# **Spinal Disorders**

Source  $\rightarrow$  Dr.Fadi Al-Hadidi

## **Disc prolapsed/Degeneration:**

The disc acts as shock absorber, it is composed of annulus fibrosus (collagen type I; stronger, hard as bone) and nucleus pulposus (collagen type II, gel-like, less harder, as cartilage). Collagen is hydrophilic (loves water), so it contains high amount of water. When water content decreases, cartilage becomes harder and this helps fractures to occur easily. Annulus fibrosus will be affected first when water content decreases; because it already has less water than nucleus pulposus.



We call any 2 vertebra and the disc between them a segment, we have multiple segments to provide us with wide range of motion.

Shape of spine:

- Lordosis at cervical and lumbar spine, Kyphosis at thoracic and sacral spine.
- Kyphosis is the natural curve of spine, and has protective mechanism
- Lordosis is not natural position, so pathologies take place here (in cervical and lumbar spine)
- Pressure affects lordosis posteriorly, while affects kyphosis anteriorly.



Fissures and subsequently herniations occur due to decrease water content. They occur either posterior (bilateral symptoms) or posterolateral (unilateral symptoms). However

most commonly Disc herniations are posterolateral, why? Because the center of gravity is in that direction.

In the lumbar region the discs are about 1 cm thick. Their posterior edges lie on the anterior boundary of the spinal canal and posterolaterally they skirt the right and left intervertebral foramina close to the nerve roots that exit at successive levels. #spondylosis

- annulus fibrosus develops fissures parallel to the vertebral end-plates running mainly
  posteriorly, and small herniations of nuclear material squeeze into and through the annulus.
- discs flatten down and bulge slightly beyond the margins of the vertebral bodies
- reactive new bone formation produces bony ridges (osteophytes)
- vertebral end-plates ossify and become sclerotic
- 80% of people who live for more than 50 years
- usually asymptomatic but pt might have recurrent backache, sometimes with pain radiating towards the buttocks or thighs

Fibrocartilaginous material may *sequestrate* through the fissure and lie free in the spinal canal or the intervertebral foramen causing inflammation.

-cartilage is aneural, avascular and alymphatic

What is the mechanism behind the pain?

They thought that the pressure on the nerve will compress the blood supply of the nerve (vasa vasorum)  $\rightarrow$  decrease blood supply to the nerve  $\rightarrow$  ischemia, but this is WRONG; because patients get better when they take NSAID, so the real mechanism must be INFLAMMATION. The mechanism is irritation of the nerve by the protruded part  $\rightarrow$  inflammation  $\rightarrow$  edema  $\rightarrow$  constriction of vasa nervosa  $\rightarrow$  ischemia  $\rightarrow$  pain So sciatica is neuritis

When we hold anything, we do **flexion** and take deep breath which **increases the intra-abdominal pressure**, this will increase the squeezing of material  $\rightarrow$  more irritation to the nerve  $\rightarrow$  more pain.

# The disc pathologies are actually two, the first can lead to the second

- 1. Disc Degeneration: With increasing age, as intervertebral discs gradually dry out, the nucleus pulposus changes from a turgid bulb to a brownish, desiccated structure. The discs flatten down and bulge slightly beyond the margins of the vertebral bodies. It occurs in over 80% of people who live for more than 50 years and, although characteristic changes can be seen on x-ray examination (flattening of the disc 'space' and marginal spur formation "osteophytes"), the condition is usually asymptomatic. However the patients experience the common and ill-defined symptoms of recurrent backache, sometimes with pain radiating towards the buttocks or thighs. The pain mostly only shows up upon flexion (sitting) as the vertebral height decreases.
- 2. Disc Prolapse: Disc herniation or protrusion is bulging of the disc, either directly posteriorly or to one or other side posterolaterally towards the intervertebral foramen. Acute disc herniations is usually initiated by mechanical stress a combination of flexion and compression but even at L4/5 or L5/S1 (where stress is most severe) it is unlikely that a disc would herniate unless there was some prior disturbance of the hydrophilic properties of the nucleus pulposus. If the disc *ruptures*, fibrocartilaginous material may sequestrate and lie free in the spinal canal or the intervertebral foramen causing inflammation. It is thus often said that disc prolapse is either traumatic (age 20-40) or degenerative. Its pain is often CONTINUOUS AND INCREASES UPON FLEXION, can be radicular, and can be associated with neurological disturbances.
  - a. posterolateral protrusion  $\rightarrow$  compress the nerve root proximal to its point of exit through the intervertebral foramen
    - i.  $L4/5 \rightarrow$  fifth lumbar nerve root
    - ii.  $L5/S1 \rightarrow$  the first sacral root;
  - b. large central herniation or sequestration → the cauda equina compression → Urinary retention is uncommon → emergency and may lead to permanent dysfunction of sphincter control if treatment is unduly delayed
  - c. Acute back pain at the onset of disc herniation probably arises from disruption of the outermost layers of the annulus fibrosus and stretching or tearing of the posterior longitudinal ligament.
    - i. disc protrudes to one side  $\rightarrow$

