



7- Acute Spinal Injuries and Cauda Equina Syndrome

Objectives:

The ability to demonstrate knowledge of the following:

- ◆ Basic anatomy of the spine
- ◆ Initial assessment and treatment of spinal injuries at the field
- ◆ Principle of spinal stability
- ◆ Understanding of neurologic syndromes caused by spinal trauma
- ◆ Management of Cauda equina syndrome

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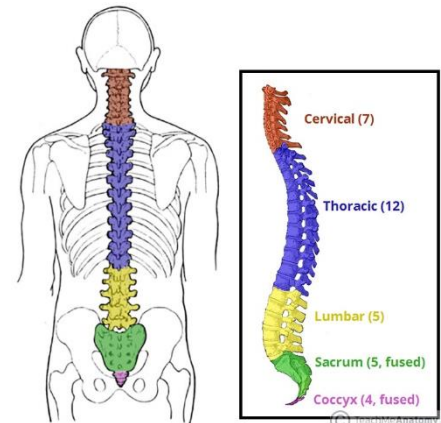
References: 435 Lectures, Notes and Teams, Apley, 436 Slides and Notes

Spine Pathology Red Flag Conditions

- 1) **Cauda Equina** or any severe neurologic injury or deficit (perianal numbness (**saddle paresthesia**), **decreased rectal tone** + bladder tone, loss of movement in the extremities) Cauda equina syndrome = saddle paresthesia + urinary retention¹ + stool incontinence.
- 2) **Tumor** weakening the vertebrae (causing cord compression or vertebral “pathological” fracture) they will have history of back pain specifically **rest** pain or **night** pain → if it becomes constant that means the destruction has become more severe and then there is impending pathological fracture or starting of instability. They may also have constitutional symptoms, swelling, etc..
- 3) Infection weakening bone (causing disc/vertebral destruction or cord compression **infection will lead to pus and the pus will compress the bone**). Remember that tumors and infections present the same way! So ddx of tumor is infection and ddx of infection is tumor. Some patients may first present with pathological fracture (from low impact) & we have to look for the cause: tumor, infection, etc..
- 4) **Traumatic Spine Fracture** (causing vertebral angulation, pain, or neuro compromise). Remember that spine fracture can occur **without trauma (like pathological fractures)!**

Anatomy of the Spine:

- The spinal cord appears straight from the coronal view and curved from the sagittal view.
- There are normal spinal curvatures: cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis.
- The spinal column is made up of 33 vertebrae: 24 are discrete (7 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae) and 9 are fused (5 sacrum and 4 coccyx).
- The basic vertebra is composed of a **body** and of an **arch** surrounding the vertebral canal.
- Vertebral column has 2 Functions: (1) weight bearing. (2) Movement.



★ Cervical vertebrae:

- There are 7 cervical vertebrae: 2 atypical and 5 typical vertebrae.

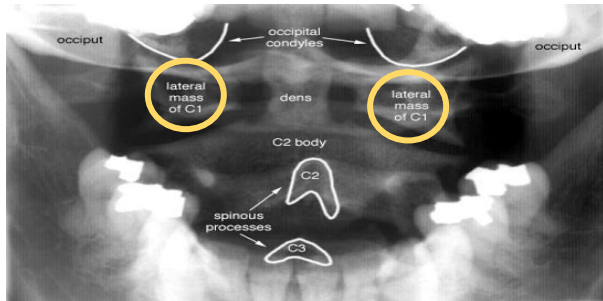
Cervical Vertebrae

Atypical C1 (Atlas) & C2 (Axis)	Typical C3 -C7
<ul style="list-style-type: none"> • The atlas (C1) is only an arch, it has no body. • The axis (C2) has the odontoid process (dens), that projects upward into the Atlas. • The occipital condyle is a hemisphere (ثلاث كرة) 	<ul style="list-style-type: none"> • C3-C7 are more classic vertebrae, having a body, pedicles, laminae, spinous processes, and facet joints. • Note that: All cervical vertebrae (C1 to C7) have a

¹ Sometimes there is confusion and people will think the patient only has urinary incontinence BUT the patient developed overflow incontinence 2ry to the retention, so if you examine the bladder it is full but the patient is still retaining.

attaches to C1.

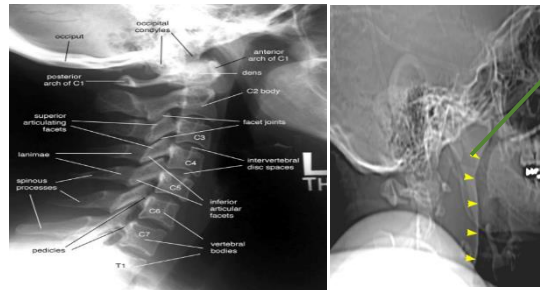
- Approximately 50% of flexion and extension (nodding) of the neck happens between the occiput and C1.
- 50% of right and left **rotation** of the neck happens between C1 and C2.
- So if a pt lost C1 and C2 joints due to fracture or fusion that means he lost 50% of all neck ROM.



