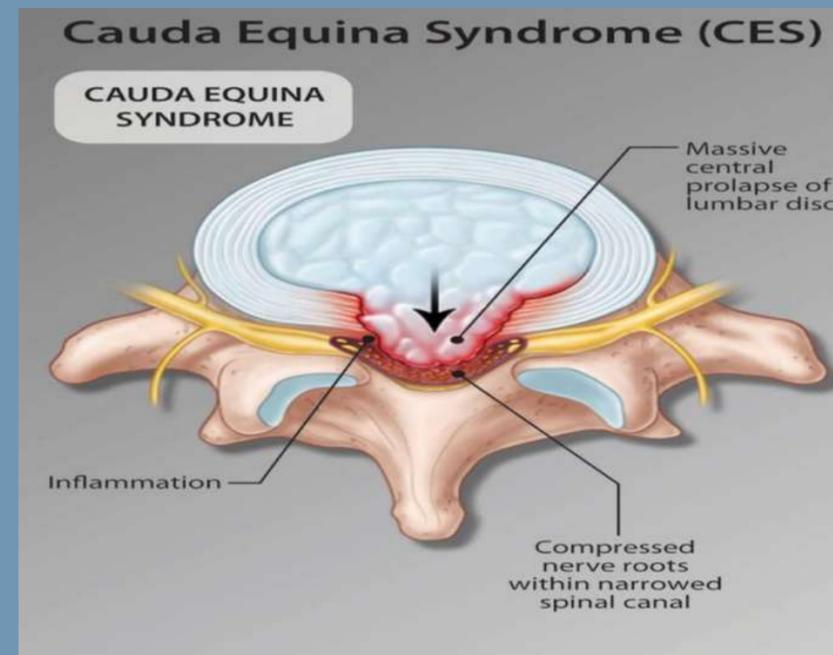
CENTRAL DISK PROLAPSE (CAUDA EQUINASYNDROME)

It's a compression of the thecal sac below L1/L2, causing a sort of lower motor neuron lesion bilaterally (one side is often more affected).



Symptoms:

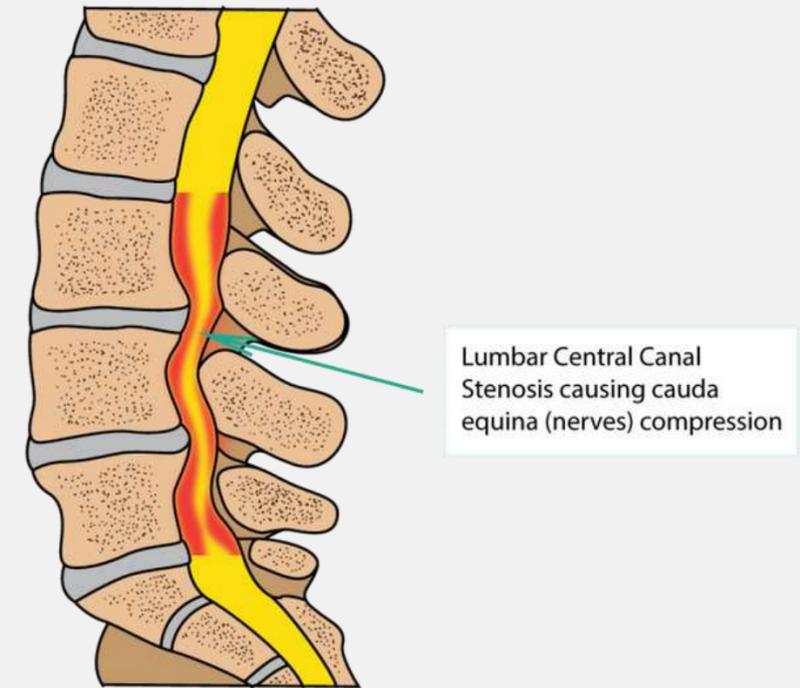
1. Low back pain
2. Acute or chronic pain radiating to the leg (Bilateral down the back of the thigh, may disappear with the onset of paralysis).
3. Unilateral or bilateral lower extremity motor and/or sensory abnormality
4. Bowel and/or bladder dysfunction
 - Bladder dysfunction may present as incontinence, but often presents earlier as difficulty starting or stopping a stream of urine.