- 1. irritate the dural covering of the adjacent nerve root causing pain in the buttock, posterior thigh and calf (sciatica).
- Pressure on the nerve root itself → paraesthesia and/or numbness in the corresponding dermatome, as well as weakness and depressed reflexes in the muscles supplied by that nerve root
- d. Clinical features
  - i. fit young adult
  - ii. while lifting or stooping (or perhaps merely coughing) the patient is seized with back pain and is unable to straighten up.
  - iii. tenderness in the midline, paravertebral muscle spasm $\rightarrow$  sciatic scoliosis  $\rightarrow$ The patient usually stands with a slight list to one side

**Cauda equina** is the only emergency in disc prolapse and it's rare. It is compression of L2-L5 + S1-S5 + coccygeal nerve. Present with bilateral sciatica, saddle anesthesia, paresthesia, weakness, incontinence ( urinary and fecal).

**SLR (straight leg rising)** test is not specific. SLR is helpful in diagnosis of (*L4*-L5) and (L5-S1) disc prolapse only. The patient should left the leg with knee straight, to increase the pressure on the sciatic nerve the cervical spine flexed and the ankle is dorsiflexed. For the test to be positive the pt should feel pain from THE BACK down the leg, it should be sharp and painful not merely a discomfort. The angle should be less than 60 for it to be positive. This test is just for a sciatic pain.

- Cross sciatic sign is more important than SLR test. It is more sensitive and specific.

- prolapse at L3/4 the femoral stretch test may be positive

-Neurological examination  $\rightarrow$  muscle weakness (and, later, wasting), diminished reflexes and sensory loss corresponding to the affected Level.

-Conservative treatment:

- 1. Rest. +Anti-inflammatory medication
- 2. Reduction. +epidural injection of corticosteroid and local anaesthetic may help
- 3. Removal.
- Rehabilitation → Light work is resumed after 1 month and heavy work after 3 months avoid heavy lifting tasks

Treatment is conservative unless surgery is indicated in cases of:

- 1. not responding to conservative treatment (pain can't be tolerated anymore)
- 2. developing weakness, paresthesia or urinary or stool incontinence.
- 3. cauda equina

The surgery is done to protect the nerve NOT to cure back pain (because the fissure is already there, it will not go away).

If conservative measures fail, then discectomy is the treatment of choice Before surgery patient should rest for 2 days (inflammatory phase). Rest of more than 1 week will make the condition worse. # Note:

- Disc herniation
  - Affects the nerve root inferior to disc in case of posterolateral herniation,
    - C3-4 disc affects c4 nerve root
    - L4-5 disc affects L5 nerve root
  - $\circ$   $\;$  In case of far lateral Disc herniation in lumbar area it will
    - Affects the nerve root superior to disc
    - L4-5 disc affects L4 nerve root

### Spondylolisthesis:

Listhesis = displacement

Definition: subluxation of one vertebral body on another; anterior slippage of one vertebra into the next one.

Anterolisthesis  $\rightarrow$  Forward or anterior displacement.