- To visualize C1 and C2 on an x-ray we take an open mouth view (b/c they are obscured by the jaw)
- Lateral masses of C1 (circled above) should be aligned and equal distance from the dens. If تباعدت then there may be fracture of anterior and posterior arch.

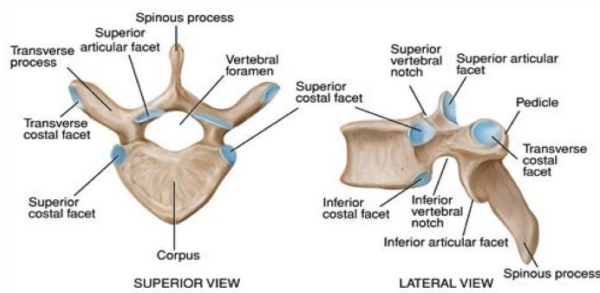
foramen transversarium.

- The vertebral artery travels through foramen transversarium.



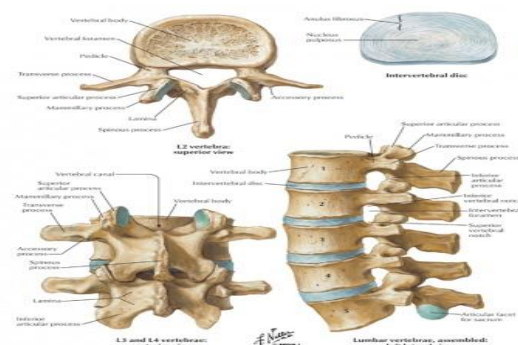
- When examining a radiograph, we need to first make sure that the anterior body line, posterior body line and spino-laminar line are متوازي
- This means it is a straight spine and there is no subluxation.
- Also examine the facets, and disc spaces.

★ Thoracic vertebrae:



- The thoracic vertebrae have 6 facets 2 superior & 2 inferior for attachment with vertebra above and below, and 2 costal for rib attachments which stabilize and splint.
- The superior and inferior facet orientation are aligned along the coronal plane (facing us).
- **Function: thoracic spine is the one responsible for rotation** range of motion.
- On x-ray we will see square shaped vertebral bodies and look for pedicles, on sagittal there is kyphosis, and on coronal it is straight.

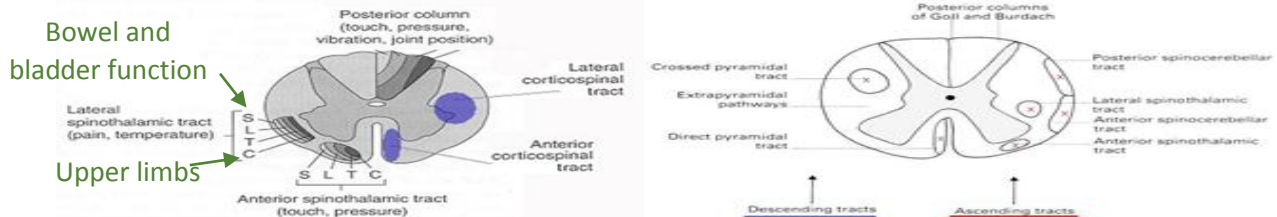
★ Lumbar vertebrae:



- Lumbar vertebrae are bigger because they are weight bearing.
- On x-ray they have box shaped body, then assess the pedicle, process, facets, pars interarticularis², dis space. Separation or widening of spinous process distance that means possible injury.
- **Function: lumbar spine is the one responsible for flexion and extension** (facet aligned along sagittal plane)

- **In case of painful flexion, which part is having the load? The disc.**
- **In case of painful extension, which part is having the load? Pars interarticularis.**
- **In case of painful flexion and extension which part is having the load? Spine motion segment.**

★ Intrinsic pathways:



- There are 2 pathways in the spinal cord: ascending and descending tracts.
- Representation of nerve roots within tracts goes from cervical, thoracic, lumbar, sacral where **cervical is more central!**
- So if the central part of the spinal cord is affected how will it present?
 - Cervical representation will be affected (i.e upper limb) so there will be disproportionate upper limb weakness compared to lower limb.
- If there is a posterior column issue what will the general clinical presentation be?
 - Gait will be affected. Why? Because proprioception and joint position will be lost. On examination it can be tested by Romberg test: ask patient to close his eyes and he will start swaying because we eliminated visual field feedback **يترنح**.
 - Also fine hand movements will be affected like writing (handwriting will change), typing, they will drop items, can't close buttons, etc.. losing dexterity.
- Generally speaking if a patient has complete or almost complete spinal cord injury the **last** thing to be affected is the **sacral** representation which is responsible for bowel and bladder control.

