



Spinal disease

Lecture 23



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★ Don't forget to check dr. Fahad's notes on last page!

Color index:

Black: Main text

Red: Important

Yellow: Golden notes

Green: Drs notes 439

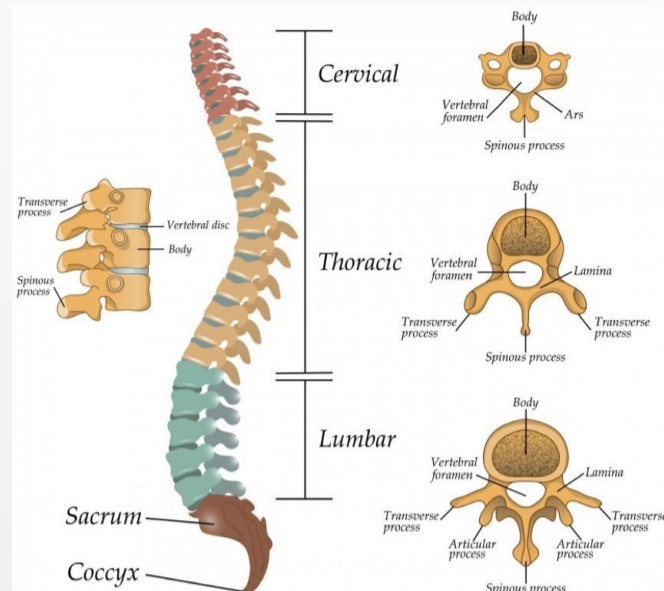
Dark green: Drs notes 438

Gray: Extra



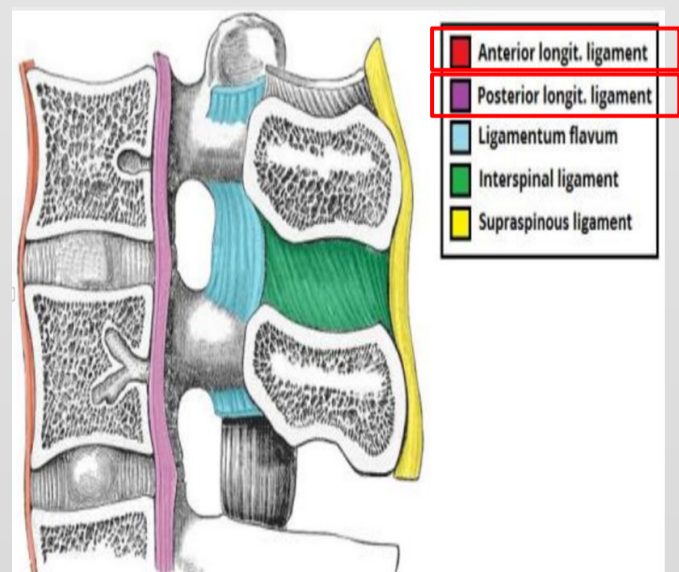
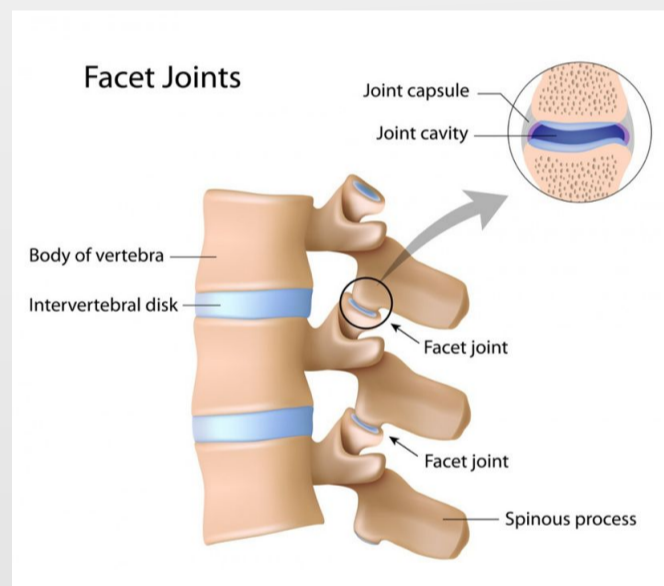
Anatomy