6. Lumbar Canal Stenosis

- The stenosis of the lumbar canal may involve:

- **a) reduction of the sagittal diameter of the canal**
- **b) narrowing of the 'lateral recess'**
- **c) stenosis of the neural foramen.**



- The pathology is frequently due to a combination of:

- Congenital canal stenosis
- Degenerative pathology, such as lumbar spondylosis with osteophyte formation & degenerative Spondylolisthesis (L4/L5).
- The most frequently affected levels are L4/5 and L3/4.
- The lumbosacral level may be involved, but this is less common

AP diameter	Normal	Mild	Moderate	Severe
	12-16 mm	< 12 mm	< 10 mm	< 8 mm

6. Lumbar Canal Stenosis

- Clinical Features

- Back pain radiating diffusely into the legs, particularly when standing or walking. it is usually relieved by sitting and patients often adopt a posture of bending the body forward when walking to help relieve the discomfort.
- The pain may be similar to that of vascular occlusive disease, but a key feature is the presence of pain when standing only
- The patient often complains of weakness and diffuse 'numbness' radiating down the legs. Called Neurogenic Claudication
- Patient present with nuerological claudication (which is pain on walking), and its releaved by changing posture unlike vascular claudication that is releaved by rest ,



6. Lumbar Canal Stenosis

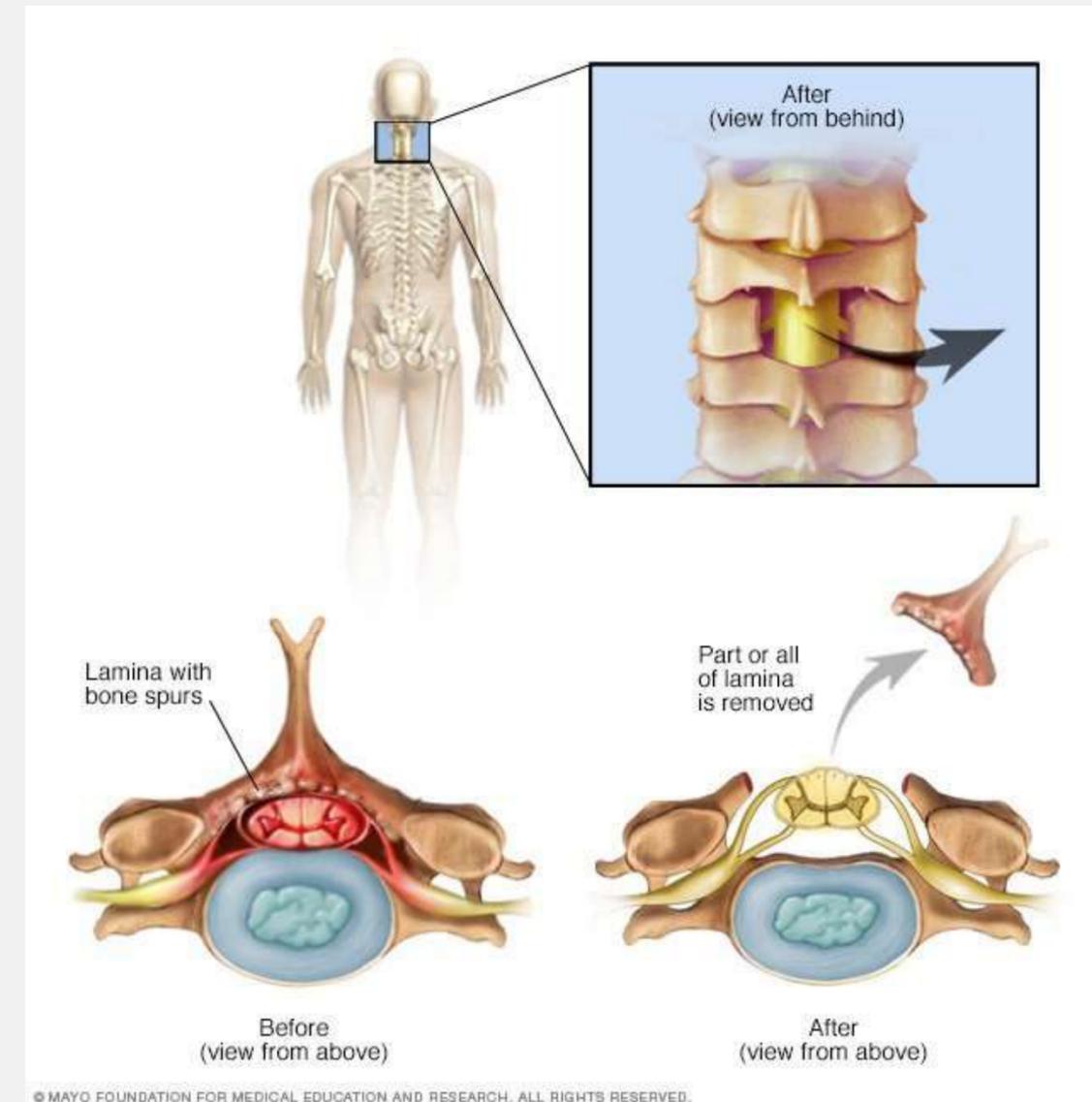
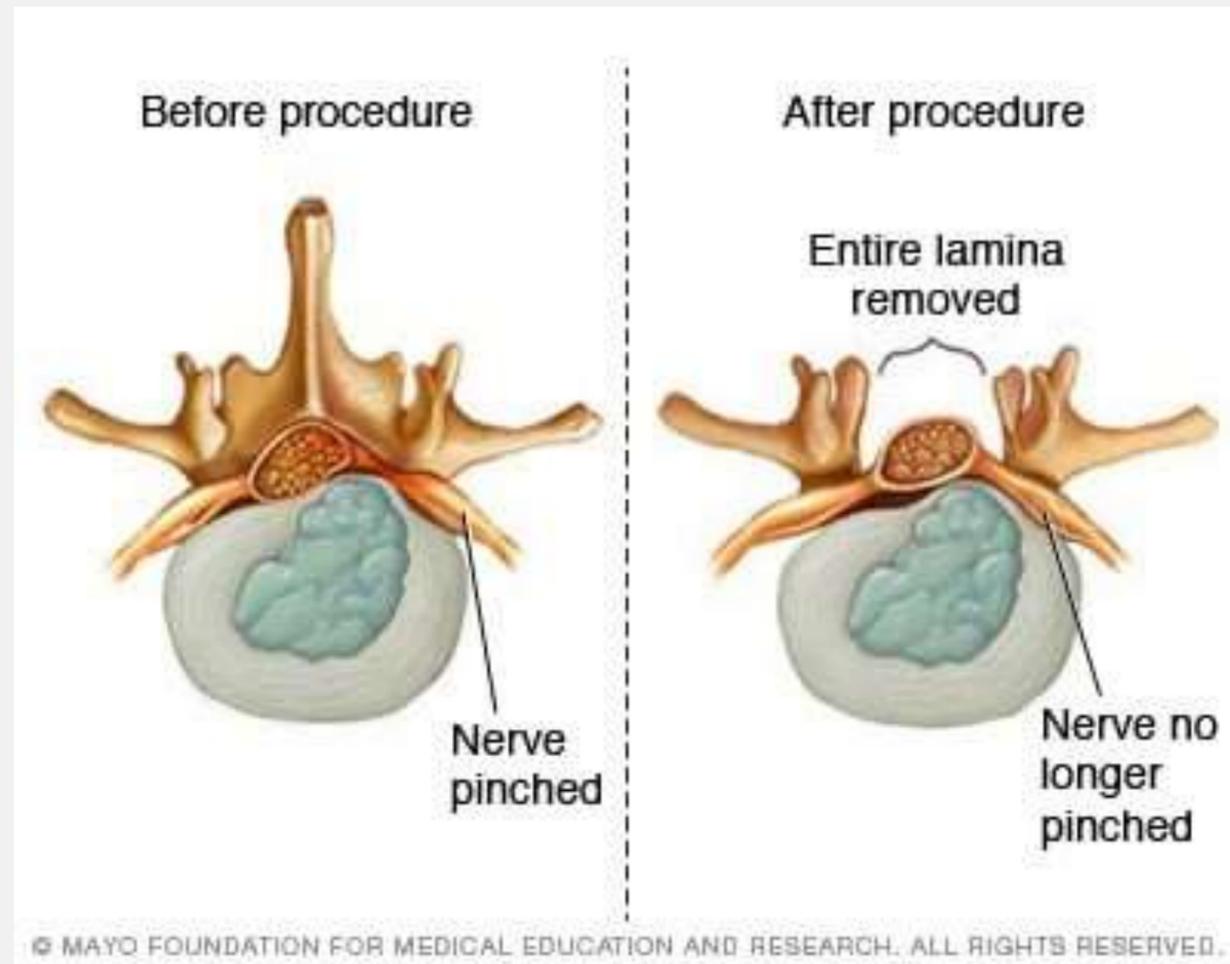
- **Investigations**
- **Myelography**: show marked indentation of the contrast column and, if the stenosis is severe, there may be a complete block.
- **High-quality CT scan and MRI**
- **Interpediculate distance (IPD)**: The transverse diameter of the spinal canal. On plain AP x-ray of lumbar spine, an IPD < 25 mm suggests stenosis.
- **Management**
- Lumbar canal stenosis does not respond to conservative treatment, and surgery is almost invariably successful in relieving the symptoms