Descending (motor)	Ascending (sensory)	
Corticospinal tract	Posterior column	Spinothalamic tract
Carries motor fibers.	Carries proprioception, vibration, 2-point discrimination.	Carries pain, temperature, general "crude touch".
Decussate at brainstem	Decussate at brainstem	Decussate at spinal level ³
Lesion: ipsilateral upper motor neuron syndrome (weakness, spastic tone, increased reflexes, clonus, and a Babinski response)	Lesion: ipsilateral loss of fine touch, vibration and proprioception sense below the site of the lesion	Lesion: contralateral loss of pain and temperature sense below the site of the lesion.

★ Blood supply:

- The arterial blood supply to the spinal cord is derived from two branches of **vertebral artery**, the **anterior and two posterior spinal arteries**.
- So, if anterior spinal artery is injured that's it, the anterior 2/3 of the spinal cord is infarcted.
- However posterior spinal infarctions are less common, due to the **dual** posterior spinal artery.

² if there's lysis > spondylolisthesis (vertebral body will slide on the other).

³ To remember it is the only one that starts with spino- and decussates at spinal.

★ Epidemiology:

- 56000 cases per year.
- 11000 new spinal cord injuries.
- 15-20% multiple non-contiguous levels.
- 10% involving the cervical spine.
- 90% involving thoracolumbar spine.
- 25% have neurologic deficit.
- Age: mostly between 15-24 years.
- Gender: mostly males (4:1).

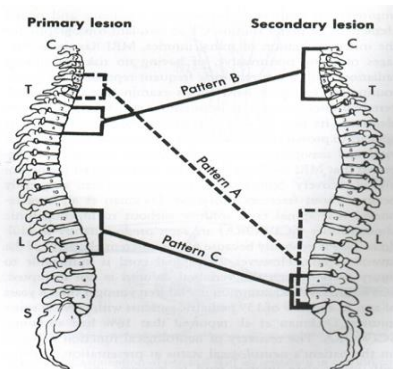
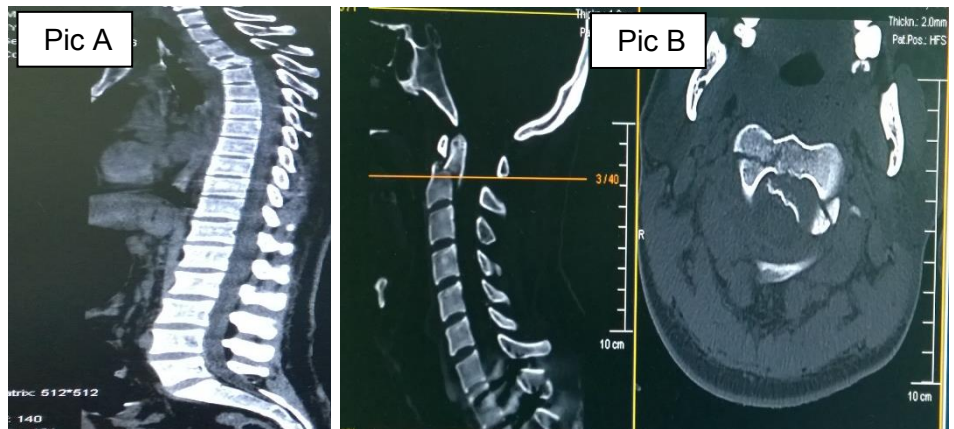


Fig. 56-6 Three patterns of multiple-level injury described by Calenoff et al. (see text). (From Calenoff L, Chessare JW, Rogers LF, et al. *Am J Roentgenol* 130:665, 1978.)



- There are 3 possible patterns of multiple non-contiguous level injury: pattern A, B, and C.
- If a patient presents with a primary lesion in the upper or lower cervical spine, he will also have a secondary lesion in the lumbar area (see pattern A), and the same goes for the other patterns.
- This is a real patient (picture A) presented with T3 fracture, he had brain injury so you can't examine him. This is the image we received, is it enough? **NO** we need cervical spine image because if we follow pattern B he may also have another non-contiguous injury, so we asked for another image (picture B) and see that he does have another injury in cervical spine (C1).

★ Mechanism of injury:

- Trauma can be divided into high velocity (like skiing or falling from horse) or low velocity injury.
- **High energy** trauma such as an MVA (motor vehicle accident) or fall from a height or a horse
 - MVA: 40-55%
 - Falls: 20-30%
 - Sports: 6-12%
 - Others: 12-21%
- **Low energy** trauma in a high-risk patient (i.e. a patient with known spinal canal compromise such as **ankylosing spondylitis**⁴, **Osteoporosis** or metastatic vertebral lesions) **pathological fracture!**
- **Penetrating** trauma from gunshot or knives.



This is a pathological fracture in a patient with cervical **ankylosing spondylitis**, you can see loss of vertebral space and **fusion** of the vertebral bodies.

