

# COMMON SPINE DISORDERS



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Lecture objectives:

The ability to demonstrate knowledge of the characteristics of the major conditions:

1. Degenerative neck or back pain.
2. Spinal cord or root entrapment (for example, herniated lumbar disc).
3. Osteoporotic vertebral fracture.
4. Spinal deformity (scoliosis, spondylolisthesis).
5. Destructive (infectious and tumor related) back pain (for example, tuberculosis, metastasis, certain cancers).

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**References:** Dr's slides & 436 team, Toronto Notes'2020'

# ANATOMY (EXTRA)

## Structure of the vertebra:

1. Body or Centrum: Weight-bearing part of the vertebra that lies anteriorly.
2. Vertebral arch:
  - Formed from fusion of: 2 Pedicles and 2 Laminae.
  - The vertebral arch carries 7 process:
    - 2 Transverse processes.
    - One spinous process.
    - 2 Superior and 2 inferior articular processes: (four facet joints associated with each vertebra)
3. Vertebral foramen: Lies between the body and the arch, through which the spinal cord passes.
4. Intervertebral disc: Pads of flexible fibrocartilage that separate the vertebrae.
  - The intervertebral discs cushion the vertebrae and absorb shocks.
  - They also make the body trunk flexible. They are thickest in the cervical and lumbar regions, where the movements of the vertebral column are greatest Each disc consists of:
    - Peripheral part: the annulus fibrosus composed of fibrocartilage.
    - Central part: the nucleus pulposus, a mass of gelatinous material containing a large amount of water 90% water, a small number of collagen fibers, and a few cartilage cells.
    - No discs between the first & second cervical vertebrae or in the sacrum or coccyx.
    - Normally disc appears WHITE in T2 weighted image (because it contains mostly water)
    -

## Cervical anatomy:

- 7 Cervical vertebrae; 8 cervical nerve roots.
- Nerve root exits above vertebra (i.e. C4 nerve root exits above C4 vertebrae), C8 nerve root exits below C7 vertebra.

## C1&C2:

- C1 (atlas):
  - No vertebral body (ring like), no spinous process and attached to the occipital condyles (hemisphere) above (50% of cervical flexion and extension happens between occiput and C1).
  - This joint allows you to nod "YES".
- C2 (axis):
  - Has Odontoid process (or Dens.) (50% of rotation in cervical spine occurs between C1 and C2).
  - This joint allows you to nod "NO".

## C3-C7:

Have Transverse foramen (specific to cervical vertebrae) which is important for Vertebral Artery which forms the circle of willis in the brain (only the vertebral vein passes through C7). So any fracture or disc herniation affect this area may affect the brain (not common).

## **Thoracic anatomy:**

- Most thoracic vertebrae are typical, have bodies, **vertebral arches and seven processes for muscular and articular connection.**
- It articulates with the ribs which acts as a splint to stabilize the thoracic spine.
- Most rigid part of the mobile spine (due to rib attachment).
- Rarely injured (usually in high energy trauma.), usually osteoporotic fractures.
- ROM: Mainly rotation, very limited extension and flexion. Why? due to the way the thoracic articular facets are oriented (superior facet is posterolateral, inferior facet is anteromedial)

### *Characteristics of thoracic vertebra:*

- Costal facets are present on the transverse processes for articulation with the tubercles of the ribs (T11 and 12 have no facets on the transverse process).
- The spines are long and inclined downwards.
- The vertebral foramen is small and circular.
- The body is medium sized and heart shaped.

## **Lumbar anatomy:**

- The most common region for fractures and disc herniation. Most of the lumbar disc herniation happen posterolateral.
- ROM: Flexion and Extension. (again, due to facet orientation that goes in the sagittal plane)
- Defect in the pars interarticularis (connection between pedicle & lamina) → Spondylolisthesis.

### *Characteristics of Lumbar vertebra:*

- The Spinous process are short, flat, and quadrangular and project backwards.
- The vertebral foramina are triangular, and the body is large, and kidney shaped.
- The laminae are thick, and the transverse process are long and slender
- The Pedicles are strong and directed backwards.

**Radiological anatomy:**

When looking to a spine x-ray always notice the alignment of each of:

- the anterior vertebral line, the posterior vertebral line and the spinolaminar line.
- These lines need to be congruent otherwise this might indicate, fractures, displacement or any other spinal column pathology.

The soft tissue shadow should measure:

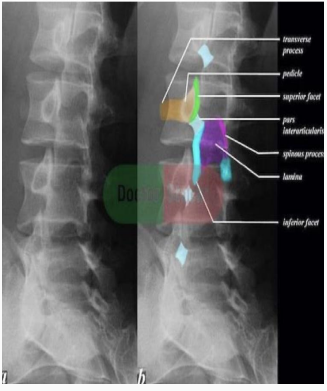
- in front of C1 = 7 mm
- in front of C2 = 2-3 mm
- in front of C6-C7 = 22 mm

Generally speaking, if it was significantly displaced → indicates trauma We must see pedicles at each level (very important), also pay attention to the alignment of the spines and the space between each vertebral body = intervertebral disc.



**A. Spinal cord**

- It is suspended in the vertebral canal & surrounded by the meninges and cerebrospinal fluid (CSF).
- In adults, its Length is approximately 45 cm.
- Extends from foramen magnum to L1- L2 (In children it extends to L3).
- The spinal cord gives rise to 31 pairs of spinal nerves



Conus medullaris: Is termination of spinal cord. Filum terminale: Is residual fragment of spinal cord that extends from conus medullaris to sacrum. Cauda equina: Nerve roots and filum terminale surrounded by dura that extend from the spinal cord.

**Spinal tracts:**

a. Ascending Tracts (Sensory):

1. Posterior columns:
  - Deep touch (pressure), proprioception (joint position), 2 point discrimination, vibrations.
  - when the posterior column is affected the patient can present with:
    - Gait disturbance: elicited by Romberg's test.
    - Loss of dexterity.
2. Lateral spinothalamic tract: pain and temperature.
3. Anterior spinothalamic tract: light touch.