 $\label{eq:Retrolisthesis} \ensuremath{\mathsf{Retrolisthesis}} \rightarrow \ensuremath{\mathsf{Backward}} \ensuremath{\mathsf{displacement}} \ .$ 

laterolisthesis→ Lateral displacement

Pars interarticularis : is a pure cortical bone between lamina and pedicle. This part of the vertebra can resist significant forces during normal motion. It is under significant stress when a person is under

**hyperextension** (as in basketball players, volleyball players and gymnastics). As with extension the lumbar lordosis increases and thus increases instability and force upon them. This is why spondylolisthesis mostly occurs on L4/L5 and L5/S1.



Defect in pars interarticularis (either congenital or because of minor repetitive trauma) will cause Spondylolisthesis.

Unilateral pars defect is called spondylolysis "fracture without slippage", It's a fracture in Pars on one side without anterior slippage of the vertebra. Treated as any fracture.

Types of spondylolisthesis :

1. Dysplastic type: congenital seen in children, associated with protruding abdomen, painless but the mother may notice the unduly protruding abdomen

2. Lytic type: because of increase in amount of stress on pars interarticularis. Basically it is a stress fracture. The commonest. Adults and intermittent backache is the usual presenting symptom

Signs:

buttocks look curiously flat,

sacrum appears to extend to the waist

transverse loin creases may be prominent.

3. Degenerative type: of a problem in facet joint. Mostly osteoarthritic changes. Female >40

Pain is due to tension "traction", it is burning sensation, increase with extension, as extension increases this anterior slippage.

On physical examination: guarding, tenderness on the affected segment, Range Of Motion : normal flexion with limited extension

-Best imaging is CT scan

-X-ray taken here is best taken in an oblique view.

Treatment :

- 1. Unilateral spondylolisthesis "spondylolysis" : Conservative treatment. WILL heal within 6 weeks. Therefore if patients comes after 6 weeks with pain, the fracture either did not heal (nonunion) or underwent malunion.
- 2. Bilateral Spondylolisthesis: Stop activities, Brace to the abdomen or physiotherapy. The physiotherapy is for strengthening the muscles of the back so as to stabilize it. MAY heal within 6 weeks.
- 3. Surgery is indicated when: (1) the symptoms are disabling; (2) anterior slippage is more than 50 %( most imp indication). (3) Neurological compression is significant.

#### Spinal stenosis:

Spinal stenosis is a radiological term

It means decrease space of the spinal canal

It is a progressive disease of the elderly, usually > 60 year old. 20% of them are asymptomatic.

It is a dynamic pain. At rest the patient has no pain but upon walking, ischemic pain develops numbness and paresthesia (**neurogenic claudication**). Pain decreases by flexion (sitting) and increases by extension. **Remember two pains increase with extension : spinal stenosis and spondylolisthesis (facet joint arthropathy)** 

Clinical features:

- Backache
- numbness and paraesthesia in the thighs, legs or feet
- spinal claudication → after standing upright or walking for 5–10 minutes and are consistently relieved by sitting or squatting with the spine somewhat flexed
- The pain is relieved when the patient flexes the spine by, for example, leaning on shopping carts or sitting. Flexion increases canal size by stretching the protruding ligamentum flavum, reduction of the overriding laminae and facets, and enlargement of the foramina. This relieves the pressure on the exiting nerve roots and, thus, decreases the pain.
- Symptoms are sometimes unilateral, suggesting an asymmetrical stenosis or intervertebral root canal stenosis.

Imaging  $\rightarrow$  CT or MRI

The cause of the stenosis : it's usually a combination of 3 events that occur in the elderly resulting in a stenosis in the canal

- 1. Lateral compression by facet joints osteophytes
- 2. Posterior compression by laxity of ligamentum flavum that occurs with age
- 3. Anterior compression by discs either degeneration or prolapse

The mechanism of the pain and relation to walking:

1. As the patient walks, more blood supply and more venous drainage is needed to the area. Due to the compression, the venous drainage ceases and causes more edema, which in turn result in more compression and a decrease in the blood supply and drainage.

2. Why does the pain decrease with flexion? As the ligamentum flavum and the lateral osteophytes are pulled thus increase the diameter of the canal.