6. Lumbar Canal Stenosis

- Management

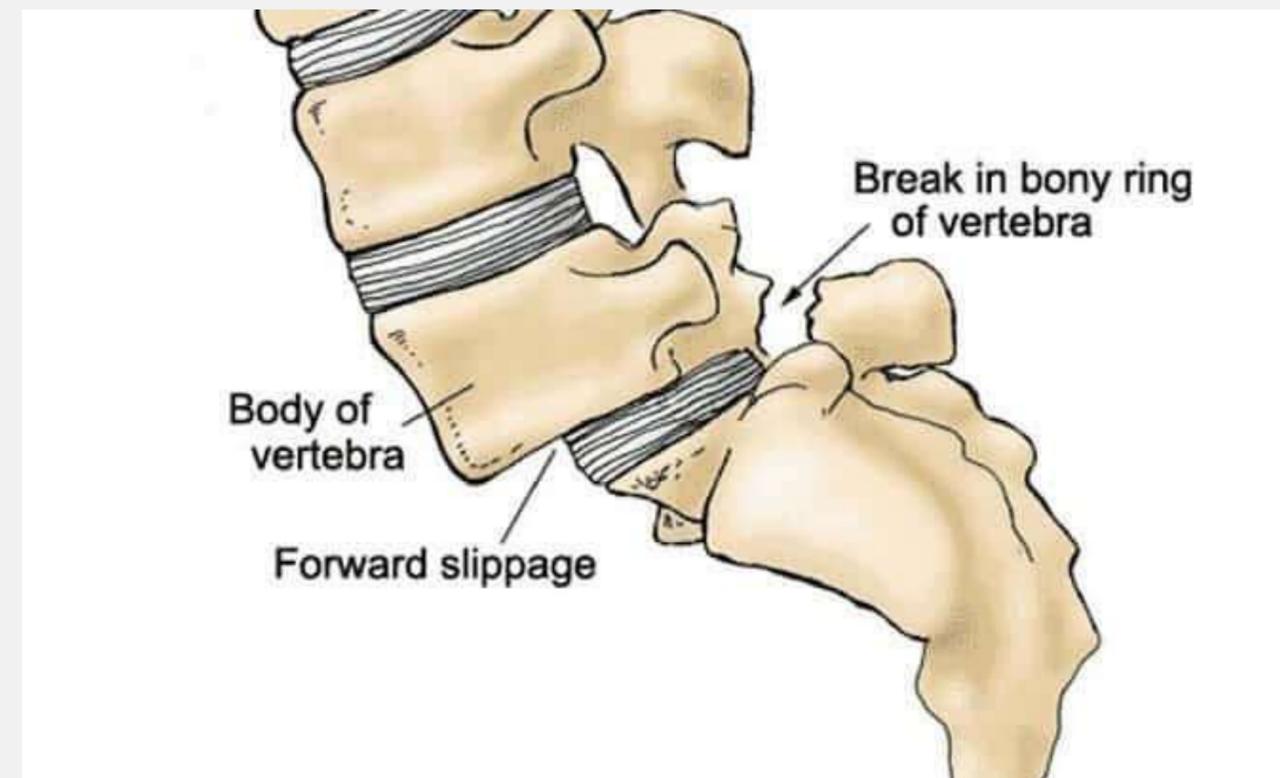
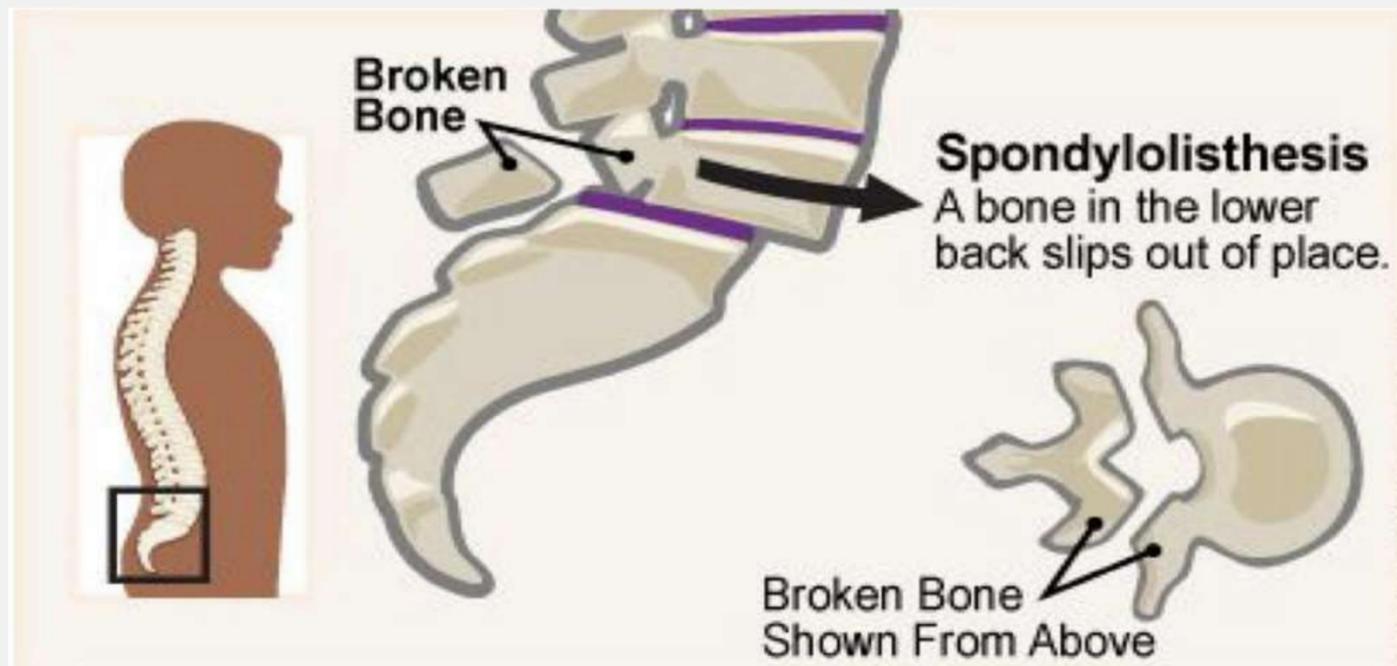
- The operation consists of a decompressive lumbar laminectomy extending over the whole region of the stenosis with decompression of the lumbar nerve roots.