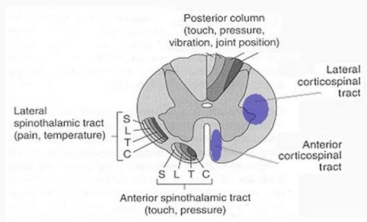
The only tract that doesn't decussate at the brain stem and instead decussate at the spinal level is the spinothalamic tract.

b. Descending tracts (motor):

Corticospinal tract (anterior and lateral): main voluntary motor.

Upper extremity motor pathways are more medial (central) which explains why a central cord injury affects the upper extremities more than the lower extremities.

The representation of the fibers in the spinal cord differs; the fibers with the most central representation are cervical fibers after that comes thoracic, lumbar and then sacral (i.e. sacral fibers are the last fibers to be affected when the source of pathology is central, a phenomenon known as sacral sparing).



## Important points the doctor mentioned at the end of the lecture you should focus on:

- 1) The Red Flags.
- 2) If myopathy Tx is Decompression.
- 3) Radiculopathy = drop foot Tx is surgery.
- 4) Sciatica Tx is conservative.
- 5) Pain when standing relieves when he bends forward, pain in down hill vs up hill.
- 6) Scoliosis = Adam's test, Coronal plane, Rotation.
- 7) Spondylolisthesis if it's a high-grade surgery!

## SPINAL PATHOLOGY RED FLAGS: Very important!

### Red flags of back pain: **IMP**

1. **Age more than 50** (of new onset pain) Red flag of lower back pain
  2. **History of malignancy**. Tumour weakening the vertebrae (causing cord compression or vertebral fracture)
  3. **History of trauma**. Traumatic Spine Fracture (causing vertebral angulation, pain, or neuro-compromise)
  4. **History of infection**. weakening bone (causing disc/vertebral destruction or cord compression)
  5. **Urinary retention/fecal incontinence**. "Cauda equina" (perianal numbness, decreased rectal tone, loss of movement in the extremities)
  6. **Acute motor deficit**. Any acute loss of motor power = Emergency Surgery rush to the OR as soon as possible 6-12 hours to save it. = Patient present with developed disc herniation and **foot drop**.
  7. **Constitutional symptoms**. (Loss of appetite, loss of weight, fever, night sweat, pain at night)
- Remember that spine fracture can occur without trauma patient can have severe osteoporosis coughs or sneezes (or any minor load) → fracture!

## DEGENERATIVE SPINAL DISORDERS

#Terms:

- Spondylosis: A degenerative disease or facet osteoarthritis.
- Spondylolysis: A fracture or defect in the pars interarticularis.
- Spondylolisthesis: Displacement of one vertebra over the other.

### Spinal motion segment is composed of:

1. Two adjacent vertebrae.
2. **Three-joint complex**. (intervertebral disc & 2 facet joints)
3. Ligaments.

Note that each level of your spine functions as a three-joint complex.

- There are two facet joints in the back and a large disc in front that comprise each intervertebral segment.
- This tripod creates great stability, supports all your weight above each level and provides support for you to move in all directions.
- The posterior **facet joints are synovial joints** whereas the intervertebral disc is a fibrocartilaginous joint.

- ❑ Degeneration: Deterioration of a tissue or an organ in which its function is diminished, or its structure is impaired.
- ❑ Other terms (that are used interchangeably with “degenerative spinal disorders”):  
Spondylosis خشونة الفقرات: which could be:
  - Degenerative disc disease.
  - **Facet osteoarthritis.**

Degeneration of IVD (intervertebral disc):

- Loss of cellular material and hydration “proteoglycans”.
- Loss of disc height.
- Abnormal loading to the facet.
- Facet joints degeneration (Loss of height + facet OA).
- Spinal stenosis +/- instability.

❑ **Causes: Multi-factorial:**

1. Genetic predisposition.
2. **Age related.** (Aging), with ageing there is a gradual loss of proteoglycans and the disc becomes somewhat dehydrated and degenerate, this is thought to be the underlying cause of two important disorders that occur particularly in the lumbar and cervical regions and to a lesser extent in the thoracic spine: Intervertebral disc herniation and chronic intervertebral disc degeneration.
3. Some environmental factors: - Smoking. - Obesity. - **Previous injury, fracture** or subluxation. - Deformity. - Operating heavy machinery, such as a tractor.

## ANATOMY:

- Anterior elements:

- Vertebral body.
- Intervertebral disc.

**Degeneration occurs at the disc.**

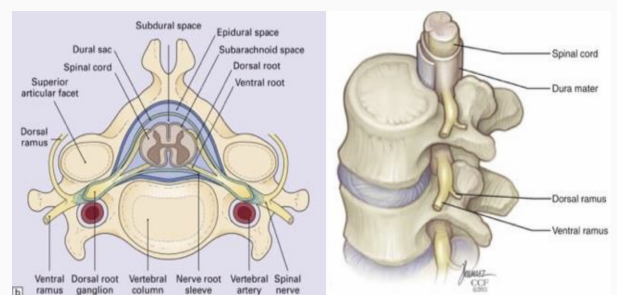
- Posterior elements:

- Pedicles, laminae, spinous process, transverse process, facet joints (2 in each level)

**Osteoarthritis occurs at the facet joints.**

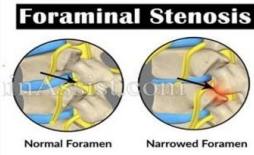
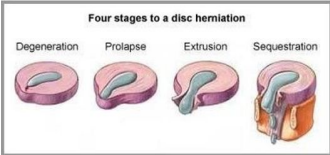
- Neurologic elements:

- Spinal cord, Nerve roots, Cauda equina



# PATHOLOGY:

Both the mechanical and neurological segments are involved.

