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# 15-acute spinal injuries and cauda equina syndrome

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## Objectives:

1- 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/severe neurologic injury (perianal numbness(saddle **parathesia** ), decreased rectal tone+ **bladder tone** , loss of movement in the extremities)
  - 2) Tumor weakening the vertebrae (causing cord compression or vertebral fracture)
  - 3) Infection weakening bone (causing disc/vertebral destruction or cord compression infection will lead to pus and the pus will compress the bone )
  - 4) **Traumatic Spine Fracture** (causing vertebral angulation, pain, or neuro compromise )
- Remember that spine fracture can occur **without trauma**

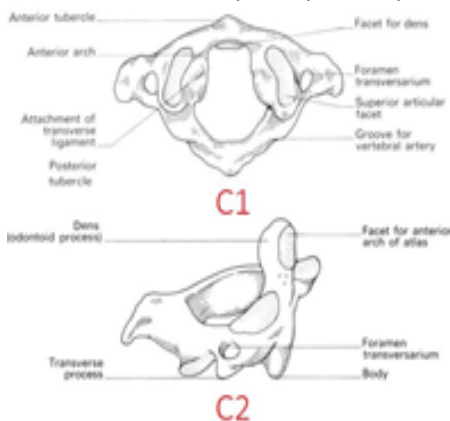
## Anatomy of the spine:

In the spine there are bones, joints, ligaments and muscles.

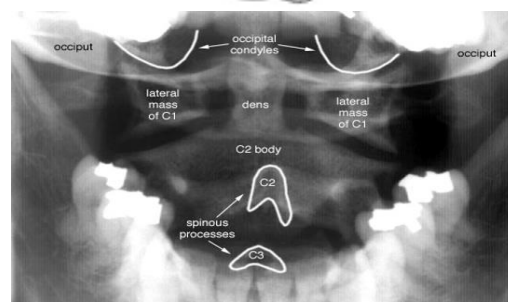
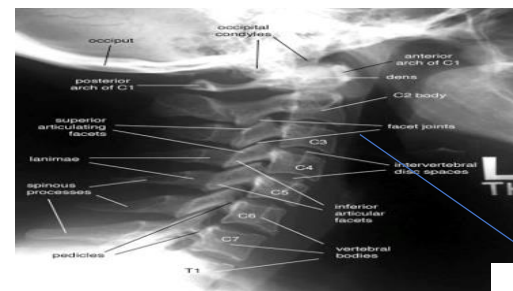
The spinal column is made up of 33 vertebrae, of which 24 are discrete vertebrae (these 24 vertebrae are: 7 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae) and 9 are fused in the sacrum and coccyx. The basic vertebra is composed of a **body** and of a **neural arch** surrounding the vertebral canal. The neural arch is made up of a pedicle and lamina on either side, spinous process posteriorly, 2 transverse processes laterally, and upper and lower articular facets. The pedicle bears a notch above and below which, with its neighbour, forms the intervertebral foramen. Vertebral column has 2 Functions: (1) weight bearing. (2) Movement.

## The cervical vertebrae

C1 (Atlas) & C2 (Axis)



C3 -C7



Soft tissue  
Shadow if  
increase  
mean  
trauma or  
infection

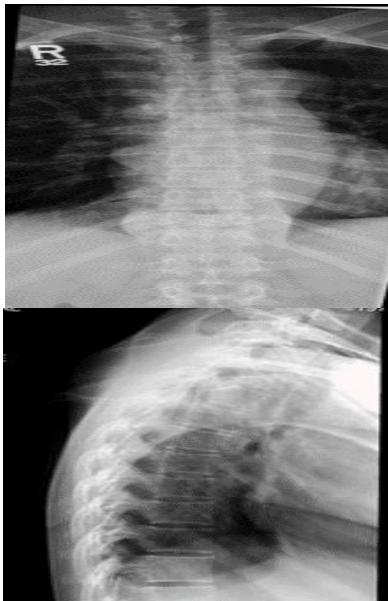
The atlas (C1) has no body. The axis (C2) bears the dens (odontoid process), that projects upward into the Atlas.

This unique anatomy provides a great degree of mobility for the skull. Approximately 50% of flexion extension of the neck happens between the occiput and C1; 50% of the rotation of the neck happens between C1 and C2.

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 **foramen transversarium**. Vertebral artery travels through foramen transversarium. As we all know vertebral artery is a component of Circle of Willis, so, if there was a fracture and a piece of bone cut or obstructed the vertebral artery the blood supply of the brain will be affected.

## The thoracic vertebrae

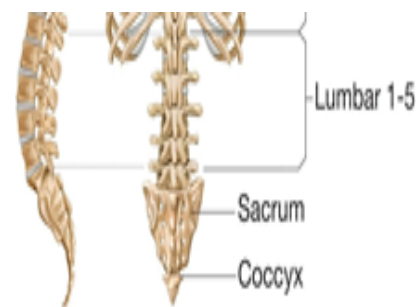


(1) Rib attachments provide a strength and stability to the thoracic spine.

