

التييم عبارة عن سلايدات المحاضرات بالإضافة إلى شرح الدكاترة

حاولنا تقديم المادة بأفضل ما نستطيع

لذا إن وجدتم أي خلل أو خطأ فاعذرونا وبلغونا حتى يتم تصحيحه

نتمنى لكم التوفيق و السداد

لا تنسونا من دعواتكم

Spinal Disorders

Khalid A. AlSaleh, FRCSC

Assistant Professor

Dept. of Orthopedic Surgery

F1 lecture notes added by : Sarah Ibrahim Bin-Hussain

Include :

- dr. slides
- dr. notes in the lec. (notes are in purple & blue)
- A1 team notes

Degenerative Spinal Disorders

Degeneration: “deterioration of a tissue or an organ in which its function is diminished or its structure is impaired”

Other terms:

- “Spondylosis” (something wrong with the vertebrae, different than Spondylolysis)
- “Degenerative disc disease” (disk is the principle joint of the vertebrae, it's not a synovial joint so we don't say "disk osteoarthritis")
- “Facet osteoarthritis”

(All could occur together but with varying degree)

Etiology (unknown)

Multi-factorial

- Genetic predisposition
- Age-related

Some environmental factors:

- Smoking (no.1 cause factor in young people especially in spine)
- Obesity (no.1 cause factor of back pain, could be associated with neck pain)
- Previous injury, fracture or subluxation
- Deformity (kyphosis "sagittal plain", scoliosis "coronal plain") accelerate degeneration b/c of body imbalance.
- Operating heavy machinery, such as a tractor (advise the pt. to change his job to office type job)

Anatomy (from C2-S1 mostly are the same)

Anterior elements:

- Vertebral body
- Inter-vertebral disc
- Degeneration occurs at the the disc

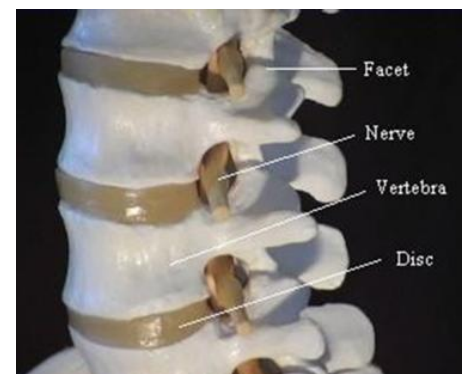
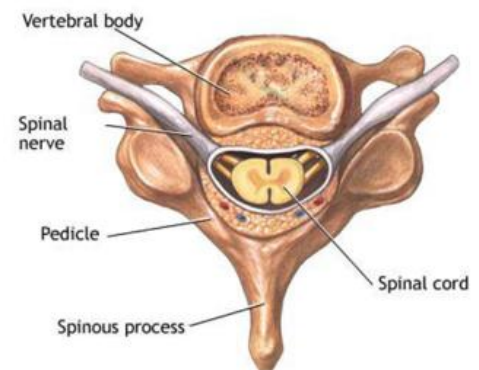
Posterior elements

–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



Team notes:

- Spine is much more complex than other joints (ex. Hip, shoulder) b/c in each segment there are 3 joints, in addition to the neurological structure that passes into the middle of the spinal canal.
- Spinal cord end at the level of L1-L2 in adult, and lower down L2-L3 in children.
- Foramen border: pedicle above & pedicle below.
- Through each foramen → spinal nerve "also called nerve root".
- Facet joint made the neural arch that protect the spinal cord.
- Mobile part of the spine:
 - In the front → inter-vertebral disk
 - In the back → facet joint "which is a synovial joint)
- CNS: section there will be permanent and never heal.
PNS: probably it will heal.
- Degeneration or disk herniation: partially goes to central canal & partially in a lot of times goes to foramen (thankfully it doesn't go centrally to spinal cord)
- Mechanical (loading) imp in Hx:
 - flexion (disk): anterior part compressed, posterior part will get distracted
الألم أكثر في الركوع والسجود
 - extension (facet): disk anteriorly Unloaded but posterior Part will be loaded "to get more space" "ما أقدر أمد ظهري محوديين"
- Joint not only facilitate movement, they facilitate movement in a specific range, if that is gone → instability
- C1-L5 → mobile, sacrum → immobile
- Thoracic spine has very limited movement b/c of the rib cage around it which is good for stability but very bad when getting injury !
- Cauda equine & nerve root:
 - After L1-L2 spinal cord no more longer, small part after will called equina medullaries then the caudaequina will present (which is nerve root, LMN if u section them u can repair)
 - What will happen if you push on part of these nerves?
Radiculopathy (general term to arm and leg)
 - in lower limp(leg)→ sciatica
 - in the arm there is no cauda equine but there are nerve roots → neuralgia