Mechanical segment	
The Intervertebral disc (Anteriorly)	The facet joints (posteriorly)
<p>The first component of the <b>3 joints complex</b>: (motion segment).</p> <ul style="list-style-type: none"> <li>- It is primarily loaded in <b>Flexion</b>.</li> <li>- Composed of “annulus fibrosus” and “nucleus pulposus”.</li> </ul> <p><b>Degeneration of the nucleus:</b></p> <ul style="list-style-type: none"> <li>- Loss of both: cellular material and hydration → pain!</li> <li>- Can be asymptomatic, Water content drops disc became hard and black on the X-ray.</li> </ul> <p><b>Disc degeneration will also cause:</b></p> <ol style="list-style-type: none"> <li>1. Bulging of the disc →”Spinal” stenosis.</li> <li>2. Loss of disc height →”Foraminal” stenosis.</li> <li>3. <b>Herniation of the nucleus</b> →”Radiculopathy” (e.g. sciatica in the lumbar spine)</li> </ol> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;">Extra:-</div> <div style="display: flex; gap: 10px;">   </div> </div> <ul style="list-style-type: none"> <li>- Annular tear (which leads to herniation of the nucleus) is extremely painful and leads to sciatica. Will improve anyway, but it gives chronic kind of pain.</li> <li>- Sequestered disc (when parts of the herniated nucleus separate from it) → it’s water, the body will eventually absorb it. Almost all will <b>improve within three months</b>. So basically, most patients with disc pathology &amp; herniated disc who are in severe pain &amp; cannot leave bed WILL also IMPROVE, almost 90% will improve within 3 months</li> </ul>	<p>Scientific name is “zygapophysial joints”.</p> <ol style="list-style-type: none"> <li>1) They are synovial joints.</li> <li>2) 2 in each motion segment.</li> </ol> <ul style="list-style-type: none"> <li>- Are primarily loaded in <b>EXTENSION</b> (along with pars interarticularis posterior muscles and ligaments)</li> </ul> <p><b>Pattern of degeneration similar to other synovial joints:</b></p> <ul style="list-style-type: none"> <li>- Loss of hyaline cartilage.</li> <li>- Formation of osteophytes.</li> <li>- Laxity in the joint capsule.</li> </ul> <p>it’s like any synovial joints in the body the degeneration process leads to loss of joint height, osteophytes formation, redundancy in capsule, inflammatory changes, excessive fluid and eventually instability which cause spondylolisthesis usually anterior posterior slippage “the vertebral above slips anteriorly”</p> <p><b>Facet joints degeneration will cause:</b></p> <ol style="list-style-type: none"> <li>1. Hypertrophy, osteophyte formation: <ul style="list-style-type: none"> <li>- contributing to spinal stenosis or foraminal stenosis.</li> </ul> </li> <li>2. Laxity in the joint capsule: <ul style="list-style-type: none"> <li>- leading to instability especially in lumbar spine (degenerative spondylolisthesis another term is slippage of one vertebra or subluxation of one vertebra or over the other usually in sagittal plane front to back )</li> </ul> </li> </ol>

# CLINICAL PRESENTATION:

## Mechanical pain

Due to joint degeneration or instability.

- “Axial pain” in the neck or back, activity related-not present as rest.

Mechanical pain: dull pain.

**Associated with movement:**

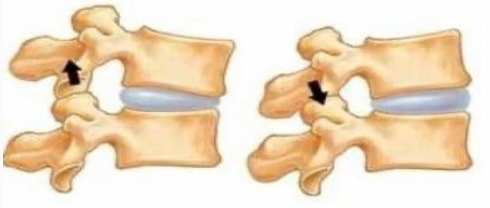
- 1- **Sitting, bending forward (flexion):**

Originating from the disc →

“**Discogenic pain**” pain when praying.

- 2- **Standing, bending backward (extension):** Originating from the facet joints → “**Facet**

**syndrome**” patient present with inability for standing or walking for long time especially downstairs b/c back extension.



## Neurologic symptoms

Due to neurologic impingement

**A) Spinal cord:** presents as myelopathy, and spinal cord injury.

### 1. Myelopathy: (Compression on the cord)

1. Loss of motor power and balance → gait disturbance.
2. Loss of dexterity → objects slipping from hands. Loss of balance, fine hand movements such as writing, inability to buttoning his shirt, coffee or tea cups slips from him.
3. UMN deficit → rigidity, hyperreflexia, **positive Babinski**.
4. Slowly progressive “stepwise” deterioration **unlike spinal cord injury**. It happens over months. Stepping pain and usually associated with neurological symptoms such as: numbness and parenthesis.

### 2. Spinal cord injury:

Spinal stenosis associated with a higher risk of spinal cord injury. Since the cord is already compressed, any sudden movement may injure the cord.

**B) Cauda-equina and Nerve roots:** presents as radiculopathy (e.g. sciatica) or neurogenic claudication.

### 1. Radiculopathy:

1. LMN deficit.
2. Commonest is sciatica, but cervical root impingement causes similar complaints in the upper limb. **Lumbar level** → radiculopathy → sciatica.

**Sciatica** refers to the symptoms of **pain**, numbness, tingling, burning sensation or weakness that **originate in the lower back**, radiate through the buttock, **and continue** down the back of the thigh, **leg** and foot. **Sciatica** occurs when there is compression, inflammation or injury to the sciatic nerve or to its (spinal nerve) roots L4-S2

### 2. Neurogenic claudication:

1. Pain in both legs caused by walking.

Must be differentiated from vascular claudication.

**The following table is very important:**

**Table – Differentiating neurogenic and vascular claudication**

Factors	Neurogenic	Vascular
Evaluation after walking	Increased weakness	Unchanged
Palliative factors	Bending over, sitting	Stopping
Provocative factors	Walking downhill Increased lordosis	Walking uphill Increased metabolic demand
Pulses	Present	Absent
“Shopping cart” sign	Present	Absent
van Gelderen bicycle test	No leg pain	Leg pain



- **Flexion** = widening of the spinal foramen (walking uphill requires flexion to bring the center of gravity anteriorly)
- **Extension** = compression of the spinal foramen (walking downhill requires extension to bring the center of gravity posterior)
- **Neurogenic claudication**
  - Pain as soon as he walks from proximal to distal (he didn't use muscles → not vascular claudication).
  - **Pain relieved by sitting** (sitting = flexion = widening)
- **Vascular claudication**
  - Pain relieved by **stopping & standing** (benefits from gravitational force on blood supply).
  - Why distal to proximal in vascular claudication? Because blood supply is less as you go distally.
- **Shopping cart sign**: the patient bends while walking, because neurogenic pain is relieved in bending position. Because ligamentum flavum is hypertrophied into spinal canal and while bending يتجمع
- **Bicycle sign**: it is like a stress test on a bicycle, patient with vascular claudication will develop pain because the metabolic demand will increase while neurogenic patients will feel no pain.