- The spinal / vertebral column provides both structural and nervous system support for your entire body.
- It holds the body upright, allows it to bend and twist with ease and provides a conduit for major nerves running from the brain to the tips of the toes and everywhere in between.
- Double S shaped
- **Can be divided into :**
 1. **Cervical spine:** C1-C7, C1 (Atlas), C2 (Axis)
 2. **Thoracic spine :** T1-T12
 3. **Lumbar spine :** L1-L5
 4. **Sacrum**
 5. **Coccyx**



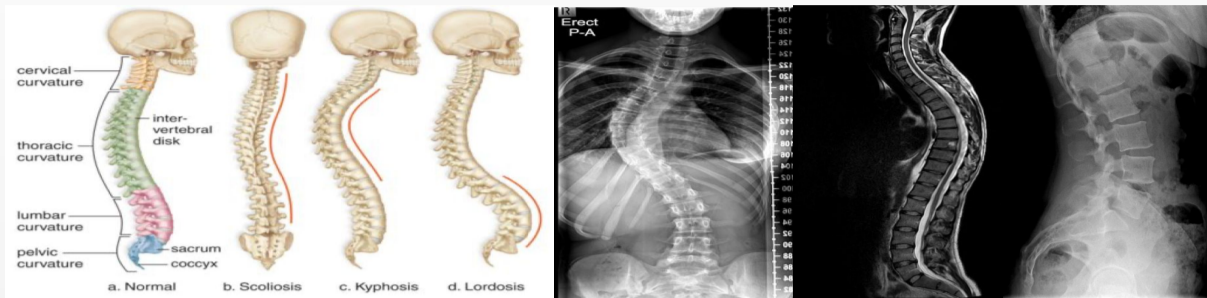
» Spine movement enablers and stabilizers

- **Intervertebral Discs :** Each disc is similar to a fibrous pad of tissue (called fibrocartilage) and anchored in place by vertebral endplates (called cartilaginous endplates) starting at C3 through L5-sacrum. These discs act as interbody spacers and shock absorbers.
- **Facet Joints :** paired (left, right sides) at the back of each vertebral body (C3-L5). Helps stabilize the spine while allowing flexion (bending forward), extension (bending backward) and twisting movement (called articulation).
- **Ligaments :** Ligaments are fibrous bands or sheets of connective tissue linking two or more bones, cartilages, or structures together. One or more ligaments provide stability to a joint during rest and movement. Excessive movements such as hyper-extension or hyper-flexion, may be restricted by ligaments.
- **Muscles :** Varies according to different segments of the vertebral column. further categorized according function such as flexion, extension, or rotation. Muscles and ligaments work together to support the spine, hold it upright, and control movement during rest and activity.



Imaging methods

» Spinal curvature



» Plain X-RAY film



- Bones
- Often the first diagnostic imaging test
- quick and cheap.
- Small dose of radiation to visualize the bony parts of the spine.
- **Can detect :**
 1. Spinal alignment and curvature (scoliosis, kyphosis)
 2. Spinal instability - with flexion and extension views
 3. Congenital defects of spinal column
 4. Fractures caused by trauma
 5. Moderate osteoporosis (loss of calcium from the bone)
Usually osteoporosis diagnosed with dexa, but these all as initial.
 6. Infections
 7. Tumors



» Computed tomography (CT)



- Uses radiation
- Obtain 2D images
- can be processed to 3D images.
- Patients lies on a table that moves through a scanner.
- Much detailed information regarding bony structures.
- Limited information about spinal cord and soft tissues.
- **Contraindicated in pregnant women and children.**
- **Might need IV or intrathecal contrast for some areas**

Better in visualizing :

1. Degenerative or aging changes, herniated disks **MRI is better**
2. Spinal alignment **MRI is better**
3. **Fractures and fracture patterns** The main indication for CT
4. Congenital / childhood anomalies especially anomalies of BONE e.g. fusion anomaly
5. Narrowing in spinal canal e.g. spinal stenosis.