Pathology:

1- The intervertebral disc

- The first component of the 3 joint complex
- It is primarily loaded in FLEXION
- Composed of "annulus fibrosus" and "nucleus pulposus" –bulky more of gelatinous– (both depend on each other while movement)
 - Tear in annulus → nucleus try to escape through it
 - Degeneration of nucleus → pressure inside the annulus will be lost → disk space become smaller

- Degeneration of the nucleus causes loss of cellular material and loss of hydration

– Movement is impaired-painful and could become unstable

- Painful: treated non-surgically (physiotherapy, ↓ weight → ↓ load on the pt. back)
- Unstable: usually they need surgery

• Disc degeneration will also cause

- Loss of disc height.
- Abnormal loading of facet joints
- Stenosis in the inter-vertebral foramen
- Bulging of the disc into the spinal canal
- Contributing to spinal stenosis
- Herniation of the nucleus into spinal canal
- Causing radiculopathy (e.g. sciatica in the lumbar spine)

2- The facet joints

- Scientific name: “zygapophysial joints”

– Synovial joints

– 2 in each segment

- Together with the disc, form the 3 joint complex

- Are primarily loaded in EXTENSION

Pattern of degeneration similar to other synovial joints (as hip & knee)

- Loss of hyaline cartilage & loss of joint space, formation of osteophytes, laxity in the joint capsule, subcondral sclerosis.

• Facet degeneration will cause:

- Hypertrophy, osteophyte formation
 - Contributing to spinal stenosis or foraminal stenosis
- Laxity in the joint capsule
 - Leading to instability (degenerative spondylolisthesis "vertebral slippage")
 - one vertebrae slips over the other one in a different degree
 - Usually what start as disk degeneration will end up as facet arthritis (most of the weight goes through the disk and the facet is somewhat protected, but when the disk start to shrink and loss its height → load more on facet joint)
 - Spinal canal & the foramen will be narrower → spinal stenosis
 - structure will be impaired but the most imp. Is the function when its lost.

✓ Notes :

- Forminal : peripheral nerve
- Spinal: the whole spinal cord
- Spondylolisthesis: slipping of the vertebra on the one beneath it, either posteriorly or anteriorly.

Presentation

•Falls into 2 categories:

- **Mechanical pain:** due to joint degeneration or instability

•“Axial pain” in the neck or back

•Activity related-not present at rest pain at night or at rest or awake the pt. from sleep are red flags ! need further elaboration of Hx, PE ...etc, could be tumor or TB examine the thyroid, breast abdomen, listen to chest & maybe you have to do some blood work, ESR, C-RP, electrophoresis....etc)

- **Neurologic symptoms:** due to neurologic impingement

•Spinal cord

Presents as myelopathy, spinal cord injury

Myelopathy: spinal cord, any dysfunction in spinal cord gradually changes along many years."not injury which is acute"

•Cauda equina & Nerve roots

–Presents as radiculopathy (e.g. sciatica) or neurogenic claudication

Bulging: the whole disk bulges out

Herniation: tear in part of the annulus → nucleus escape in it " the rest of disk looks normal in MRI"