Foraminal area increase during flexion and decrease during extension

Vascular claudication	Neurogenic claudication
Cramping in the calf	Vague pain beginning in the lower back
Increase when going up (flexion, more energy is required)	Increase when going down (extension)
Worse with walking and bicycling , Better when stops activity	Worse with extension and standing, Rare with bicycling
Ascending pain (starts mostly at calf)	Descending pain (from proximal to distal)
Occurs at long distance early, then short distance late (progressive)	Occurs at fixed distance
Normal posture while sitting	Flexed while sitting
Pulses could be affected	

- Vascular claudication and Neurogenic claudication may coexist
- 20% of patients with spinal canal stenosis have vascular insufficiency
- 30% of patients with spinal canal stenosis have diabetic neuropathy

How do we differentiate between vascular and neurogenic claudication by physical examination?

- · Bilateral intact pulses  $\rightarrow$  unlikely to be vascular cause
- · Change in skin temperature (cold)  $\rightarrow$  suggests vascular cause

How do we differentiate between vascular and neurogenic claudication by investigations?

- ABPI (for peripheral vascular disease)
- Nerve conduction study (for diabetic neuropathy)

If both are normal, we do MRI to confirm spinal canal stenosis

\*NOTE: neurological Physical exam in spinal canal stenosis at rest is NORMAL.

Treatment depends on patient's' activity; it's related to the quality of life.

1. Operation is very successful, but you shouldn't push the patient to do it if his life quality is not much affected, because he's old.

operative decompression  $\rightarrow$  Will not improve their backache

2. Conservative treatment: vitamin B6 and NSAIDs, long-acting local anaesthetic and corticosteroid injection

Evaluation	Vascular	Neurogenic
Walking distance	Fixed	Variable
Palliative factor	Standing	Sitting/bending
Provocative factor	Walking	Walking/standing
Walking uphill	Painful	Painless
Bicycle test	Positive (painful)	Negative
Pulse	Absent	Present
Skin	Loss of hair; shiny	
Weakness	Rarely	Occasionally
Back pain	Occasionally	Commonly
Back motion		Limited
Pain character	Cramping—distal to proximal	Numbness, aching-proximal to distal
Atrophy	Uncommon	Occasionally

Description	Stenosis	Disc Herniation
Age	Usually > 50 years	Usually < 50 years
Onset	Insidious	Sudden
Positional changes		
Sitting (Flexion)	Better	Worse
Extension	Worse	Better
Focal motor weakness	Less Common	Common
Dural tension signs	Less Common	Common
Focal muscle stretch reflex changes	Less Common	Common

Myotome distributions of the upper and lower extremity are as follows;

- 1. C1/C2: neck flexion/extension
- 2. C3: neck lateral flexion
- 3. C4: shoulder elevation
- 4. C5: shoulder abduction
- 5. C6: elbow flexion/wrist extension
- 6. C7: elbow extension/wrist flexion/finger extension
- 7. C8: finger flexion
- 8. T1: finger abduction
- 9. L2: hip flexion
- 10. L3: knee extension
- 11. L4: ankle dorsiflexion
- 12. L5: great toe extension
- 13. S1: ankle plantar-flexion/ankle eversion/hip extension

- 14. S2: knee flexion
- 15. S3-S4: anal wink

#### Dermatomes distributions

- 1. C4 Over the acromioclavicular joint.
- 2. C5 On the lateral (radial) side of the antecubital fossa, just proximally to the elbow.
- 3. C6 On the dorsal surface of the proximal phalanx of the thumb.
- 4. C7 On the dorsal surface of the proximal phalanx of the middle finger.
- 5. C8 On the dorsal surface of the proximal phalanx of the little finger.
- 6. T1 On the medial (ulnar) side of the antecubital fossa, just proximally to the medial epicondyle of the humerus.
- 7. L1 Midway between the key sensory points for T12 and L2.
- 8. L2 On the anterior medial thigh, at the midpoint of a line connecting the midpoint of the inguinal ligament and the medial epicondyle of the femur.
- 9. L3 At the medial epicondyle of the femur.
- 10. L4 Over the medial malleolus.
- 11. L5 On the dorsum of the foot at the third metatarsophalangeal joint.
- 12. S1 On the lateral aspect of the calcaneus.
- 13. S2 At the midpoint of the popliteal fossa.
- 14. S3 Over the tuberosity of the ischium or infragluteal fold
- 15. S4 and S5 In the perianal area, less than one cm lateral to the mucocutaneous zone