CT disadvantages:

- Expensive
- Radiation

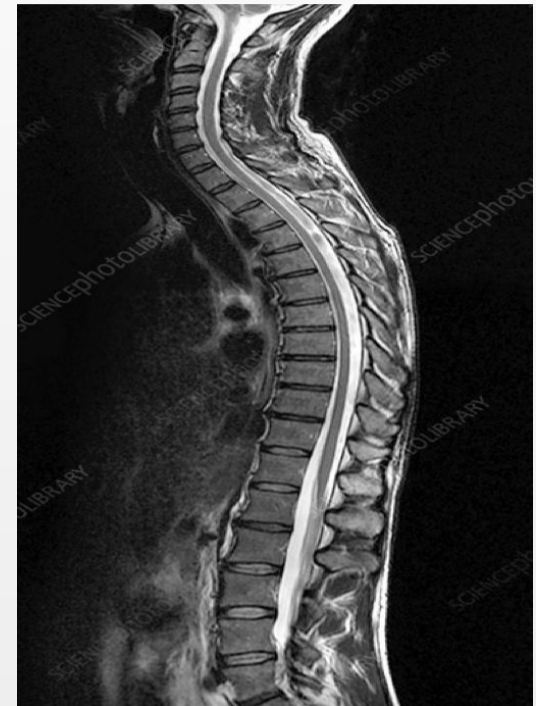


Imaging methods

➤ Magnetic resonance imaging (MRI)



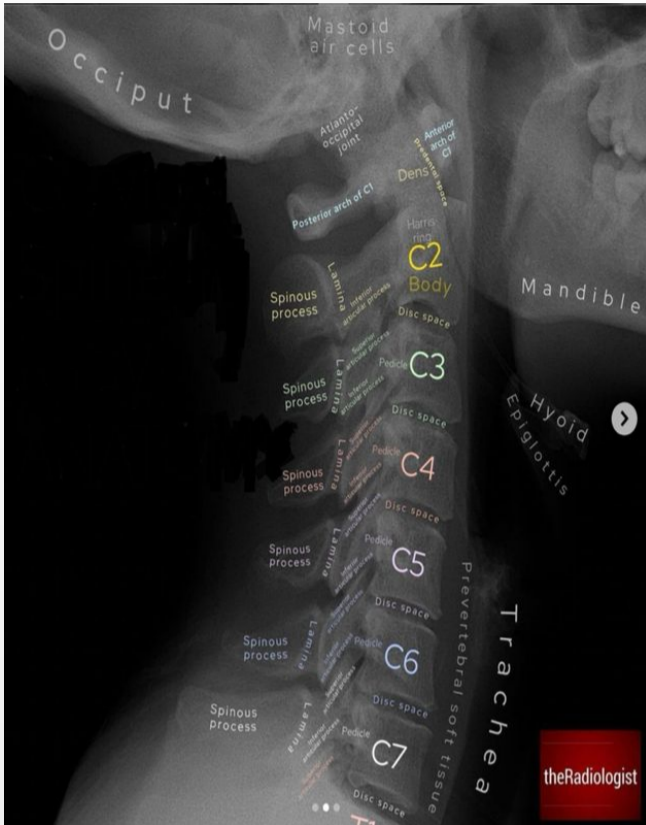
- **Gold standard** of imaging for spinal disorders.
- Does not use ionizing radiation safe in pregnancy (without contrast) and children.
- Can identify abnormalities of bone, discs, muscles, ligaments, and spinal cord.
- Intravenous contrast is sometimes administered to better to better visualize certain structures or abnormalities eg: infection, tumor but normally we do not use contrast.
- Patient lies still in a tunnel like structure for about 25 minutes.
- Images are multi planar and high resolution.
- Open/closed (open MRI is less helpful and not enough to conduct open surgery)
- If there is narrowing of the spinal canal suspect spinal cord injury
- MRI disadvantages: 1) Expensive 2) Time consuming