## IMAGING:

- X-ray examination: typically shows flattening of the 'disc spaces' and spur formation at the borders of the vertebral bodies, often accompanied by characteristic features of osteoarthritis in the small facet joints.
- MRI scans: may show bulging of one or more discs in both sagittal and axial projections. Most imp scan.
- **Patient presented after RTA with thoracic spine pain, normal neurological examination & unclear x-ray. Second step? CT.**

## I- DEGENERATIVE CERVICAL SPINE

### داء الفقار العنقي التنكسي

- ❑ Degenerative changes typically occur in **C3-C7**

#### How is it presented?:

History:	Physical examination:
1. Axial <u>neck</u> pain. 2. Myelopathy. 3. Radiculopathy.	<ul style="list-style-type: none"> <li>- Stiffness (loss of ROM)</li> <li>- Neurologic exam: (along upper limbs)               <ol style="list-style-type: none"> <li>1. <b>Weakness.</b></li> <li>2. <b>Loss of sensation.</b></li> <li>3. <b>Hyper-reflexia, hypertonia because of <u>UMN</u> lesion.</b></li> <li>4. <b>Special tests: Spurling's sign<sup>1</sup></b></li> </ol> </li> </ul> <p style="color: green;">Axial compression + rotation and lateral bending to make the spinal foramen in one side more compressed to excite the nerve root that already being compressed to know if it's really radiculopathy rather than shoulder pain or peripheral neurological disease.</p>



1. The examiner turns the patient's head to the affected side while extending and applying downward pressure to the top of the patient's head. a positive sign is when the pain arising in the neck radiates in the direction of the corresponding dermatome ipsilaterally.

## ❑ Management:

### ● Conservative treatment:

First line of treatment for axial neck pain and mild neurologic symptoms (e.g. mild radiculopathy without any motor deficit)

1. Rest and short periods of immobilization.
2. Physiotherapy: focus on ROM and muscle strengthening.
3. NSAID: e.g. Diclofenac, ibuprofen, naproxen. Pay attention to patient who has peptic ulcer, nephropathy and HTN.
4. Neuropathic medication: for radiculopathy pain – e.g. Gabapentin or pregabalin or Amitriptyline.

### ● Surgical management:

Indicated for:

1. Spinal stenosis causing myelopathy.
2. Disc herniation causing severe radiculopathy and weakness. Acute limb weakness.
3. Failure of conservative treatment of axial neck pain or mild radiculopathy.

Procedures:

1. Anterior discectomy and fusion.
2. Posterior laminectomy.

Image of anterior discectomy and fusion:



## 2- DEGENERATIVE LUMBAR SPINE:

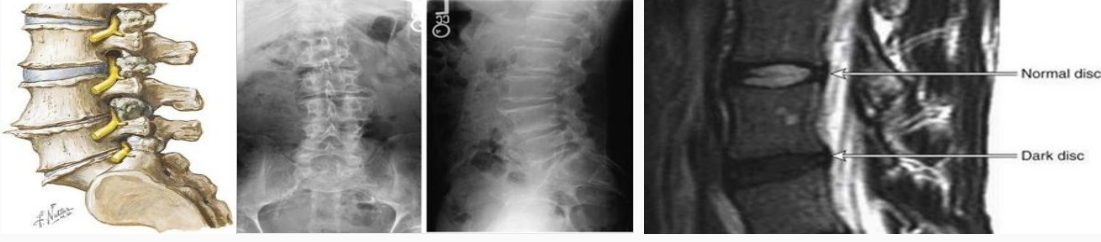
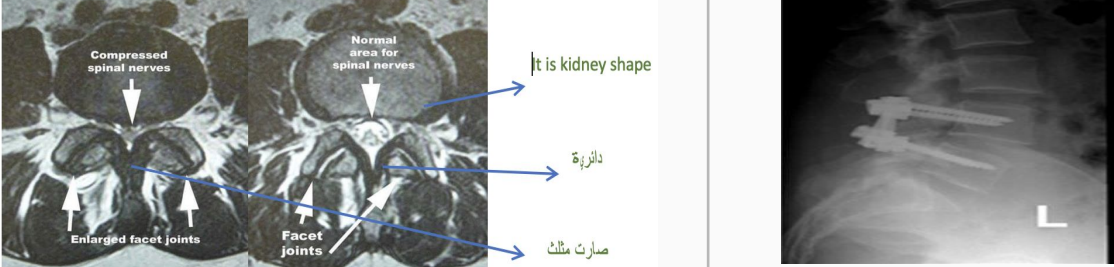
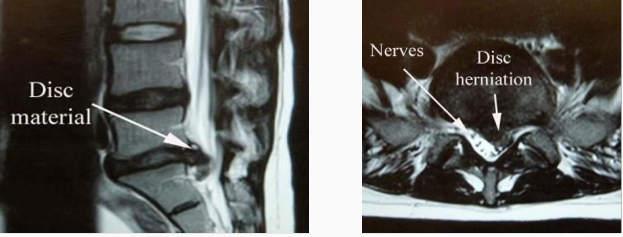
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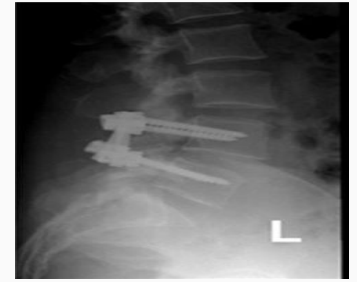
❑ Degenerative changes typically occur in **L3-S1**

How is it presented?:

History:	Physical examination:
<ol style="list-style-type: none"><li>1. Axial <u>back</u> pain.</li><li>2. <b>Sciatica</b>.</li><li>3. Neurogenic claudication.</li></ol>	<ul style="list-style-type: none"><li>- Stiffness (loss of ROM)</li><li>- Neurologic exam: (along lower limbs)<ol style="list-style-type: none"><li>1. <b>Weakness</b>.</li><li>2. Loss of sensation.</li><li>3. Hypo-reflexia, hypotonia because of <b>LMN</b> lesion</li><li>4. <b>Special tests: Straight leg raise test (SLRT)</b>.</li></ol></li></ul>

# IMAGING:

<p>Lumbar Spondylosis</p>	
<p>Spinal stenosis</p>	
<p>Disc herniation</p>	



Spinal fusion

## Management:

### A) Axial low back pain:

- Conservative treatment is first line and mainstay of treatment:
  1. Physiotherapy: core muscle strengthening, posture training.
  2. NSAID.
- Surgical treatment, Indicated for:
  1. Instability or deformity e.g. high- grade spondylolisthesis. الفقرة قدام على متر حلقة
  2. Failure of conservative treatment.