(2) The rib cage and ligaments limit range of motion and protect many vital organs. So thoracic vertebrae are somewhat stiff, and they are relatively stronger than cervical vertebrae and the lumbar vertebrae.

They are less likely to degenerate, and to develop any trauma.

## The lumbar vertebrae



As we go down the vertebra becomes bigger in size.

L5 is the biggest vertebra and C1 is the smallest vertebra. This correlates with their function in weight bearing - so initially:

- (in cervical spine) there is only the weight of the head.
- And then the weight of the chest will be added on the thoracic vertebrae.
- then in the lumbar vertebrae there will bear the whole weight of the trunk and pelvis -
- then the weight transmitted to the hip joint

### Thoracic spine is the one responsible for rotation

function:

- allows some rotation, minimal flexion-extension (also limited by ribs) \_
- prevents downward flexion on heart and lungs \_

### Lumbar spine is the one responsible for flexion and extension

function:

- allows flexion-extension, minimal rotation
- helps increase abdominal pressure

**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** place where is contact between pedicles and lamella

**In case of painful flexion and extension which part is having the load? Spine motion segment**

Spinal motion segment is composed of:

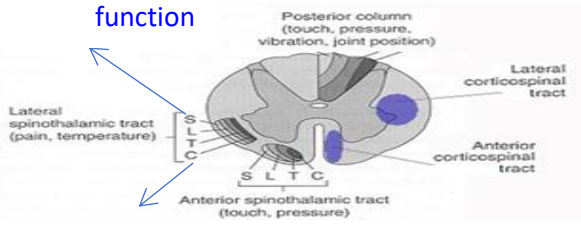
1. Two adjacent vertebrae.
2. Three-joint complex. (intervertebral disc & 2 facet joints)
3. Ligaments.
  - Note that each level of your spine functions as a three-joint complex.
  - There are two facet joints in the back and a large disc in front that comprise each intervertebral segment.
  - This tripod 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.

The spinal cord is continuous above with the medulla oblongata at the level of the foramen magnum and ends below at the lower level of the 1st, or the upper level of the 2nd lumbar vertebra (in children, it extends up to L3). Inferiorly, it tapers into the conus medullaris from which a prolongation of pia mater, the filum terminale, descends to be attached to the back of the coccyx.

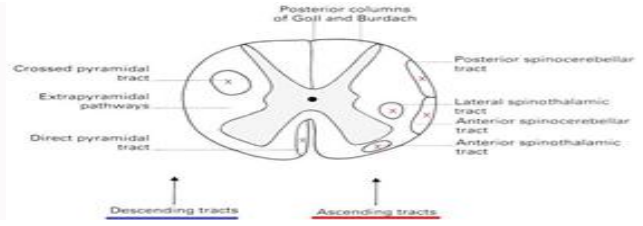
The lumbar and sacral roots below the termination of the cord at vertebral level L2 continue as a leash of nerve roots termed the cauda equina.

## Intrinsic pathways

Bowel and bladder function



Upper limbs

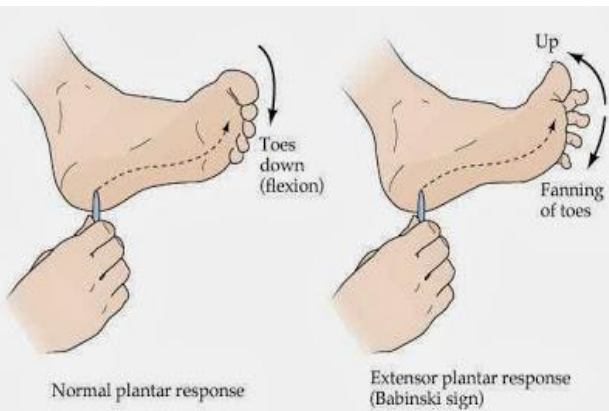


### Descending tracts

1/ The pyramidal (lateral cerebrospinal or crossed motor) tract (90% of the pyramidal fibers). cortical spinal tract

The motor pathway commences at the pyramidal cells of the motor cortex, decussates in the medulla, then descends in the pyramidal tract on the contralateral side of the cord.

So: Any lesion of the lateral corticospinal tract causes an **ipsilateral** (because fibers have already crossed) upper motor neuron syndrome: weakness, disuse atrophy, spastic tone, increased reflexes, clonus, and a Babinski



response

2/ The direct pyramidal (anterior cerebrospinal or uncrossed motor) tract (10% only) It is a small tract descending without medullary decussation.

### Ascending tracts

1/ The lateral and anterior spinothalamic tracts.

Lateral spinothalamic tracts carry **pain and temperature** fibers. Anterior spinothalamic tracts carry pressure and **crude touch** fibers. These fibers **cross to the opposite side in the spinal cord** to ascend in these tracts to the thalamus, where they are relayed to the sensory cortex. So: Any lesions of the lateral spinothalamic tract cause loss of pain and temperature sense **on the opposite side of the body below** the site of the lesion.