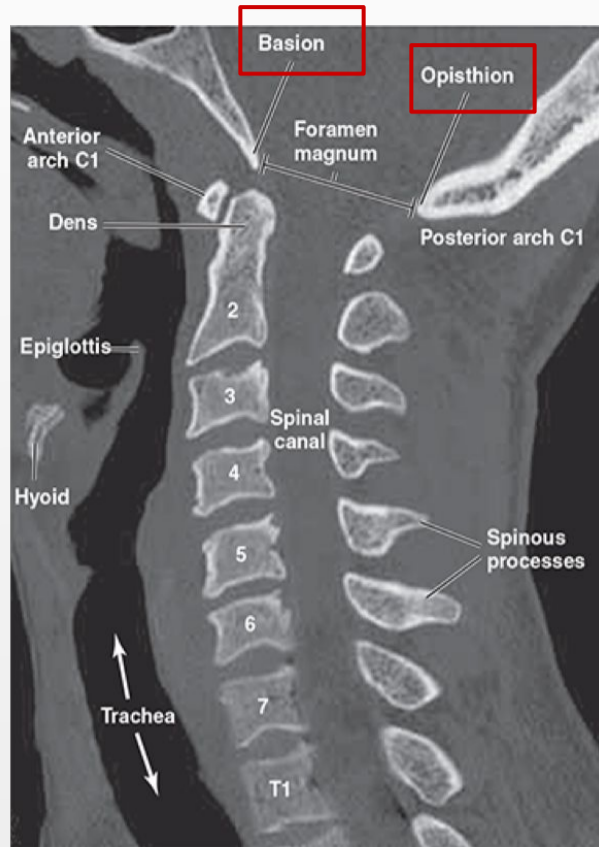
➤ Other modalities

Myelogram For spinal canal imaging	Contrast material injected into CSF to better identify areas where spinal cord or spinal nerves may be compressed.
Spinal angiography	To evaluate arteries and veins
Ultrasound For neonates (first modality)	Pediatric
Radionucleotide bone scan	Intravenous injection of radioactive material bound to phosphonates which deposit in bones, followed by images by gamma camera.
DEXA For bone density	Radionuclide scan for bone density (osteoporosis).

» Cervical spine



Lateral X Ray



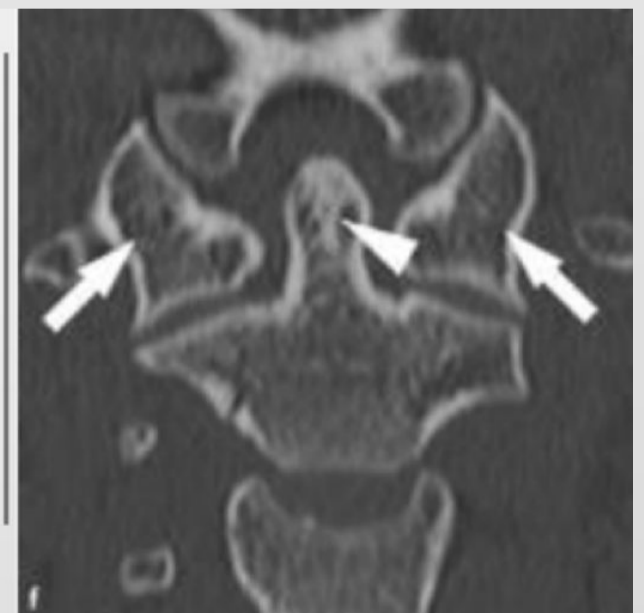
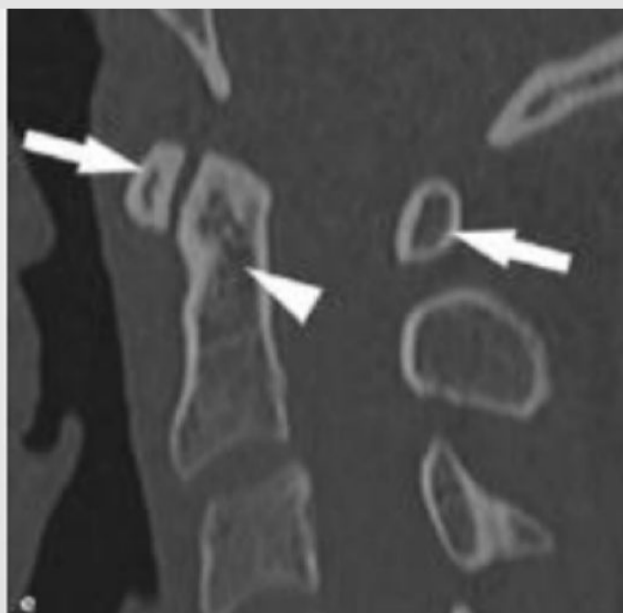
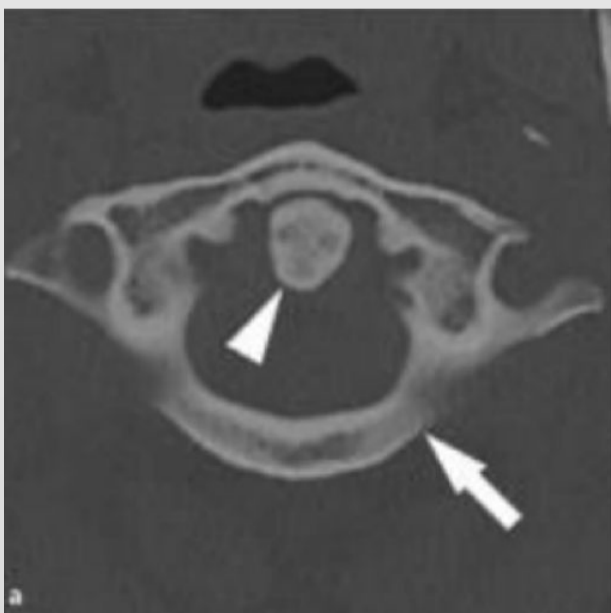
CT sagittal