### B) Spinal stenosis:

- Conservative treatment is the first line of the treatment:
  1. Activity modification
  2. Analgesic.
  3. Epidural corticosteroid injections.
- Surgical treatment, Indicated for:
  1. Acute Motor weakness e.g. **drop foot** it is an emergency you have to operate within a day or less.
  2. Failure of minimum 6 months of conservative treatment.
    - Procedure: Spinal decompression (laminectomy) is the commonest procedure.

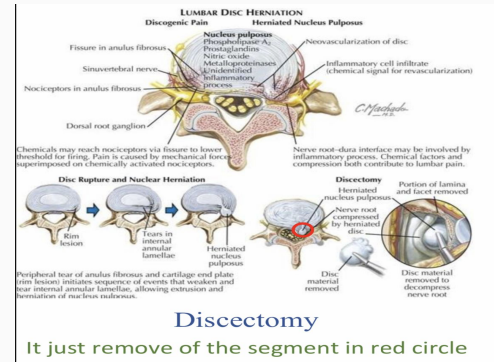
### C) Disc herniation:

- Conservative treatment is first line of treatment for mild sciatica without motor deficit: **IMP**
- 1. Short (2-3 day) period of rest.
- 2. NSAID.
- 3. Physiotherapy
- 4. Epidural corticosteroid injection.

- **95% of sciatica resolves within the first 3 months without surgery.**

- **Surgical treatment Indicated for : IMP**

1. **Cauda-equina syndrome.**
  2. **Acute Motor deficit.** Muscle power 3 or less
  3. Failure of 2-3 months of conservative treatment.
- Procedure: Discectomy (only the herniated part)
1. Patient with 10 days of acute pain, he cant get out of the bed=conservative
  2. Patient with 4 months history of the pain+ failed of physiotherapy=surgery
  3. Patient with 2 days history of the pain+ features of cauda equina= surgery
  4. Why most herniated discs are posterolateral not central? Central part is stronger due to the support of the posterior longitudinal ligament.



## OSTEOPOROTIC VERTEBRAL FRACTURES

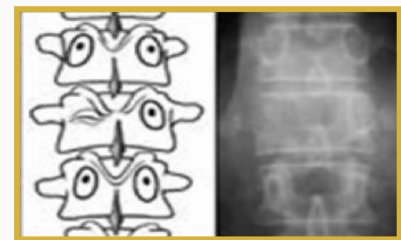
### كسور العمود الفقري الناتجة عن هشاشة العظام

- Pathologic fractures, low energy fractures.
- Anterior column (±middle column) only compromised (Wedge/Burst Fracture)
- Often missed, (Common injury in postmenopausal women).
- Repetitive fractures result in kyphotic deformity (hunchback)
- **Treat the underlying cause!!** (e.g. osteoporosis). It increases the mortality rate by increasing The DVT and pneumonia

-Possible surgical management is kyphoplasty/ vertebroplasty if severe pain is present.

-Other pathological vertebral fractures are also low energy fractures and are caused most commonly by either infection or tumors (red flags).

- With these **pathological fractures**, spinal X-ray shows “winking owl sign” also known as “absent pedicle sign” which **indicates erosion of spinal pedicle** (most commonly suggests osteolytic spinal metastasis).

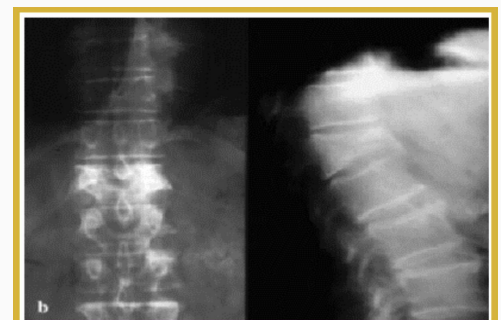


## SPINAL DEFORMITIES:

### I-KYPHOSIS الحداب

Deformity of the spine in the **Sagittal** plane.

Give the patient **anti-osteoporotic medications** (Bisphosphonate maybe)



## 2-SCOLIOSIS الجنف

Deformity of the spine in the **Coronal** plane (more common than kyphosis).

### Types:

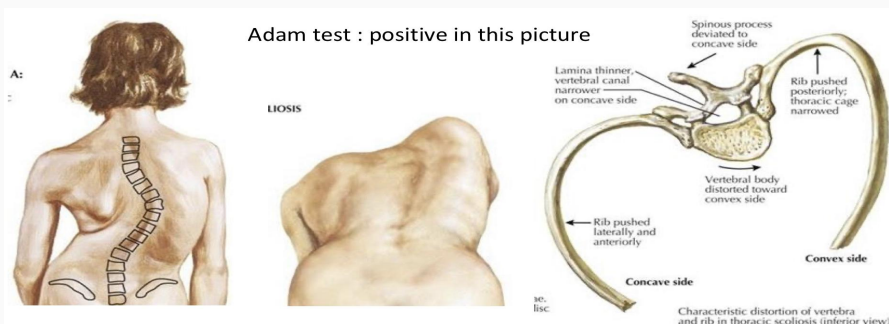
- **Congenital:** Associated with anomalies of the bony vertebral column, e.g hemivertebra. (They have half vertebra)
- **Acquired:** Secondary to other pathology, e.g tumor, infection.
- **Idiopathic:** Most common is adolescent type.
- **Syndromic:** Secondary to other syndromes e.g. Ehler danlos', marfan's syndrome. - Neuromuscular: Secondary to poor muscle control or nerve problems e.g. muscular dystrophy, cerebral palsy.