Just notice how the fibers are arranged inside the tract (in the 2nd pic - anterior and lateral spinothalamic tracts). The cervical fibers (upper limb) are the most medial fibers followed by trunk fibers, lumbar fibers (lower limb) and then sacral fibers (perianal sensation)

2/ The posterior columns comprise a medial and lateral tract, termed respectively the fasciculus gracilis and fasciculus cuneatus. They convey 1st order sensory fibres subserving **fine touch, vibration and proprioception**, mostly uncrossed, to the gracile and cuneate nuclei in the medulla. The 2nd order fibres decussate, pass to the thalamus and 3rd order fibres are relayed to the sensory cortex. So: Any lesions of the posterior column cause loss of fine touch, vibration and proprioception sense **on the ipsilateral side of the body 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 gone (infarcted). However posterior spinal infarctions are less common, due to the dual posterior spinal artery and the pial collateral network.

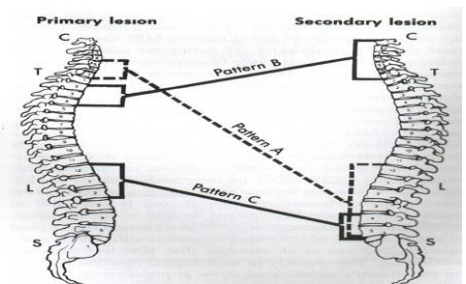


Fig. 56-6 Three patterns of multiple-level injury described by Calenoff et al. (see text). (From Calenoff L, Chessare JW, Rogers LF, et al. *Am J Roentgenol* 130:665, 1978.)

## 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)

## Mechanism of 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, Osteoporosis or metastatic vertebral lesions)
- Penetrating trauma from gunshot or knives



This example of cervical ankylosing spondylitis

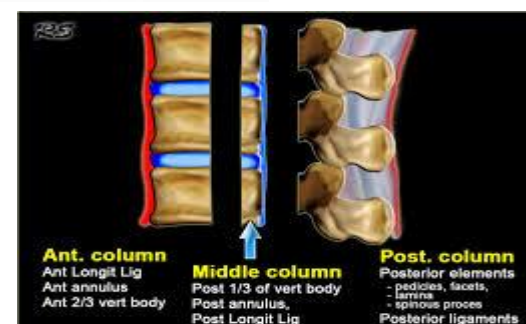
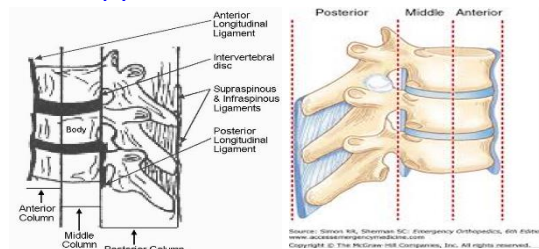
## Spine stability:

- Cervical spine instability:
  - Compression fracture with 25% loss of height
  - Angular displacement > 11 degrees
  - Translation > 3.5mm
  - Disc space separation >1.7mm
- Thoracic and lumbar spine: Denis three column

## The three columns:

**Instability exists with disruption of any two of three columns.** Denis three column model proposes that the **thoracolumbar** spine can be divided into three columns. Vertebral body has 70% of weight bearing function that's why they are occupying 2 columns and the posterior elements of the vertebra occupy 1 column.

- The first column includes the anterior longitudinal ligament (ALL) up to the first half of the vertebral body.
  - The second column includes the second half (posterior half) of the vertebral body, up to, and including the posterior longitudinal ligament (PLL).
  - The third column includes the pedicles, spinal cord/theal sac, lamina, transverse processes, facet joints, spinous process, and the posterior ligaments (supraspinous, interspinous, and ligamentum flavum).
- It is used to describe which injuries to the thoracolumbar spine is considered "unstable".** 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**.





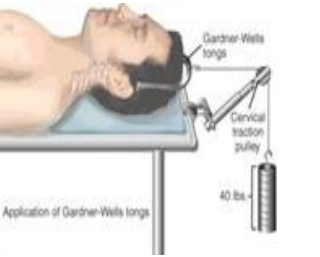
**Assessment:**

**1- Immobilization: of cervical spine**

Trauma patients are usually assessed at the scene by paramedics and then they are 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.

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**.