MRI sagittal T2

» CRANIOCERVICAL JUNCTION

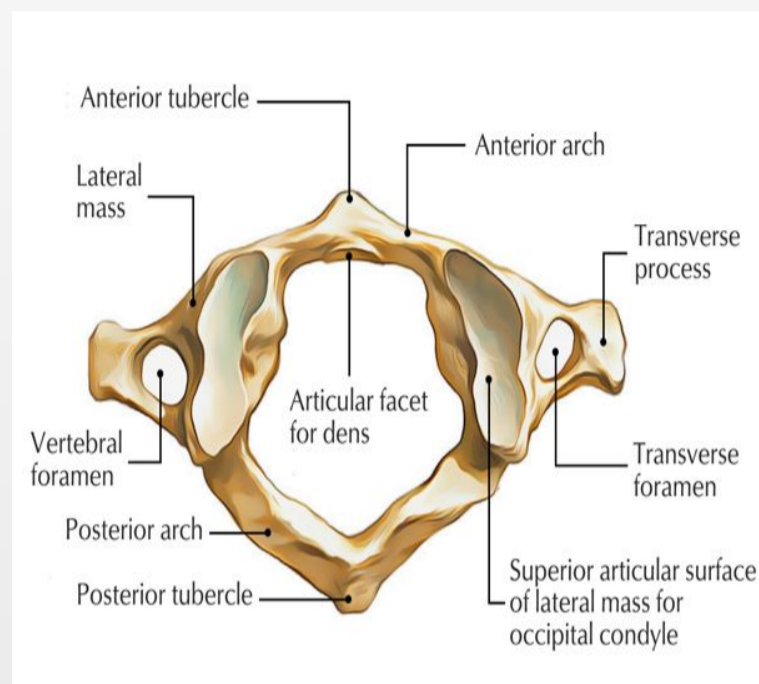
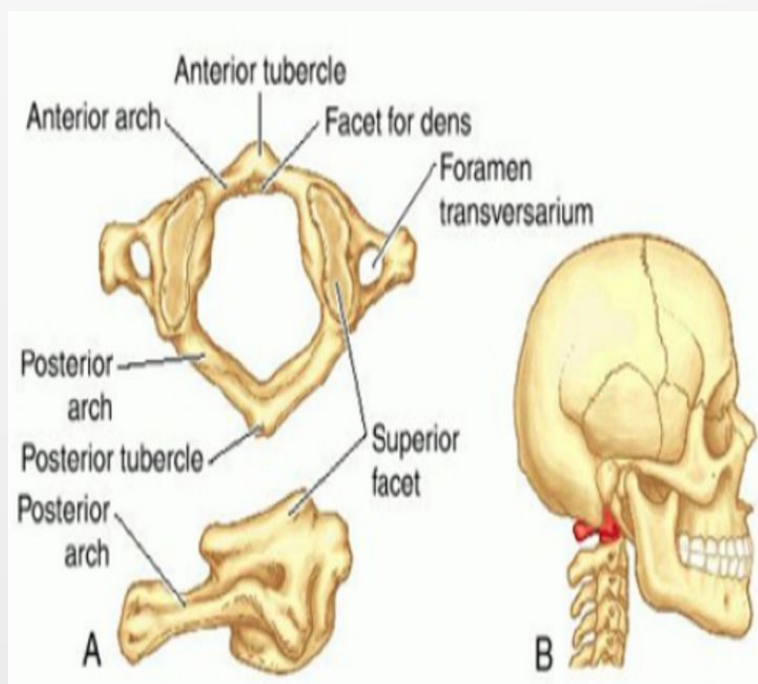
- The Craniocervical junction (CCJ) is comprised of the inferior surface of the skull, the atlas and axis, as well as muscles and connective tissues that attach the skull to the cervical spine.
- The CCJ encloses the central nervous system (CNS), encephalic vasculature and the cerebrospinal fluid (CSF) system.
- Two major joints: the atlanto-occipital joint and the atlanto-axial joint