⁴ Ankylosing spondylitis → what happens? Fusion of vertebra and loss of disc / disc acts as a shock absorbent so if the spine is fused together it acts as one unit (like tibia or femur) any injury will still cause similar fracture (esp in cervical and thoracic) spinal cord injury is extremely high since motion is very big at site.

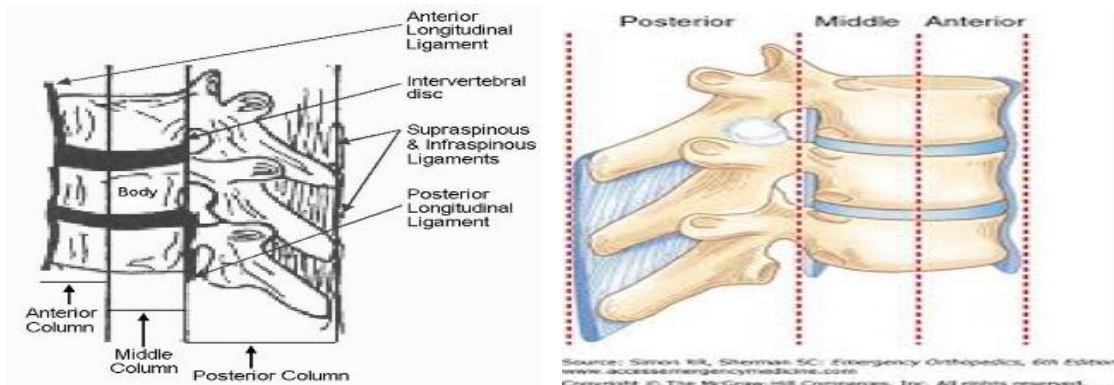
★ Spine Stability:

There is cervical spine instability if:

- Compression fracture with 25% loss of height.
- Angular displacement > 11 degrees.
- Translation (تحركت الفقره) > 3.5mm.
- Disc space separation >1.7mm

Thoracic and lumbar spine stability depends on Denis three column → **Instability exists with disruption of any two of three columns** (≥ 2 columns affected = instability).

★ The three columns:



- Denis three column model divides the **thoracolumbar** spine into three columns: put a line through the vertebral body and you have the anterior and middle columns then everything behind the vertebral body makes up the posterior column.
 - 1) **Anterior column:** includes the anterior longitudinal ligament (ALL) up to the first half of the vertebral body).
 - 2) **Middle column:** includes the second half (posterior half) of the vertebral body, up to, and including the posterior longitudinal ligament (PLL).
 - 3) **Posterior column:** includes the **pedicles**, spinal cord/theal sac, lamina, transverse processes, facet joints, spinous process, and the posterior ligaments (supraspinous, interspinous, and ligamentum flavum).
- If the injury involved **one third or less of the spine** (= one column or less) - it is considered a “stable injury” and it is **managed conservatively**. If the injury involved **two third or more of the spine** - it is considered an “unstable injury” and it is **managed by surgery**.

★ Assessment:




- In cases of trauma, **ABCDE's⁵** must be assessed first and treated appropriately.
- Patients should be examined with a **spinal collar** until spinal pathology is excluded.
- Careful log rolling keeping the head, neck and pelvis in line should be done to examine the spine properly.

1. Immobilization of cervical spine

- Trauma patients are usually first assessed at the scene by paramedics and then transported to the hospital. The assessment at the scene is very important. So every trauma patient that presents in the emergency needs to be **immobilized** with **cervical collar and spinal board** and spinal injury is assumed in every patient to prevent further neurological deficit that can happen if the patient was not immobilized.

⁵ A → airway and c-spine immobilization

- At the scene, one member of rescuer team stabilizes head and neck in neutral position without applying traction. Another rescuer should apply a cervical collar. Then rescuer 1 stabilizes the head and neck and the others perform log rolling to place the patient in the spine board. Even with the collar in place, Rescuer 1 must maintain the head and neck in a neutral position until the log-rolling maneuver is complete.
- Once the patient is transported safely to the hospital, we can use **cervical traction**.
- Spinal board is **only** used for **transport** not for immobilization! Prolonged use at the hospital may lead to pressure ulcer.
- Log rolling is done by 3 or 4 (preferably) people: one for the head, one for the torso, and one for the lower limb ([video](#)).

Types of Immobilization		
Collar	Spine board	Log rolling
 <p>Left: Hard collar (used in trauma) Right: Soft collar (only for neck pain NOT for trauma)</p>	 <p>Only used for transport.</p>	 <p>Prevent ulcers in the back</p>

2. History

- Mechanism of injury: compression, flexion, extension, distraction.
- Seat belt (People who are wearing a lap belt only → can lead to chance injury)
- Other injuries.
- Other casualties.

3. Physical examination

- Inspection (ecchymosis, swellings, open wound...), palpation (tenderness)
- Neurologic examination:
 - Muscle Test.
 - Sensory exam: light touch, sharp dull discrimination, vibration sense, proprioception and two-point discrimination.
 - Reflexes.