	 <p>It has holes in the sides for the straps and it also have handles for carrying the patient. The head of a child is bigger than that of an adult; placing a pediatric patient on a standard spine board could cause dangerous flexion of the head. Different type of spine board has to be used only in paediatric patients in order to ensure the correct and safe neutral position for the spinal column with the ideal alignment of the airways</p>	
<p><b>cervical collar</b></p>	<p><b>spine board</b>  <b>Its function is only for transportation</b></p>	<p><b>cervical traction</b></p>

**2- History:**

- Mechanism of injury: compression, flexion, extension, distraction. (Each one of them can cause one kind of injury that's why it is extremely important)
- Head injuries and facial injury (it can lead to cervical spine trauma)
- Seat belt injury (People who are wearing a lap belt only → can lead to chance injury which is also known as seat-belt fracture)
- Other injuries
- Other casualties

**3- Physical examination:**

- Inspection (ecchymosis, swellings, open wound...), palpation (tenderness, gaps, steps,)
- Neurologic examination:
- Muscle Test
- Sensory exam: light touch, Sharp dull discrimination, Vibration sense, Proprioception and two-point discrimination
- Reflexes

## {ASIA (American Spinal Injury Association)}

It is important to perform the neurovascular examination. So, you need to examine the patient (dermatome and myotome neurological evaluation) in order to know the level of injury and to know if an immediate intervention is needed to save the patient's life. The higher the level of injury (NLI), the greater will be the impact on the body.

### ASIA Impairment Scale (AIS)

**A = Complete.** No sensory or motor function is preserved in the sacral segments S4-5.

**B = Sensory incomplete.** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

**C = Motor incomplete.** Motor function is preserved at the most caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments (S4-S5) by ILL, IIP or DAP), and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body.  
(This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C – less than half of key muscle functions below the single NLI have a muscle grade  $\geq 3$ .

**D = Motor incomplete.** Motor incomplete status as defined above, with at least half (half or more) of key muscle functions below the single NLI having a muscle grade  $\geq 3$ .

**E = Normal.** If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

**Using ND:** To document the sensory, motor and NLI levels, the ASIA Impairment Scale grade, and/or the zone of partial preservation (ZPP) when they are unable to be determined based on the examination results.

A = Absent of everything , E = Excellent

1) Determine sensory levels for right and left sides. Examine all dermatomes from C2 to S5 (right & left). and then put a score according to your findings

0 = absent, 1 = altered, 2 = normal or NT = not testable (if patient's GCS is 3 for example) Don't forget the deep anal pressure 1 (DAP) as a part of sensory examination. DAP may be the only evidence of an incomplete injury (in the absence of S3 or S4-5 sensation and VAC)

2) Determine motor levels for right and left sides. Examine all myotomes → upper & lower extremities (right & left) + voluntary anal contraction (VAC)2. and then put a score according to your findings

NT = not testable, 0 = paralysis, 1 = visible contractions, 2 = active movement with gravity elimination, 3 = active movement against gravity, 4 = active movement against some resistance, 5 = active movement against full resistance (functional movement means power is 3 or more)

3) Determine the neurological level of injury (NLI)

4) Determine whether the injury is Complete or Incomplete. If there is absent voluntary anal contraction + absent Deep anal pressure + absent perianal sensation → it is considered as complete injury or grade "A".

Otherwise, injury is Incomplete. Intact VAC and S4-5 is associated with a good prognosis

5) Determine ASIA Impairment Scale (AIS) Grade. E = normal, D & C & B = incomplete, A = complete

B, C, D can be helped usually with surgery. A have a really poor prognosis. D can have a full recovery if there is an early diagnosis and intervention.

### Signs of Spinal Trauma:

- Apnea, lower cranial nerve injury VIII-XII (high C-spine). **Apnea : BC the diaphragm may be affected**
- 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



## Prognosis for recovery of spinal cord injury:

Poor prognosis for recovery if:

- pt arrives in shock
- pt cannot breath
- pt has a complete injury

### Spinal cord syndrome:

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### Severity of neurologic deficit

- **Complete (Complete cord transection):**
  - Flaccid paralysis below level of injury (**complete cord transection causes spastic paralysis (UMN injury), but in acute settings they present with LMN injury (due to spinal shock) which will manifests as flaccid paralysis**)
  - May involve diaphragm if injury above **C5** Injury in the upper part of the cervical spine is very dangerous (because C3,4,5 → phrenic nerve → supply the diaphragm) → our priority here is to keep patient alive. They need mechanical ventilation.  
**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 **T6** Parasympathetic nerve fibers arise from craniosacral region while sympathetic fibers arise from thoracolumbar region and in case of spinal injury sympathetic nerve fibers are going to be affected → Unopposed vagal tone → vasodilation of all the vessels below the NLI → the blood will keep pooling and the pressure will drop and the patient will present with a “neurogenic shock”.  
**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

- **Incomplete (Good prognosis for recovery):**

#### Central cord syndrome

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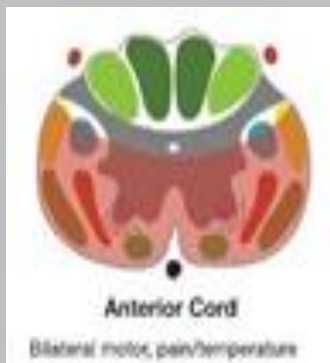