» C1 (ATLAS)

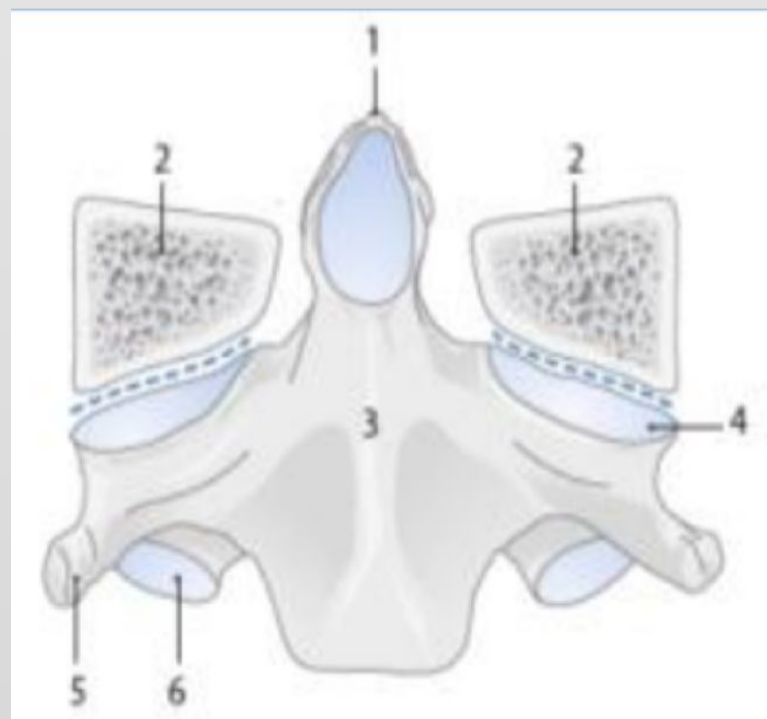
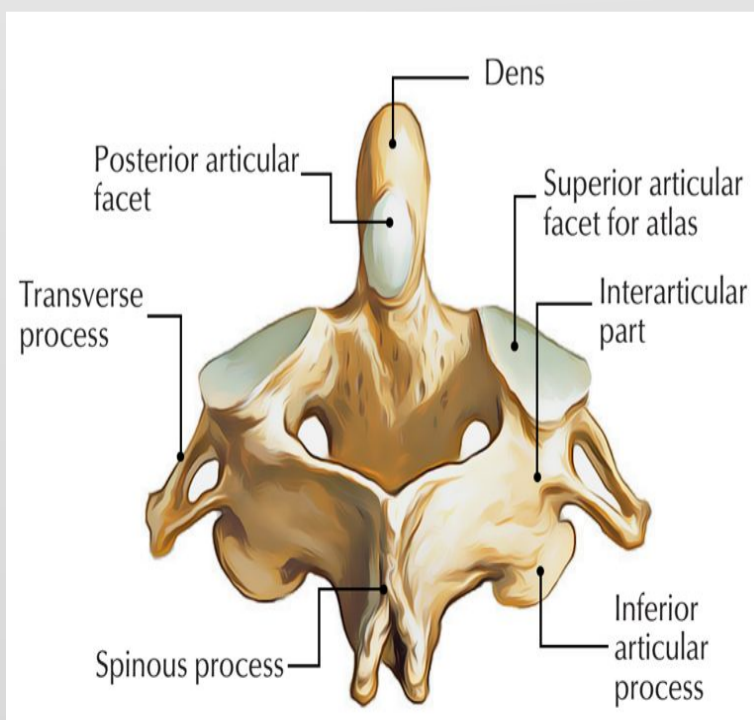