★ Signs of spinal trauma:

- ✓ Apnea (diaphragm may be affected), lower cranial nerve injury VIII-XII (high C-spine).
- ✓ Deformity of the spine or neck.
- ✓ Tenderness on palpation along spinal processes.
- ✓ Paralysis or muscle weakness (which spinal level).
- ✓ Loss of sensation (which dermatomes).
- ✓ Loss of rectal tone.
- ✓ **Positive Babinski sign** (brainstem injury).

American Spinal Injury Association (ASIA) Score:

Patient Name _____ Date/Time of Exam _____
 Examiner Name _____

ASIA STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY **ISC**

MOTOR
 KEY MUSCLES (scoring on reverse side)
 CS R L Elbow flexors
 C6 R L Wrist extensors
 C7 R L Elbow extensors
 C8 R L Finger flexors (first phalanx of middle finger)
 T1 R L Finger abductors (middle finger)

UPPER LIMB TOTAL (MAXIMUM) (25) (25) (50)

Comments: _____

L2 R L Hip flexors
 L3 R L Knee extensors
 L4 R L Ankle dorsiflexors
 L5 R L Long toe extensors
 S1 R L Ankle plantar flexors

Voluntary anal contraction (Yes/No) _____

LOWER LIMB TOTAL (MAXIMUM) (25) (25) (50)

TOTALS (MAXIMUM) (50) (50) (100)

NEUROLOGICAL LEVEL (The most caudal segment with normal function) _____

COMPLETE OR INCOMPLETE? _____

ASIA IMPAIRMENT SCALE _____

ZONE OF PARTIAL PRESERVATION (Level(s) of sensory/motor segments) _____

SENSORY MOTOR R L _____

ASIA IMPAIRMENT SCALE

- A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- E = Normal:** motor and sensory function are normal

CLINICAL SYNDROMES

- Central Cord
- Brown-Sequard
- Anterior Cord
- Conus Medullaris
- Cauda Equina

- ASIA Score Brief Trauma Neurologic Survey: evaluates sensation (dermatomes) and muscle action (myotomes) of the nerve roots.
- You **have to know** the nerve roots for lumbar = dermatomes + reflexes.
- After thorough neuro-assessment an ASIA score is given:
 - E = "Excellent" Normal examination
 - A = "Absent" = absent motor / sensory / reflexes → Complete injury
 - B = Incomplete (only sensation)
 - C = Incomplete (only sensation and muscle power < 3)
 - D = Incomplete (muscle power ≥ 3)

If you label a patient as **incomplete** you have to classify him into one of the clinical syndromes: central cord, brown-sequard, anterior cord, conus medullaris, or cauda equina.

Level of Cord Injury determines level of function (conus medullaris + cauda equina happen only in conus and below, does NOT occur in cervical or thoracic area / while central, brown, and anterior syndromes happen in thoracic spine area).

★ Prognosis for recovery of spinal cord injury:

Poor prognosis for recovery if:

- Patient arrives in shock.
- Patient cannot breathe.
- Patient has a complete injury.

Severity of neurological deficit (spinal cord syndrome)

[DR.Nabil](#) [toronto notes](#)

★ Complete (complete cord transection)

Flaccid paralysis below level of injury: **initially** the patient will have flaccid paralysis and might develop rigidity later⁶.

- May involve **diaphragm** (respiratory function may be affected) if injury above **C5**⁷.




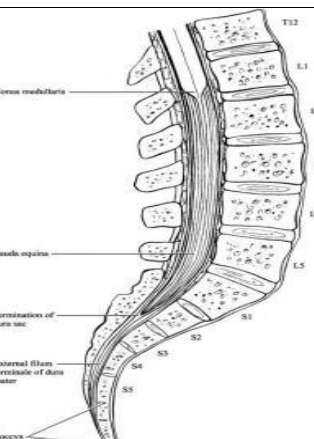
⁶ Complete cord transection causes **spastic** paralysis (UMN injury), but in acute settings they present with LMN injury (due to spinal shock) which will manifest as flaccid paralysis.

⁷ Patient fractured his C1 and C2 spines and arrived to the hospital and the ICU team failed to extubating him, what's the diagnosis? Diaphragmatic Palsy.