7. Spondylolisthesis



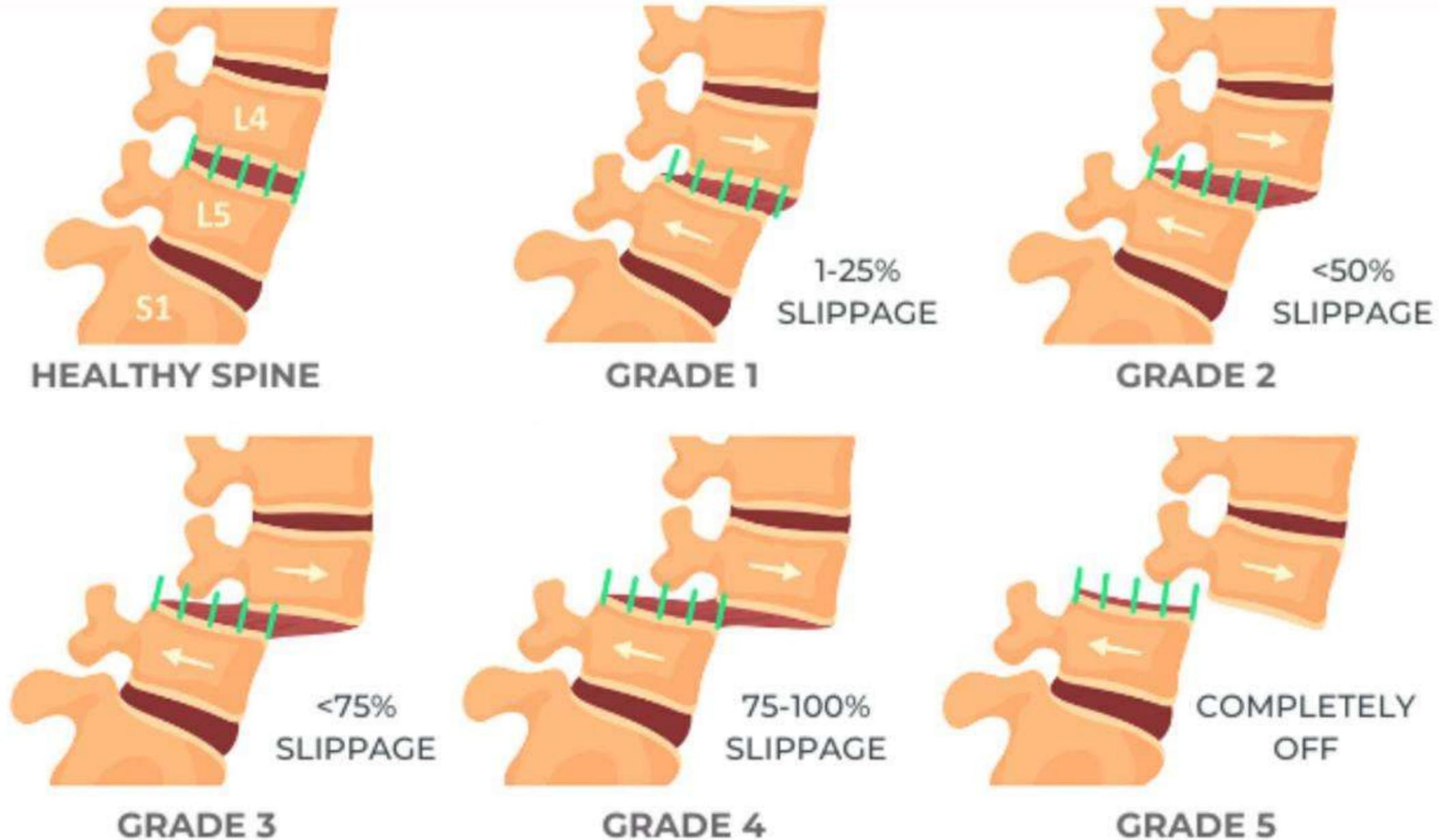
- It is slippage of one vertebral body over another.
- More commonly between L4/L5 , L5/S1.
- It is the most common cause of back