Mechanical pain

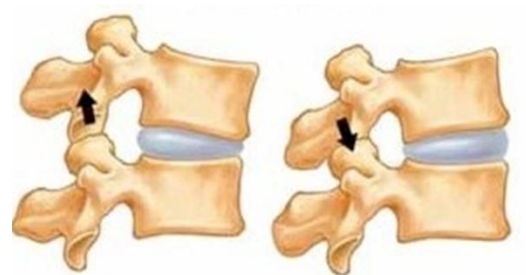
–Associated with movement

•Sitting, bending forward (flexion):

–originating from the disc »“discogenic pain”

•Standing, bending backward (extension) :

–originating from the facet joints »“Facet syndrome”



Neurologic symptoms

–Spinal cord

•Myelopathy:

–Loss of motor power and balance

–Loss of dexterity »Objects slipping from hands "alarming"

–UMN deficit (rigidity, hyper-reflexia, positive Babinski, hypertonia, Hoffmann's reflex.)

–Slowly progressive “step-wise” deterioration.take time to notice it on himself'. "أمشي بدون أتران "

• **Spinal cord injury** (could be asymptomatic but come with neck pain → MRI: spinal cord & spinal canal are more or less the same volume !)

–With Spinal stenosis, there is a higher risk of spinal cord injury

–Complete or incomplete

- Spinal stenosis → spinal cord injury (normally there is space in the spinal canal → spinal cord moves easily with vertebral column) but with stenosis and he get injured even when its minor or simple → more likely to develop spinal cord injury than a normal person
(Affected person → weakness while in Normal person → only mild muscular pain)
- Tell the pt he has a spinal stenosis but no symptoms you have to see a surgeon b\c there is ↑ risk to develop spinal cord injury..
- He has 2 options: 1- surgery to eliminate the risk 2- stay as you are but the risk is there.

• **Cauda equina & Nerve roots**

–Radiculopathy

- LMN deficit (areflexia, flaccidity...)
- Commonest is sciatica, but cervical root impingement causes similar complaints in the upper limb

Both UMN or LMN deficit could present with weakness

–Neurogenic claudication

- Pain in both legs caused by walking
- Must be differentiated from vascular claudication

Vascular vs. Neurogenic claudication

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

Bending over, sitting: widens the spinal canal

Shopping cart sign: bending on the cart while pushing it.

Bicycle: Bending the back

Team notes:

Neurogenic claudication vs Vascular claudication:

- **Vascular claudication:** pain after activity
 - Pathophysiology behind the vascular claudication → peripheral vascular diseases → when you request more blood to come → ischemia & pain
- **Neurogenic claudication:** they have the same complaint but differ in details
 - ischemia occurs at the nerve root inside the spinal canal "function of nerve normally → transmission of impulses" if you ask them to transmit more impulses at more frequency and speed → need more blood to go in and there isn't any b\c they are compressed → so you will get exactly the same symptoms.
- **The different is that Neurogenic is related to the posture of the spine:**
 - pt. become more comfortable when he bends forward "↑ space inside the spinal canal".
 - Also he feel more comfortable when going uphill than downhill "in downhill he can't walk further enough"
(uphill → bend forward, downhill → bend backward)
 - If he use a bike → no problem while in vascular the pain is there !

The Cervical spine

introduction

- Degenerative changes typically occur in C3-C7
- Presents with axial pain, myelopathy, radiculopathy
(Usually sub-axially "below C2")



Physical examination:

- Stiffness (loss of ROM)
- Neurologic exam
- Weakness
- Loss of sensation
- Hyper-reflexia, hypertonia
- Special tests: Spurling's sign

Spurling's sign: turning the patient's head to the affected side and applying downward (axial) pressure on the top of the patient's head. If there is stenosis → radicular pain is elicited "positive Spurling's sign")

The Cervical spine: Management (of Pt. with neck pain)

• Conservative treatment

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

• Physiotherapy:

- Focus on ROM and muscle strengthening (it's like pulling the vertebrae away from each other → less load on joint)

•Non-steroidal anti-inflammatory medications (NSAID)

–E.g. Diclofenac, ibuprofen, naproxen "non-selective"

•Neuropathic medication: for radiculopathy pain

–E.g. Gabapentin or pregabalin

(designed specifically to treat nerve pain, modulate transmission in nerve fiber → ↓ pain)

•Surgical management Indicated for :

- Spinal stenosis causing myelopathy
- Disc herniation causing severe radiculopathy and weakness
- Failure of conservative treatment of axial neck pain or mild radiculopathy
- radiculopathy & wrist drop , weakness 0 out of 5 → SURGERY especially if its acute (the only chance of recovery is with surgery otherwise he could be like this for the rest of his life) !