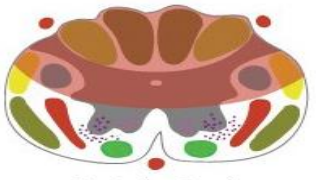
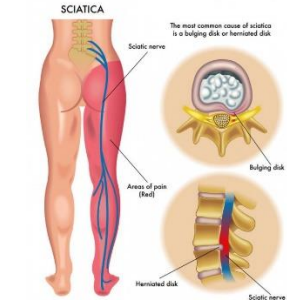
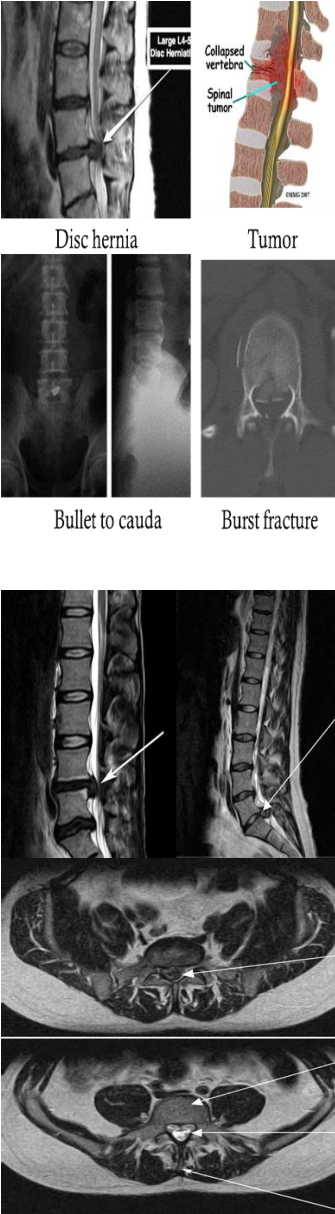
- Sympathetic tone loss if fracture above T6⁸ → **Neurogenic shock** is a circulatory status due to loss of sympathetic tone and unopposed vagal tone (hypotension + bradycardia).

★ **Incomplete:**

If the patient has **any sensation** or **sacral sparing**.

Syndrome	Picture	Features
Central cord syndrome DR.Nabil	 <p>Central Cord Bilateral upper extremity weakness, pain/temperature</p>	<ul style="list-style-type: none"> • Characterized by disproportionately (UL>LL) The distal affect more than proximal, hand more than shoulder. • Mechanism: hyper-extension (spondylosis → nutcracker effect on spinal cord.) • Occur with or without fractures. • Recovery: 50% regaining function! الرقم مهم • Prognosis is fair.
Anterior cord syndrome	 <p>Anterior Cord Bilateral motor, pain/temperature</p>	<ul style="list-style-type: none"> • Characterized by loss of corticospinal (motor) and spinothalamic (pain, temperature) tract with preserved posterior column (proprioception, vibratory sense). • Mechanism: ischemia (reversible) or infarction (complete loss of function) to spinal cord = anterior spinal artery (supplies anterior 2/3 of spinal cord) gets occluded due to injury, infection, abscess, tumor. • Common injury • Recovery: 10% • Prognosis is good if progressive recovery within 24hrs, • Absent SS (sacral sparing) after 24hrs pretends a poor outcome. • Rapid loss = vascular related injury..
Brown-Sequard syndrome osmosis High yield notes osmosis	 <p>Brown-Sequard Unilateral weakness, contralateral pain/temperature</p>	<ul style="list-style-type: none"> • Characterized by hemicord injury with ipsilateral paralysis, loss of proprioception and light touch (dorsal “posterior” column), and contralateral temperature and sharp pain loss (spinothalamic tract) • Caused by disc, tumor, fracture, or hemicord transection due to penetrating trauma. • Anything other than transection → Prognosis is good, with over 90% regaining of bowel and bladder function and ambulatory capacity
Conus medullaris syndrome (IMPORTANT) DR.Nabil		<ul style="list-style-type: none"> • Conus medullaris: It is the terminal part of the spinal cord around T12/L1. It is the area between spinal cord and the cauda equina. • Seen in T12-L1 injuries. • Loss of voluntary bowel and bladder control with preserved lumbar root function. • Uncommon as pure lesion (mixed conus-cauda). • Will have features of cauda equina and UMN signs (fasciculations).

⁸ Patient fractured his T1 and T2 spines and arrived to the hospital with full conscious but the ICU team can't increase his blood pressure, what is the treatment? Vasopressor because he is having Neurogenic Shock