**Adolescent idiopathic scoliosis:** Between 10 and 14 years old (most common)

- Three dimensional deformity of the spine – Vertebral **Rotation** is the hallmark. (meaning it's not just curving in different directions NO it's a 3D deformity)
- **Painless** deformity: **Usually noticed by parents or others.** If it is pain need to see another causes like infection, tumor.
- Examination: neurologically normal, **positive Adams test.** **When the patient bend forward the back is not symmetrical there's hump in one side**
- Management: depends on age & degree of deformity (45 degrees or more) you do not need to know the details of but if the patient have severe scoliosis we will operate, young surgery old brace. Rx surgically, attempt to correct as much as possible and prevent further progression
- instrumented PSF (posterior spinal fusion)

What are the positive clinical signs in this patient shown in the x-ray?

1. Shoulder asymmetry (which side is elevated? Left, evident by the clavicle another hint shoulder is usually elevated at the convex side of spine).
2. Waist is asymmetric right side is bulging, left side is pushed.
3. Positive Adam forward test + rib hump.
4. Lateral image will show either exaggerated kyphosis or hypokyphosis of thoracic spine.



Pic show you pt standing with scoliosis and trunk shift toward in this case to right, when bending forward b/c vertebrates are rotated the ribs in one side are prominent and the other side are less, so when you take cut section you see that the ribs are prominent unilaterally so that positive of Adams test; Unilateral hump after bending forward.

# 3- SPONDYLOLISTHESIS انزلاق الفقار

**Translation** (Displacement/subluxation) of one vertebra over another. (Slippage)

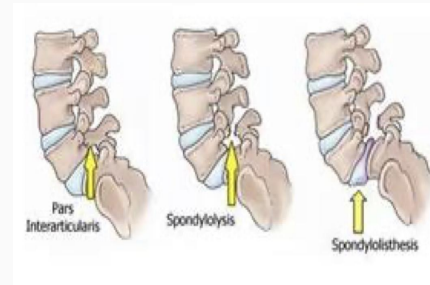
- It's a defect in the pars interarticularis.
- Most people are asymptomatic.

**Types:** when the facet joint capsule becomes redundant and you get slippage

1. "Degenerative" Spondylolisthesis most common
2. "Isthmic" spondylolisthesis → caused by interarticularis defect (spondylolysis)

pars = body, interarticularis = in between two joints (facet joints) acquired from pedicle trauma or congenitally

Severity is according to the degree of displacement.

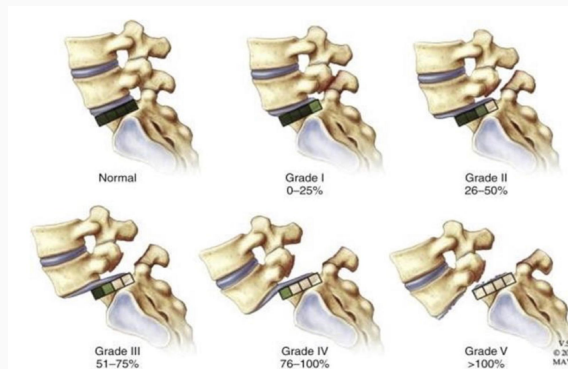


## Management:

- Conservative treatment first.
- **Surgery if Grade 3 or more or failed conservative management** (even if low grade)
- Surgical procedure: Instrumented PSF (posterior spinal fusion) with decompression +/- interbody fusion is the commonest.

## Grades:

1. Grade I 25% displacement
2. Grade II 50% displacement
3. Grade III 75% displacement
4. Grade IV full displacement
5. Grade V = spondyloptosis (no contact)



Degeneration so it is slipped



Both are slipped

Broken during bony development

# DESTRUCTIVE SPINAL LESIONS

آفات العمود الفقري

- o Present with **pain at rest** or **pain at night** → this spinal lesion weakens bone → more pain (axial pain with movements) → further fracture with minor trauma → severe pain with loss of function.
- o Associated with **constitutional symptoms**.
- o Most common causes are infection & tumors (**infection is always a differential for tumor and vice versa**)
- o Vertebral **body and pedicles** are the commonest sites of pathology. **Why? B/C it's highly vascular.**

## 1) Tumor

### Primary Spinal tumors:

- Rare.
- Benign (e.g. osteoid osteoma) or **malignant** (e.g. chordoma).
- Management depends on pathology.

### Spinal metastasis:

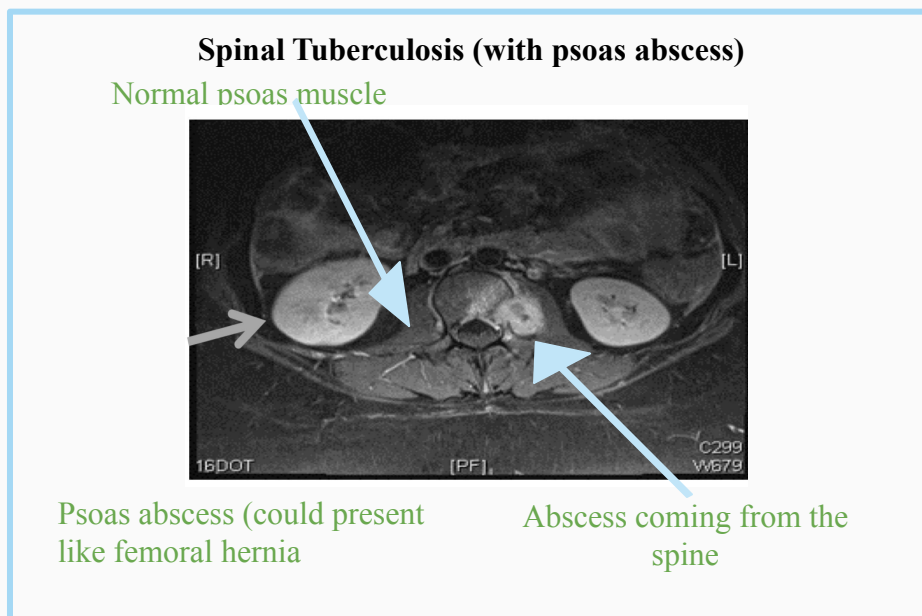
- Very common.
- **Biopsy required if primary unknown. If you suspect lesion = biopsy! Spinal cord presentation is according to the site of compression (thoracic vs cervical, anterior vs posterior, hemi brown Sequard syndrome or combined feature...etc.)**

## 2) Infection

- o Most common is TB and Brucellosis.
- o History of contact with TB patient or raw milk ingestion.
- o Potentially treatable diseases once diagnosis is established and antimicrobials administered. (management is usually medical).