Procedures:

- Anterior discectomy and fusion "1 vertebra in sit of 2" of bone.
- Posterior laminectomy
- Anterior Discectomy and fusion

Anterior Discectomy and fusion:

The two vertebrae are removed after removing the intervening disc. This procedure will affect the full range of motion; however it will slightly affect the functional range of motion.

Pt. with disk herniation and radicular pain, this pic is one year after surgery" discectomy and fusion", bone graft was taking from the iliac crest.



The Lumbar spine

(Injury cause no paralysis unless all the nerve roots were destroyed which rarely happens)

- Degenerative changes typically occur in L3-S1
- Presents with axial pain, Sciatica, neurogenic claudication

Physical examination:

–Stiffness (loss of ROM)

–Neurologic exam (LMN)

- Weakness
- Loss of sensation
- Hypo-reflexia, hypo-tonia
- Special tests: SLRT

SLRT: for sciatica: compressed nerve root, if you stretch it the pain will increase (30-70°), pain will be along the same distribution.

The Lumbar spine: management

1- Axial low back pain

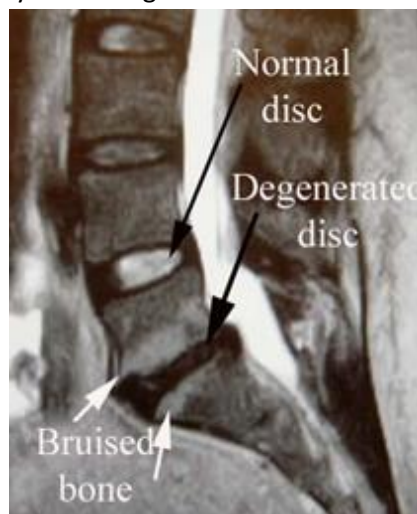
- **Conservative treatment** if first-line and mainstay of treatment
- **Physiotherapy**: core muscle strengthening, posture training
- **NSAID**
- Neurological symptoms "sciatica" without weakness: could use Neuropathic medication
- **Surgical treatment indicated for:**
 - Instability or deformity e.g. high-grade spondylolisthesis
 - Failure of conservative treatment

Lumbar spondylosis (Low intensity of the degenerated disc on the MRI)



On xray:

- disk space reduced
- Foramen narrower
- spondylophytes



On MRI:

- flat disk "normally its elliptical"
 - loss of hydration "compare it with the color of the CSF in the spinal canal"
 - bruising and edema
- on MRI T2 bone is gray, disk is white

2- Spinal stenosis

Conservative treatment is first line of treatment

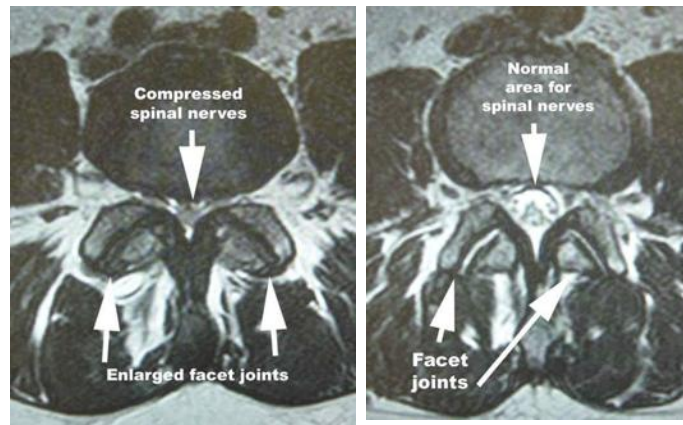
Activity modification , analgesics, epidural cortico-steroid injections (part of the pathophysiology is inflammation, NSAID ↓ inflammation → ↓ pressure on the nerves → pain relieved)