- Characterized by disproportionately (UL>LL)
- Mechanism: hyper-extension
- Occur with or without fractures
- Recovery: 50% regaining function
- **Prognosis is fair**
- **The distal affect more than proximal hand more than shoulder**

(with sacral sparing)

It is believed to be caused by spinal cord compression and central cord edema. Anatomy of spinal cord explains why upper extremities and hand preferentially affected as the hands and upper extremities (cervical, thoracic fibers), are located "centrally" in the tracts

### Anterior cord syndrome



- Characterized by loss of corticospinal and spinothalamic tract with preserved posterior column
- Mechanism: ischemia or infarction to spinal cord **BC anterior spinal artery get block**
- Common injury
- Recovery: 10%
- Prognosis is good if progressive recovery within 24hrs, absent SS after 24hrs pretends a poor outcome

Anterior cord syndrome often occurs as a result of flexion injury, or due to injury to the anterior spinal artery. This may occur as a result of vascular or atherosclerotic disease in the elderly, or iatrogenic secondary to cross clamping of the aorta

Bilateral Loss → corticospinal (motor) & spinothalamic (pain, temperature) preserved → DC (proprioception, vibratory sense)

### Brown-Sequard syndrome

[osmosis](#)

[High yield notes osmosis](#)



- Characterized by hemicord injury with ipsilateral paralysis, loss of proprioception and light touch(dorsal column), and contralateral temperature and sharp pain loss (spinothalamic tract)
- Prognosis is good, with over 90% regaining of bowel and bladder function and ambulatory capacity

Caused by complete cord hemitransection Usually seen with penetrating trauma

ipsilateral deficit → Posterior column (proprioception & vibratory sense) and Corticospinal (Motor deficit)

contralateral deficit → Spinothalamic (pain & temperature) You need to rule out stroke. (check cranial nerve)

### Conus medullaris syndrome(IMPORTANT) MCQS

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- Seen in T12-L1 injuries
- Loss of voluntary bowel and bladder control with preserved lumbar root function
- Uncommon as pure lesion (mixed conus-cauda)

**Conus medullaris: It is the terminal part of the spinal cord around L1/L2. It is the area between spinal cord and the cauda equina.**

Mixture of UMN deficits (Because spinal cord is injured → myelopathy) and LMN deficits (Due to damage of cauda equina → radiculopathy)

So, it is confusing clinically. In the x-ray you will see fracture around L1

### Posterior cord syndrome



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)

### Nerve root deficit

#### LMN deficits

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. If fracture was fixed (decompression of L3) the patient will recover.

### Cauda-Equina syndrome

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**Cauda equina:** They're peripheral nerves (LMN deficit) that haven't form plexuses yet, the lesion is **usually around L4- L5 or L5 - S1.**

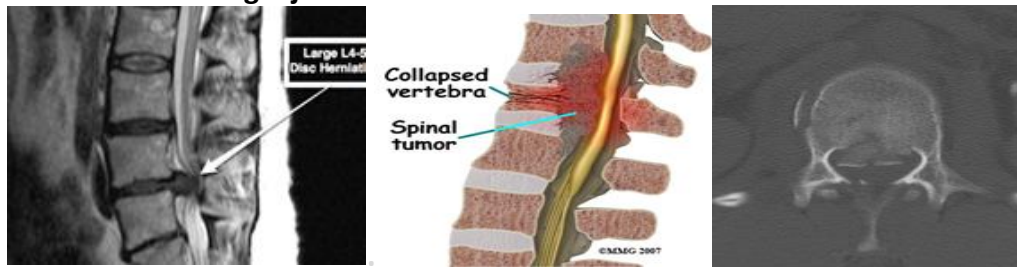
In general, PNS heals better than CNS and recovery is possible.

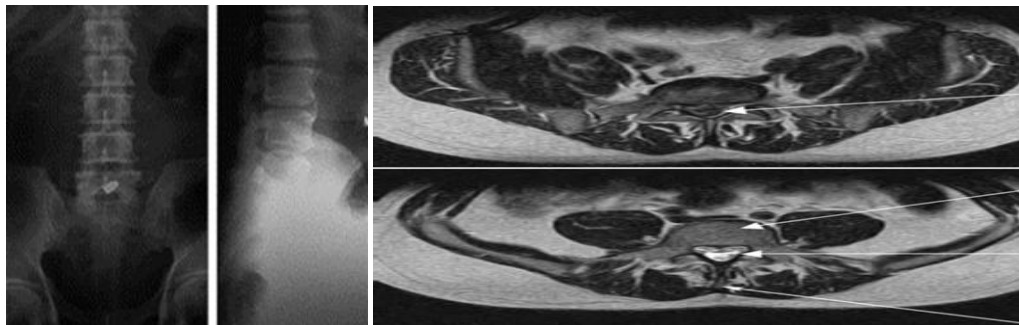
**Urinary retention, bowel incontinence and saddle anesthesia**

signs of CES include lower back pain, sciatica (L4, L5 is involved); foot weakness; saddle-type hypoesthesia or anesthesia in the areas innervated by nerve roots S2 to S5; and retention or incontinence of urine, stool, or both.