<p>Posterior cord syndrome</p>	 <p>Posterior Cord Bilateral proprioception</p>	<ul style="list-style-type: none"> Extremely rare, vascular compromise appears to be the most common etiology. With occlusion to the posterior spinal artery, a Posterior Cord Syndrome will ensue. (Remember we have 2 posterior spinal arteries. That's why it is very rare) Patient will have loss of proprioception which will affect gait and fine hand movements (as discussed above).
<p>Nerve root deficit (LMN deficits)</p>	 <p>SCIATICA The most common cause of sciatica is a bulging disk or herniated disk. Sciatic nerve Bulging disk Areas of pain (heel) Herniated disk Sciatic nerve</p>	<p>Example:</p> <ul style="list-style-type: none"> Sciatica (most common). SLR test Patient with L3 fracture will present with ipsilateral weakness in knee extension and absent knee jerk, loss of sensation in L3 dermatome with no other deficits. This is the simplest kind of neurological deficit and usually have the best outcome in term of prognosis.
<p>Cauda-Equina syndrome osmosis</p> <p>HIGH YIELD NOTES OSMOSIS</p> <p>toronto notes</p>	 <p>Disc hernia Tumor Bullet to cauda Burst fracture</p>	<ul style="list-style-type: none"> Urinary retention, bowel incontinence (can start incomplete and the patient will say he can't control his gases initially) and saddle anesthesia. <p>Causes (usually due to large central disc herniation rather than fracture):</p> <ul style="list-style-type: none"> - Central disc prolapse. - Burst fractures of lumbar spine. - Penetrating injuries such as stab wounds or bullets. - Epidural hematoma from spinal anesthesia, or post-surgery (rare). - Tumors compressing the lower spinal nerve roots. - Severe spinal stenosis. <p>Management: It is a surgical emergency, requires full neurologic examination <u>including rectal examination for anal tone.</u></p> <p>#Investigations: X-rays initially, but MRI is mandatory as X-rays are usually unremarkable. If MRI is contraindicated (like patient has bullet) do CT scan! (ex: Patient has Arrhythmia and having pacemaker? → CT not MRI).</p> <p>Treatment: Emergency decompression-usually discectomy-within 24 hours. If fracture = stabilization.</p> <p>✓ Keep in mind: Patient who have disc which lead to cauda equina is different from the patient with thoracic spine injury and paraplegia w/ features of cauda equina b/c if he has complete spinal injury at the thoracic level he will have:</p> <ul style="list-style-type: none"> - Complete loss of sensation from the chest down (including perianal area). - Neurogenic bladder (urinary retention). - Loss of anal tone = completely open (but they are constipated b/c of bowel paralysis + no ambulation > stool harden need digital disimpaction) <p>These are all features of cauda equina BUT this is not cauda equina syndrome but complete spinal injury.</p>

Spinal shock (This is neurological and transient) DR.nabil	Neurogenic shock (Vascular “circulatory” phenomena)
<ul style="list-style-type: none"> ○ Transient (مُؤَقَّت) loss of spinal reflexes. ○ Physiologic shutdown of all spinal cord (sensory, motor, reflexes) function b/c of injury. ○ Lasts 24-72 hours. <p>How do I know if spinal shock is over (b/c you can't declare him as complete or incomplete due to the physiological shutdown)? Return of bulbocavernosus reflex.</p>	<ul style="list-style-type: none"> ○ Reduced tissue perfusion due to loss of sympathetic outflow and un-opposed vagal tone. ○ Peripheral vasodilatation (hypotension and bradycardia). ○ Rx: fluid resuscitation initially and vasopressors (is a MUST)

4. Imaging

★ **X-rays: fell from tree → normal examination → x-ray**

- Cervical: 3 views (AP, lateral and open mouth⁹).
- Thoraco-lumbar: 2 views (AP & lateral).
- Flexion-Extension views¹⁰

★ **CT:**

Best for **bony** anatomy. “In case of burst fracture”

★ **MRI:**

Best to evaluate **soft tissue**.

Management of spinal injury

★ **Depends on:**

- (1) Level of injury. (C3 Vs. L5? totally different consequences).
- (2) Degree and morphology of injury: **STABILITY**.
- (3) Presence of neurologic deficit.
- (4) Other factors (Pathological fracture vs. High energy trauma)

★ **Some general rules:**

- ✓ **Stable** injuries are usually treated **conservatively**.
- ✓ **Unstable** injuries usually require **surgery**.
- ✓ **Neurologic compression** requires **decompression**.

⁹ An open mouth view is a special view → AP view of C1 and C2 vertebrae

¹⁰ Do not do it in trauma patient as it may cause iatrogenic spinal cord injury. You might do it later.

Specific Injuries

I. Cervical spine fractures:

- Descriptive: depends on mechanism of injury:
 - Flexion/extension.
 - Compression/distraction.
 - Shear.
- Presence of subluxation/dislocation.
- SCI:
 - High fracture (upper) results in **quadriplegia**.
 - Low fracture (lower) results in **paraplegia**.
- If a pt presented with cervical fracture/dislocation:
 - Symptoms: can't move, can't feel, neck pain
 - Signs (go with the symptoms): paralysis, loss of sensation, ecchymosis, neck swelling, etc...



Normal cervical x-ray



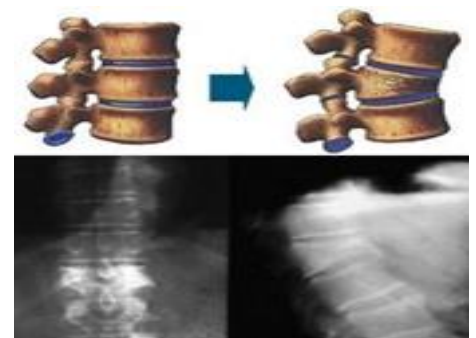
C5/6 fracture dislocation (Spine is **Unstable**).