**Most indicative feature is fever.**

**Spinal Tuberculosis with psoas abscess: (Abscess can act just like tumor and compresses structures in the spine)**  
Treat the cause and all symptoms will go away.



## DEGENERATIVE DISC DISEASE

- loss of vertebral disc height with age resulting in:
  - bulging and tears of annulus fibrosus
  - change in alignment of facet joints
  - osteophyte formation

### Mechanism

- compression over time with age

### Clinical Features

- axial back pain without radicular symptoms
- pain worse with axial loading and flexion
- negative straight leg raise

### Investigations

- X-ray, MRI, provocative discography

### Treatment

- non-operative
  - staying active with modified activity
  - back strengthening
  - NSAIDs
  - **do NOT treat with opioids**; no proven efficacy of spinal traction or manipulation
- operative – rarely indicated
  - decompression ± fusion
  - no difference in outcome between non-operative and surgical management at 2 yr

## SPINAL STENOSIS

- narrowing of spinal canal <10 mm
- congenital (idiopathic, osteopetrosis, achondroplasia) or acquired (degenerative, iatrogenic – post spinal surgery, ankylosing spondylosis, Paget's disease, trauma)

### Clinical Features

- ± bilateral back and leg pain
- neurogenic claudication
- ± motor weakness
- normal back flexion; difficulty with back extension (Kemp sign)
- positive straight leg raise, pain not worse with Valsalva

### Investigations

- CT/MRI reveals narrowing of spinal canal, but gold standard = CT myelogram

### Treatment

- non-operative
  - vigorous physiotherapy (flexion exercises, stretch/strength exercises), NSAIDs, lumbar epidural steroids
- operative
  - indication: non-operative failure >6 mo
  - decompressive surgery

**Table 16. Differentiating Claudication**

	Neurogenic	Vascular
<b>Aggravation</b>	With standing or exercise Walking distance variable	Walking set distance
<b>Alleviation</b>	Change in position (usually flexion, sitting, lying down)	Stop walking
<b>Time</b>	Relief in ~10 min	Relief in ~2 min
<b>Character</b>	Neurogenic ± neurological deficit	Muscular cramping

## MECHANICAL BACK PAIN

- back pain NOT due to prolapsed disc or any other clearly defined pathology

### Clinical Features

- dull backache aggravated by activity and prolonged standing
- morning stiffness
- no neurological signs

### Treatment

- symptomatic (analgesics, physiotherapy)
- prognosis: symptoms may resolve in 4-6 wk, others become chronic



Cauda equina syndrome and ruptured aortic aneurysms are causes of low back pain that are considered surgical emergencies



**LUMBAR DISC HERNIATION**

- tear in annulus fibrosus allows protrusion of nucleus pulposus, causing either a central, posterolateral, or lateral disc herniation, most commonly at L5-S1 > L4-5 > L3-4
- 3:1 male to female
- only 5% become symptomatic
- usually a history of flexion-type injury

**Clinical Features**

- back dominant pain (central herniation) or leg dominant pain (lateral herniation)
- tenderness between spinous processes at affected level
- muscle spasm ± loss of normal lumbar lordosis
- neurological disturbance is segmental and varies with level of central herniation
  - motor weakness (L4, L5, S1)
  - diminished reflexes (L4, S1)
  - diminished sensation (L4, L5, S1)
- positive straight leg raise
- positive contralateral SLR
- positive Lasegue and Bowstring sign
- cauda equina syndrome (present in 1-10%): surgical emergency

**Investigations**

- X-ray, MRI, consider a post-void residual volume to check for urinary retention; post-void >100 mL should heighten suspicion for cauda equina syndrome

**Treatment**

- non-operative
  - symptomatic
    - extension protocol
    - NSAIDS
- operative
  - indication: progressive neurological deficit, failure of symptoms to resolve within 3 mo, or cauda equina syndrome due to central disc herniation
  - surgical discectomy
- prognosis
  - 90% of patients improve in 3 mo with non-operative treatment

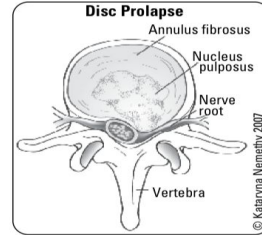


Figure 28. Disc herniation causing nerve root compression



Neurogenic claudication is position dependent; vascular claudication is exercise dependent



MRI abnormalities (e.g. spinal stenosis, disc herniation) are quite common in both asymptomatic and symptomatic individuals and are not necessarily an indication for intervention without clinical correlation

Table 17. Types of Low Back Pain

	Mechanical Back Pain		Direct Nerve Root Compression	
	Disc Origin	Facet Origin	Spinal Stenosis	Root Compression
<b>Pain Dominance</b>	Back	Back	Leg	Leg
<b>Aggravation</b>	Flexion	Extension, standing, walking	Exercise, extension, walking, standing	Flexion
<b>Onset</b>	Gradual	More sudden	Congenital or acquired	Acute leg ± back pain
<b>Duration</b>	Long (weeks, months)	Shorter (days, weeks)	Acute or chronic history (weeks to months)	Short episodes Attacks (minutes)
<b>Treatment</b>	Relief of strain, exercise	Relief of strain, exercise	Relief of strain, exercise + surgical decompression if progressive or severe deficit	Relief of strain, exercise + surgical decompression if progressive or severe deficit