#### Causes:

- Central disc prolapses.
- Burst fractures of lumbar spine.
- Tumors compressing the lower spinal nerve roots.
- Epidural hematoma from spinal anesthesia, or post surgery(rare)
- Severe spinal Stenosis
- Penetrating injuries such as stab wounds or bullets





Usually due to large central disc herniation rather than fracture

It is a surgical emergency

Requires full neurologic examination including rectal examination for anal tone

**Investigations:** X-rays initially, but **MRI** is mandatory as X-rays are usually unremarkable. I need to see the nerve (It is a soft tissue),

**What if the patient has Arrhythmia and having pacemaker? Do CT not MRI**

**Treatment:** Emergency decompression-usually discectomy- **within 24 hours.**

## the difference between spinal shock and neurogenic shock:

**Spinal shock:** This is neurological and transient [DR.nabil](#)

- Transient loss of spinal reflexes below the NLI (= LMN injury)
- Lasts 24-72 hours **The bulbocavernosus reflex** indicates the absence or presence of **spinal shock**. **Spinal shock** usually occurs between 24 and 72 hours after **spinal injury**. The **reflex** is checked by monitoring anal sphincter contraction in response to squeezing of the penis or clitoris, or by pulling on an indwelling Foley catheter

It is a state of loss of motor and sensory as well as total loss of reflexes after an injury or trauma happens. It starts after a few minutes from injury though it may take several hours for the effects to fully manifest. It is manifested by a flaccid areflexia post spinal cord injury. As edema around the cord resolves, symptoms will improve over a period of time (24 -72 hours usually). This is associated with poor prognosis because it means a disconnection between brain and spinal cord.

**Neurogenic shock: circulatory phenomena**

- Reduced tissue perfusion due to loss of sympathetic outflow and un-opposed vagal tone Usually noted with lesions above T6.
- Peripheral vasodilatation (hypotension and bradycardia)
- Rx: fluid resuscitation and **vasopressors**

### 4-Imaging:

**X-rays:**

- Cervical: 3 views (AP, lateral and open mouth<sup>1</sup>)
- Thoraco-lumbar: 2 views (AP & lateral)
- Flexion-Extension views<sup>2</sup>

**CT:** best for bony anatomy

**MRI:** best to evaluate soft tissue

<sup>1</sup> An open mouth view is a special view → AP view of C1 and C2 vertebrae

<sup>2</sup> Do not do it in trauma patient as it may cause iatrogenic spinal cord injury. You might do it later.

## 5-Imaging:

### 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)


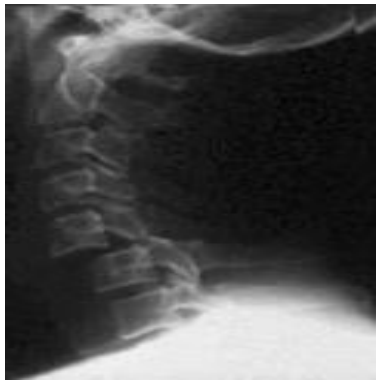
### Some general rules:

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

## Specific Injuries:

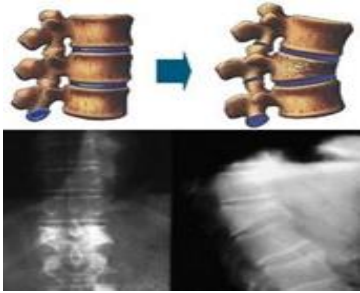
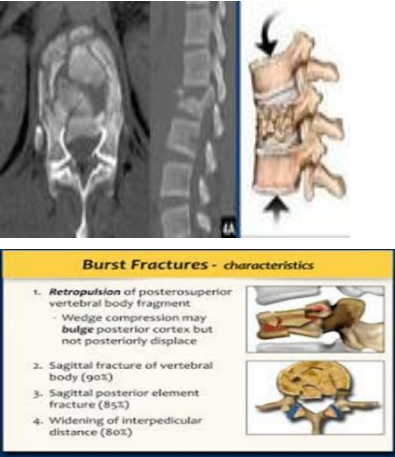
### Cervical spine fractures:

- Descriptive: depends on mechanism of injury
  - Flexion/extension
  - Compression/distraction
  - Shear
- Presence of subluxation/dislocation
- SCI:
  - High fracture results in quadriplegia
  - Low fracture results in paraplegia

Normal lateral X-ray	Here what do you see?
<p>• The lateral view must include the occiput and T1, otherwise an injury at the cervicothoracic junction could be missed. If the cervicothoracic junction cannot be seen, the lateral view should be repeated while the patient's shoulders are pulled down. If this fails, then a CT scan is required.</p> <p>• The alignment should be normal (checked by drawing lines)</p> <p>• The soft-tissue shadows. Increased soft tissue space anterior to upper cervical vertebrae indicates hemorrhage from fractures. (In front of C2 = 6mm / In front of C6 = 22mm)</p> 	 <p>Over 50% anterior subluxation of C5 over C6 Spine is <b>Unstable</b>.</p>