II. Thoracolumbar fractures:

- Spinal cord terminates at L1/2 disc in adult (L2/3 in a child).
- 50% of injuries occur at Thoracolumbar junction (T12/L1).
- Common fractures: wedge, **burst**, chance fracture.

★ Wedge¹¹ fracture (flexion/compression):



- This is by far the most common vertebral fracture and is due to severe spinal flexion.
- Anterior part is **مخفوس** and posterior is intact and distance b/w spinous process are normal.
- The posterior part of the vertebral body, pedicles, laminae and spinous processes are intact.
- Only the anterior column is affected so the spine is stable.



★ Burst¹² fracture (compression):

- Severe axial compression may 'explode' the vertebral body.
- Posterior wall is involved and there is loss of height anterior and posterior compared to adjacent vertebrae + there might be widening of spinal processes → the spine is compromised (unstable)
- **The whole vertebral body is affected = anterior column and middle column.**



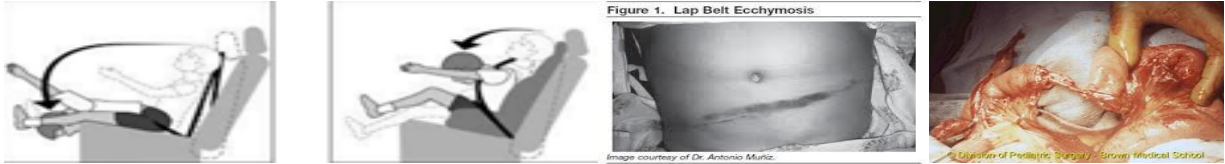
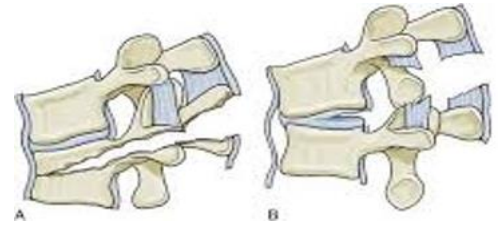
Burst Fractures - characteristics	
1. Retropulsion of posterosuperior vertebral body fragment. - Wedge compression may bulge posterior cortex but not posteriorly displace	
2. Sagittal fracture of vertebral body (90%)	
3. Sagittal posterior element fracture (85%)	
4. Widening of interpedicular distance (80%)	

¹¹ مخروطي

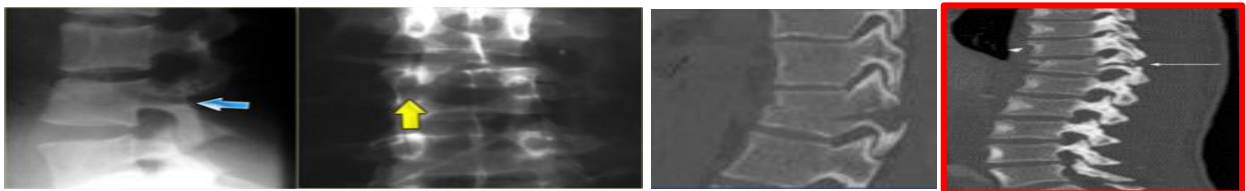
¹² متفجره

★ Chance fracture (flexion/distraction):

- Hyperflexion injury can result in 2 issues:
 - A. bony chance: affecting vertebral body + pedicle + spinous process
 - B. ligamentous chance: supraspinous, facet and disc without bony fracture.
- This is a three columns injury = unstable injury.
- 40% associated w/ abdominal injury = bowel perforation, mesenteric rupture or **bowel rupture**.
- Mechanism? Wearing only lap belt.
- Children must either be in a car seat or have a seat booster to prevent these types of injuries!

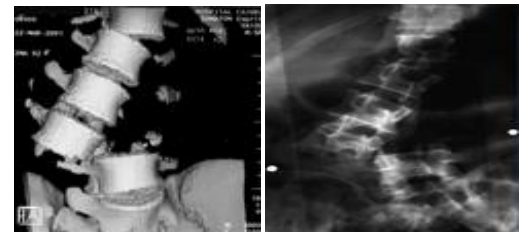


- X-rays may show horizontal fractures in the pedicles or transverse processes, and in the AP view the apparent height of the vertebral body may be increased.
- If it was in the ligaments the x-ray will be normal, but in clinical examination you will feel the gap, and there will be severe tenderness upon palpation.



★ Fracture dislocation:

- **Unstable** = all three columns are disrupted
- These are the most dangerous injuries and are often associated with neurological damage to the lowermost part of the cord or the cauda equina.
- There will be coronal and sagittal loss of alignment on X-rays.



★ Pathological fractures:

- Usually due to infection or tumor.
- Low-energy fractures.
- **Osteoporotic** is common. **What is the most common cause of pathological fracture? Osteoporosis**
- X-rays: **“winking owl”** sign (pathognomonic). The (absent) pedicle sign.
- You need to treat the fracture and the underlying cause.