pain in adolescents but most cases are asymptomatic.



7. Spondylolisthesis

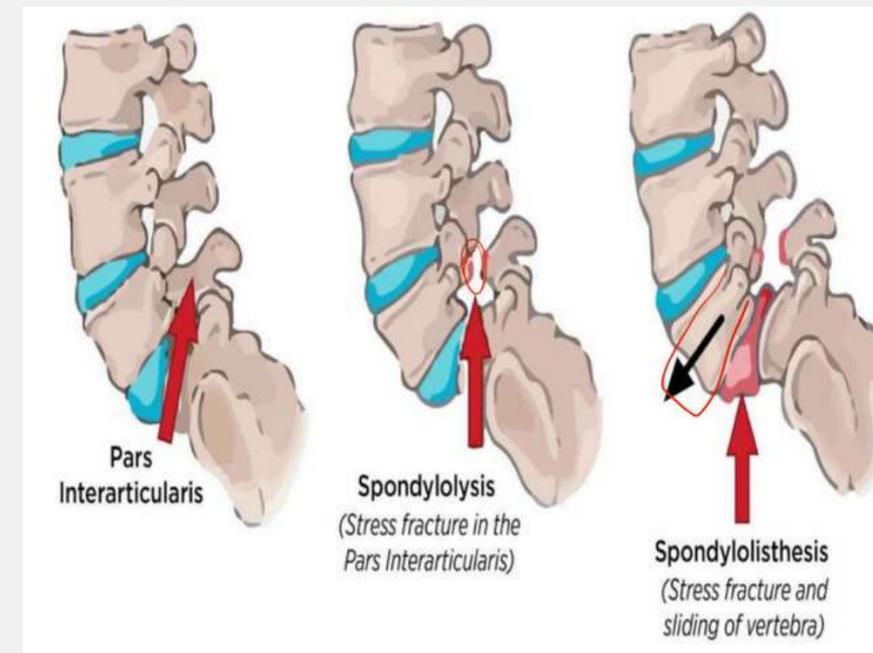
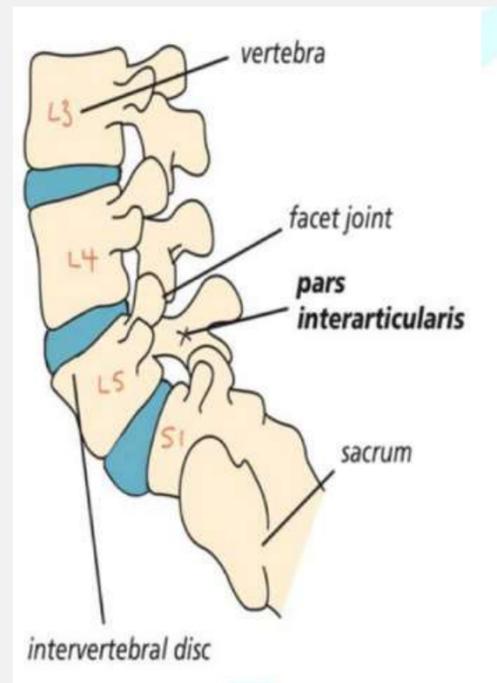
- *meyerding classification:*