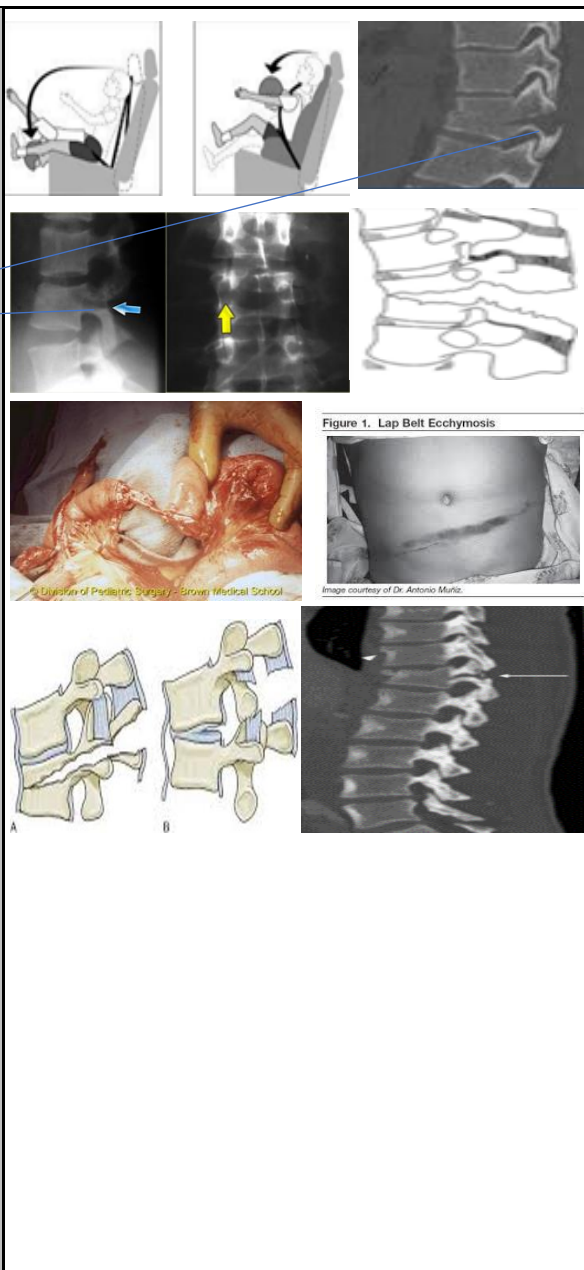
## Thoracolumbar fractures:

- Spinal cord terminates at L1/2 disc in adult (L2/3 in a child)
- 50% of injuries occur at Thoracolumbar junction (why?) Most injuries of the thoracolumbar spine occur in the transitional area – T11 to L2 – between the somewhat rigid upper and middle thoracic column and the flexible lumbar spine

<p><b>Wedge fracture (flexion/compression)</b></p>		<p>This is by far the most common vertebral fracture and is due to severe spinal flexion.</p> <p>The posterior part of the vertebral body, pedicles, laminae and spinous processes are intact.</p> <p>Pain may be quite severe but the fracture is usually <b>stable</b> (one third or less of the spine - anterior vertebral body only = <b>anterior column only</b>).</p> <p>Neurological injury is extremely rare.</p>
<p><b>Burst Fracture (compression)</b></p>	 <p><b>Burst Fractures - characteristics</b></p> <ol style="list-style-type: none"> <li>1. <b>Retropulsion</b> of posterosuperior vertebral body fragment - Wedge compression may <b>bulge</b> posterior cortex but not posteriorly displace</li> <li>2. Sagittal fracture of vertebral body (90%)</li> <li>3. Sagittal posterior element fracture (85%)</li> <li>4. Widening of interpedicular distance (80%)</li> </ol>	<p>Severe axial compression may 'explode' the vertebral body.</p> <p>The posterior part of the vertebral body is shattered and fragments of bone and disc may be displaced into the spinal canal.</p> <p><b>The whole vertebral body is affected = anterior column and middle column</b> (sometimes posterior column is affected as well)</p> <p>Most of the time is <b>unstable</b> I should do surgery</p>

the pedicle elongated

**Chance Fracture (flexion/distraction)**  
= jack-knife injury  
= seat-belt



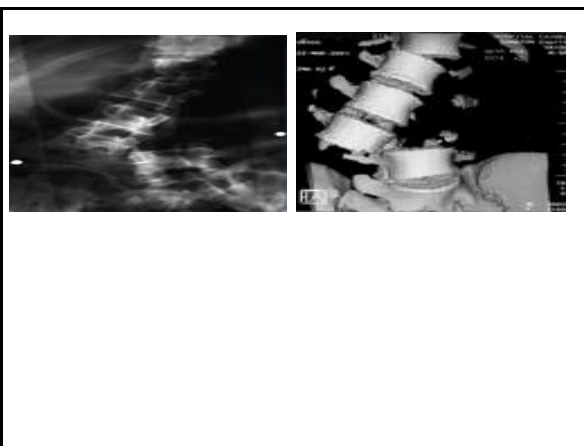
Combined flexion fracture and posterior distraction may cause the mid-lumbar spine to jack-knife around an axis that is placed anterior to the vertebral column. This is seen most typically in lap seat-belt injuries, where the body is thrown forward against the restraining strap. **In clinical Exam you will feel a gap.**