Surgical treatment Indicated for :

- Motor weakness e.g. drop foot
- failure of –minimum- 6 months of conservative treatment
- Spinal decompression (laminectomy) is the commonest procedure

Spinal Stenosis

- disk bulging
- facet joint enlarged & enter the spinal canal
- spinal canal is triangular instead of being circular



- Nerve roots are the black dots
- Spinal canal is circular and open

3- Disc herniation ("alternative name which isn't acceptable these days: disk prolapse or rupture")

Conservative treatment is first line of treatment for mild sciatica without motor deficit

• Short (2-3 day) period of rest, NSAID, physiotherapy "few wks later not right away", epidural cortico-steroid injection

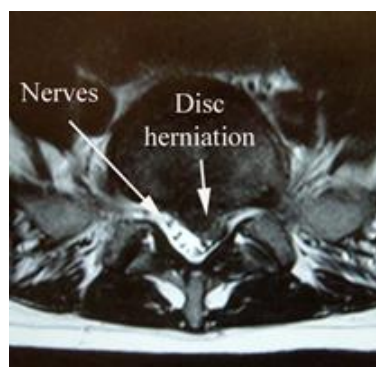
• 95% of sciatica resolves within the first 3 months without surgery

Surgical treatment: Indicated for :

cauda-equina syndrome, motor deficit, failure of 3 months of conservative treatment

• Procedure: Discectomy (only the herniated part "if you remove it all you will need instrument fusion → instable! has to be fixed, not like cervical spine where we remove the whole disk!")

Disc Herniation



Spinal Fusion



- pt. with back pain, numbness on foot, on examination there was decrease sensation in S1, absent ankle jerk, mild hesitation in planter flexion, can walk on toes with difficulty, on heels there was no problem (problem not in L4-L5) → conservative management
- if there is WEAKNESS or inability to hold sphincters → SURGERY

Osteoporotic Vertebral Fractures

- Pathologic fractures (abnormal bone , low energy trauma could cause a fracture!)
- Anterior column (±middle column) only compromised (Wedge/Burst Fracture)
- Often missed
- Repetitive fractures result in kyphotic deformity (hunchback) "kyphosis gradually developed usually in thoracic spine"
- Treatment of underlying cause (TB, osteoporosis, tumor, infection...) !!
 - Osteoporotic are known that when they have one fracture they will have others!
 - Could have Back pain along the dermatomes (T6-T7 → chest, T10 → umbilicus ...)

Spinal Deformities

- Scoliosis
 - deformity of the spine in the Coronal plane (Rt to Lt)
- Kyphosis:
 - deformity of the spine in the Sagittal plane

Spondylolisthesis

– Translation of one vertebra over another

Types of scoliosis

- Congenital
 - Associated with anomalies of the bony vertebral column, e.g hemivertebra
- Acquired (=secondary)
 - Secondary to other pathology "pushes the spine", e.g tumor , infection, spinal cord anomalies, degeneration
- Idiopathic
 - Most common is adolescent type
(most COMMON, 3 dimension, twisting of the spine "not only turning RT to Lt")

Adolescent idiopathic scoliosis

- Three dimensional deformity of the spine
- Vertebral Rotation is the hallmark (on CT or MRI)
- Presents with deformity with little or no pain (that differentiate it from the acquired type)
- Usually noticed by parents/others, not the patient herself/himself
- Examination: neurologically normal, positive Adams test (bending forward → hump on one side)
- Management depends on degree of deformity (if it was severe "all the trunk goes to the side" → surgery to fix it)

Scoliosis

Young girl (17 y/o, she didn't have pain but if left it could keep going to the same direction, try to reduce it as much as possible, now all most are resolved and the trunk is aligned with the pelvis & head.