SPONDYLOLISTHESIS STAGES



Spondylolisthesis Vs spondylosis:

- **SPONDYLOLYSIS:**
- pars interarticularis', is a small length of bone that joins the facet joints of one vertebra to the facet joints of the vertebra below it. There is a pars interarticularis on each side of the vertebrae at the back of the spine.
- fracture in the bone that connects the facet joints and they become separated is called "Spondylolysis".
- About 80% of pars defects occur on both sides of the vertebra (bilateral) More than 85% of pars defects are found in the L5 vertebrae



Spondylolisthesis Vs spondylosis:

Feature	Spondylolisthesis	Spondylosis
Meaning	Slippage of a vertebra	Degeneration of spinal structures
Cause	Congenital, traumatic, degenerative	Age-related wear and tear
Common Site	Lumbar spine	Cervical and lumbar spine
Symptoms	Back pain, nerve pain, spinal instability	Back/neck pain, stiffness, radiculopathy
Seen On X-ray	Misaligned vertebrae (slippage)	Disc narrowing, osteophytes

7. Spondylolisthesis

- **PRESENTATION OF SPONDYLOLITHESIS:**

- **Low back pain:**

Begins with the growth spurt of adolescence.

- **Sciatic pain with radiation to the buttock, back of the thigh and calf.**
- **Spinal claudication:**

**The pain is related to activity, walking, or prolonged standing.
It improves with rest, either sitting or lying down.**

- **Sensory loss.**
- **Leg weakness.**



7. Spondylolisthesis

- Diagnosis:

- ✓ Plain lumbar spine X-ray: On the lateral view the slip is clearly seen.
- ✓ MRI: Helpful in demonstrating the degree of nerve compression.
- ✓ Lumbar myelogram.
- ✓ Post-myelographic CT: Helpful in planning surgical treatment.

Scotty dog (in spondylolisthesis, it seems there is a fracture across the neck of the scotty dog).



7. Spondylolisthesis



- **Treatment:**

- **Conservative:**

- Rest
- Physical therapy
- Analgesia
- Anti-Inflammatory drugs
- Epidural Steroid Injection (cortisone) is used for patients who suffer from numbness, tingling and even on pain in the lower extremities.

if failed:



- Surgery involves : a laminectomy to decompress the neural structures and a spinal fusion to prevent instability.
- (Laminectomy should be done if there is lumbar canal stenosis or nerve root compression)

7. Spondylolisthesis



- Treatment:

- Surgical treatment:

- Common indications
- High-grade spondylolisthesis (Meyerding classification grades \geq III)
- Significant neurogenic claudication or radiculopathy
- Progressive or persistent symptoms (e.g., after 3-6 months) despite conservative treatment
- Traumatic spondylolisthesis and spinal instability
- Bladder or bowel symptoms

Thanks