The tear passes transversely through the bones (spinous process, the transverse processes, pedicles and the vertebral body) or the discoligamentous structures, or both. This is a three columns injury = **unstable** injury.

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.

**What is the injury associated with chance fracture? Bowel rupture**

**Fracture dislocation**



All three columns are disrupted and the spine is grossly unstable. 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. Fractures may occur even with normal stresses if the bone has been weakened by a change in its structure.
- Osteoporotic is common. **What is the most common cause of pathological fracture?** Osteoporosis
- X-rays: **“winking owl” sign. The (absent) pedicle sign.**  
The pedicles have an extensive blood supply that's why they are affected first.
- You need to treat the fracture and the underlying cause.



**RED pointes in this lecture very important for MCQ**



## MCQs

**1-2-an x-ray of winking owl, where's the defect?**

- A. Pedicle
- B. Facet joint
- C. Pars interarticularis

Ans : A

**2-A 60-year-old woman comes to the emergency department because of urinary incontinence and bilateral medial thigh paresthesia for the past 3 hours. Her past medical history is noncontributory. She says symptoms suddenly started with mild back pain that is gradually worsening. She is now unable to feel toilet paper on her perineum when wiping after urination. Which is the most appropriate next step in management?**

- A. immediate surgical consultation
- B. Lumbar puncture
- C. observation and NSAID

Ans: A

**3-A 50-year-old man comes to the emergency department because of urinary incontinence for the past 5 hours. His past medical history is noncontributory. He says the onset was sudden and accompanied by worsening back pain. He now cannot feel anything as he wipes after voiding his bowel or bladder. He also feels "pins and needles," along both medial thighs. Which of the following is the most likely diagnosis?**

- A. cauda equina
- B. conus medullaris
- C. lumbar disc herniation

Ans: A

**4-A 56-year-old man comes to the emergency department because of a high-speed motor vehicle accident which caused a laceration to his left spinal cord at the T8 vertebral level. After emergency surgery, he is in stable condition and his temperature is 37.3°C (99.1°F), pulse is 80/min, respirations are 18/min, and blood pressure is 142/90 mm Hg. He is alert and oriented to person, place, and time while resting in his hospital bed. He says his pain is managed well, but that he is concerned about his spinal cord injury. Which of the following neurologic deficits is most likely found on physical examination of this patient?**

- A. loss of left side pain and temperature sensation below the injury
- B. loss of sensation in left side below the injury for fine touch and proprioception
- C. loss of right-side motor control

Ans: B

**5-What is the most common clinical cord syndrome in incomplete injuries?**

- A. central cord syndrome
- B. conus medullaris
- C. cauda equina

Ans: A

**6- Which of the following is not true regarding anterior cord syndrome?**

- A. Loss of motor below level
- B. Loss of proprioception/vibration
- C. Loss of pain and temp

Ans: B

**7- 30-35-year-old male presented with back pain, urinary retention, loss of anal tone, anesthesia in the perineal space. X-ray was done . Which of the following is the best management?**

- A. Emergent L5/S1 discectomy.
- B. Emergent decompression and ORIF.
- C. T10 Laminectomy.
- D. T12/L1 discectomy.

Ans: A

**8- 32 years old female presented to the ED because of sudden lower back pain with positive symptoms of cauda equina syndrome, x ray done and it was normal, what is the best investigation to confirm the diagnosis?**

- A- bone scan.
- B- B-MRI.
- C- C-US.
- D- D-DEXA.

Ans: B

**9- Patient presented to the ER after an RTA Examination suggest cauda equine syndrome also X-ray suggest burst fracture of the spine. What's the best modality to confirm the diagnosis?**

- A-Myelogram.
- B-T99 bone scan.
- C-PET scan.
- D-CT scan

Ans: D

**10- 60 year old male rescued from RTA and was delivered to the hospital safely. Sign of pressure ulcer in the back over his sacroiliac region was noticed later. Which of the following if used could have prevented this complication?**

- A. Using ambulatory bed in transporting only not in the hospital
- B. Soft collar use
- C. log rolling
- D. Hard collar use

Ans: A

**11- 70 years old male with ASIA score of B in upper limbs and C in lower limbs.**

**What is the possibility of regaining neurological function?**

- A.90%
- B.10%
- C.30%
- D.50%

Ans: D