- Ring shaped
- Atlas was the primordial titan who supported the heavens.
- Anterior arch, posterior arch, and 2 bulky lateral masses.
- It plays vital roles in the support of the skull, spinal cord, and vertebral arteries and provides attachment points for several muscles of the neck .

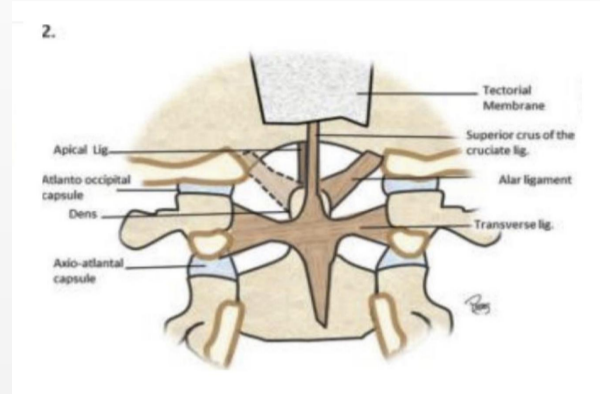
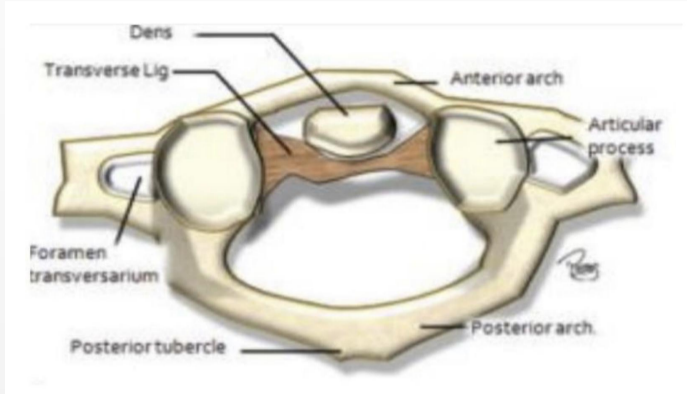


» C2 (axis)

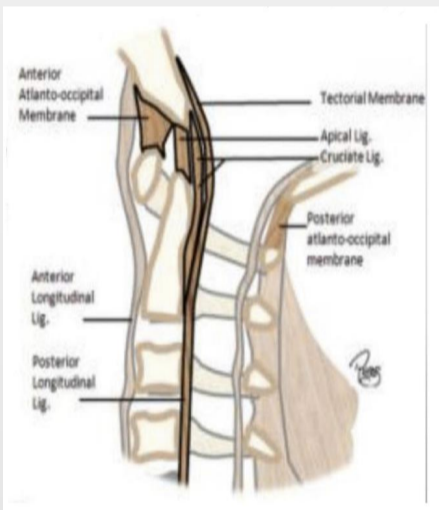
- It is unique in that it contains the odontoid process(also known as odontoid peg and dens) - odontoid means “tooth” and that is what this bone looks like.
- It forms a pivot point on which C1 atlas can rotate.
- Injuries to the odontoid are common in motor vehicle accidents and falls.