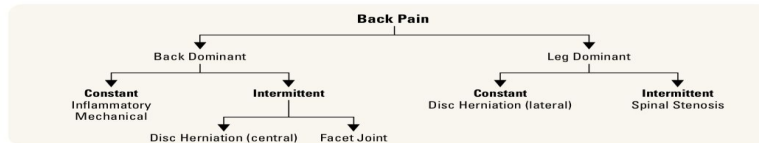


Figure 29. Approach to back pain

**SPONDYLOLYSIS**

**Definition**

- defect in the pars interarticularis with no movement of the vertebral bodies

**Mechanism**

- trauma: gymnasts, weightlifters, backpackers, loggers, labourers



**Red Flags for**

- BACK PAIN**
- Bowel or bladder dysfunction
- Anesthesia (saddle)
- Constitutional symptoms/malignancy
- Chronic disease
- Paresthesias
- Age >50 yr
- IV drug use
- Neuromotor deficits



**Sciatica**

- Most common symptom of radiculopathy (L4-S3)
- Leg dominant, constant, burning pain
- Pain radiates down leg ± foot
- Most common cause = disc herniation

**Clinical Features**

- activity-related back pain, pain with unilateral extension (Michelis' test)

**Investigations**

- oblique X-ray: "collar" break in the "Scottie dog's" neck
- bone scan
- CT scan

**Treatment**

- non-operative
  - activity restriction, brace, stretching exercise

**ADULT ISTHMIC SPONDYLOLISTHESIS**

**Definition**

- defect in pars interarticularis causing a forward translation or slippage of one vertebra on another, usually at L5-S1, less commonly at L4-5

**Mechanism**

- congenital (children), degenerative (adults), traumatic, pathological, teratogenic

**Clinical Features**

- lower back pain radiating to buttocks relieved with sitting
- neurogenic claudication
- L5 radiculopathy
- Meyerding Classification (percentage of slip)

**Investigations**

- X-ray (AP, lateral, oblique flexion-extension views), MRI

**Treatment**

- non-operative
  - activity restriction, bracing, NSAIDS
- operative

Table 18. Classification and Treatment of Spondylolisthesis

Class	Percentage of Slip	Treatment
1	0-25%	Symptomatic operative fusion only for intractable pain
2	25-50	Same as above
3	50-75	Decompression for spondylolisthesis and spinal fusion
4	75-100	Same as above
5	>100	Same as above

**Specific Complications**

- may present as cauda equina syndrome due to roots being stretched over the edge of L5 or sacrum

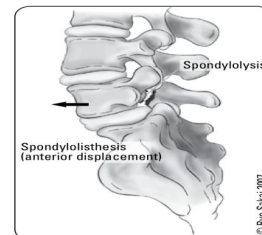


Figure 30. Spondylolysis, spondylolisthesis

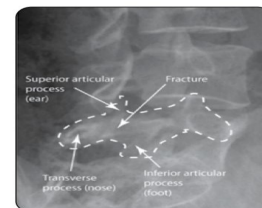


Figure 31. "Scottie dog" fracture

# Scoliosis

## Definition

- lateral curvature of spine with vertebral rotation
- age: 10-14 yr
- more frequent and more severe in females

## Etiology

- idiopathic: most common (90%)
- congenital: vertebrae fail to form or segment
- neuromuscular: UMN or LMN lesion, myopathy
- postural: leg length discrepancy, muscle spasm
- other: osteochondrodystrophies, neoplastic, traumatic

## Clinical Features

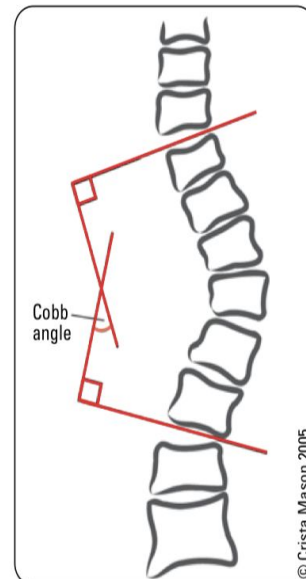
- cosmetic concern ± back pain
- primary curve where several vertebrae affected
- secondary compensatory curves above and below fixed primary curve to try and maintain normal position of head and pelvis
- asymmetric shoulder height when bent forward
- Adam's test: rib hump when bent forward
- prominent scapulae, creased flank, asymmetric pelvis
- associated posterior midline skin lesions in neuromuscular scoliosis
  - café-au-lait spots, dimples, neurofibromas
  - axillary freckling, hemangiomas, hair patches
- associated pes cavus or leg atrophy
- apparent leg length discrepancy

## Investigations

- X-ray: 3-foot standing, AP, lateral
  - measure curvature: Cobb angle
  - may have associated kyphosis

## Treatment

- based on Cobb angle
  - $<25^\circ$ : observe for changes with serial radiographs
  - $>25^\circ$  or progressive: bracing (many types) that halt/slow curve progression but do not reverse deformity
  - $>45^\circ$ , cosmetically unacceptable, or respiratory problems: surgical correction (spinal fusion)



**Figure 55. Cobb angle** – used to monitor the progression of the scoliotic curve



Scoliosis screening is not recommended in Canada (Grieg A, et al. 2010; Health Canada, 1994)



In structural or fixed scoliosis, bending forwards makes the curve more obvious



Postural scoliosis can be corrected by correcting the underlying problem



# QUESTIONS

1- 68 years old diabetic and Chronic RF male come with severe back pain that decrease with going uphill. What is the investigation to confirm the diagnosis?

- A-Pelvic US.
- B-Lumbar spine MRI.
- C-CT hip.

Ans: B

2- patient presented with cervical pain that radiates to the arm, weakness, numbness and loss of function but no gait disturbance which one of the following is the diagnosis?

- A-Myelopathy.
- B-Radiculopathy.

Ans: B

3- 14 years old female brought by her parents. They are concerned about the abnormality seen in her back. On examination, the only positive thing was a unilateral hump on the right side of her back when she bends forward. What is the most likely diagnosis?

- A-Degenerative disc disease
- B-Spinal TB
- C-Scoliosis
- D-Spondylolisthesis

Ans: C