Spondylolisthesis (slippage)

• **Conservative** treatment first (grade 1-2, physiotherapy, strengthening)

• **Surgery if** Grade 3 or more or failed conservative management. (even when the pt didn't complain of pain, it may progress causing significant disability & neurological compromise)

•Types:

1- Degenerative Spondylolisthesis

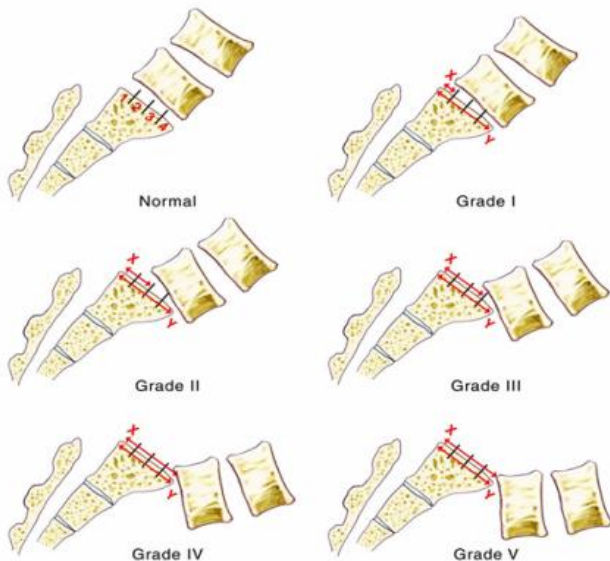
• Causes spinal stenosis

Advanced degeneration → instability

2- Isthmic spondylolisthesis:

• Caused by inter-articular defect (spondylolysis)

usually in young, no continuity b/w one vertebra and the other..



Grades are determined by the degree of translocation over the vertebra below, which is assigned by numbers (as shown left in the picture)



- Normal: 0
- grade 1: 0-25%
- grade 2: 25-50%
- grade 3: 50-75%
- grade 4: 75-100%
- grade 5: no contact between vertebrae at all

Destructive Spinal Lesions

- Present with pain at rest or at night (red flags)
- Associated with constitutional symptoms (fever, night pain, weight loss, night sweat)
- Most common causes
 - Infection (non specific : pyogenic, , streptococcus .. but most common in our society is the specific: TB & brucellosis)
 - Tumors (why? They are highly vascular. "disk is completely avascular that's why we get more degeneration there")
- Vertebral body and pedicle are the commonest sites of pathology

Spinal Tumors

• Primary Spinal tumors:

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

• Spinal metastasis (most common)

- Very common
- Biopsy required if primary unknown

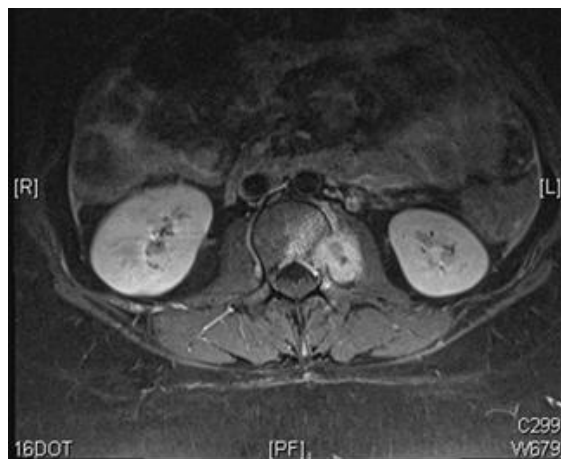
Spinal infections

- Most common is TB and Brucellosis
- History of contact with TB patient, raw milk ingestion
- Potentially treatable diseases once diagnosis is established and antimicrobials administered (although they are red flags but they are potentially good red flags b\c if you treat the pt, he will be completely fine)

Spinal Tuberculosis (with psoas abscess)

Pt. with fever, night sweat, loss 5 kg, ↑ ESR, ↑ C-RP and this is his MRI..

Pedicles are eaten out and there is abscess (TB)



Summary:

- Pt. come with mechanical, neurological and sometimes both.
- Mechanical pain is activity related pain, dull and aching while radicular pain is sharp electrical and radiates along dermatomes.
- don't forget to ask about red flags which is:
 - extreme of ages (very young, very old)
 - constitutional symptoms with all the details
 - trauma "especially in neck and back pain)

Good luck :")