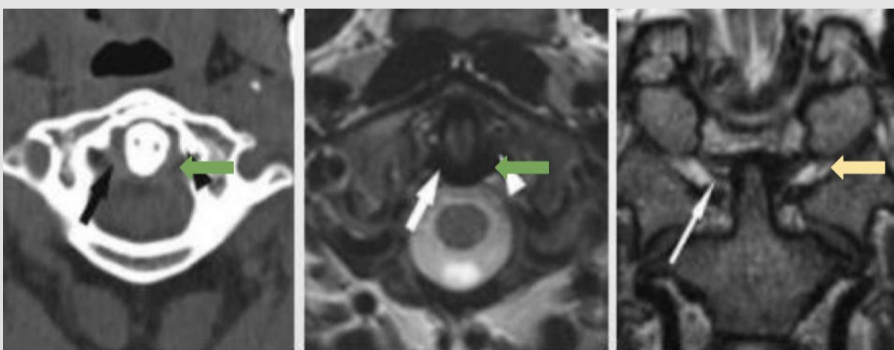
➤ Ligamentous anatomy of craniocervical junction (C1, C2):



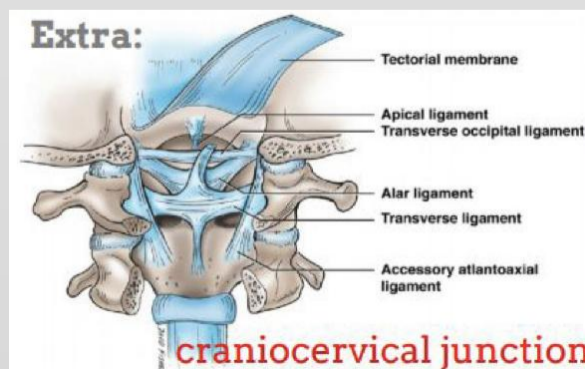
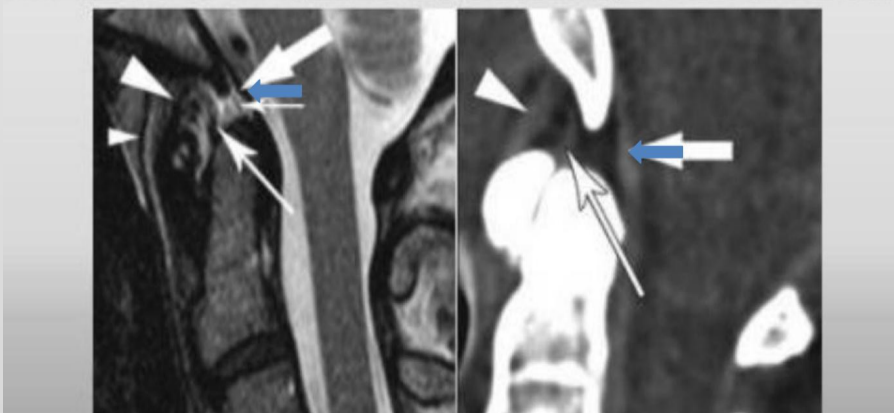
- Posterior to the Dens is the transverse ligament which is attached on either side to a small tubercle on the medial surface of the lateral mass of the Atlas.
- The anterior atlanto-occipital membrane is a thin membrane that joins the upper border of the anterior arch of the atlas (C1) to the anterior inferior surface of the foramen magnum. It is a continuation of the anterior longitudinal ligament above the C1 level. It is immediately posterior to the prevertebral muscles.



- Apical ligament connects the tip the odontoid process with the anterior margin of foramen magnum. Posterior to it lies the cruciate ligament from anterior margin of the foramen magnum to the posterior aspect of c2. And posterior to that lies the tectorial membrane from the anterior margin of foramen magnum to c2 and its continuation called the posterior longitudinal ligament
- Posteriorly we have posterior atlanto-occipital membrane, its continuation called posterior ligamentum flavum
- Lateral masses of c1 and c2 should be aligned, if not you may suspect fracture.
- The vertebral artery passes through foramen transversarium, so if you have fracture along the foramen transversarium you should do vascular imaging to detect any injury to the vertebral artery.

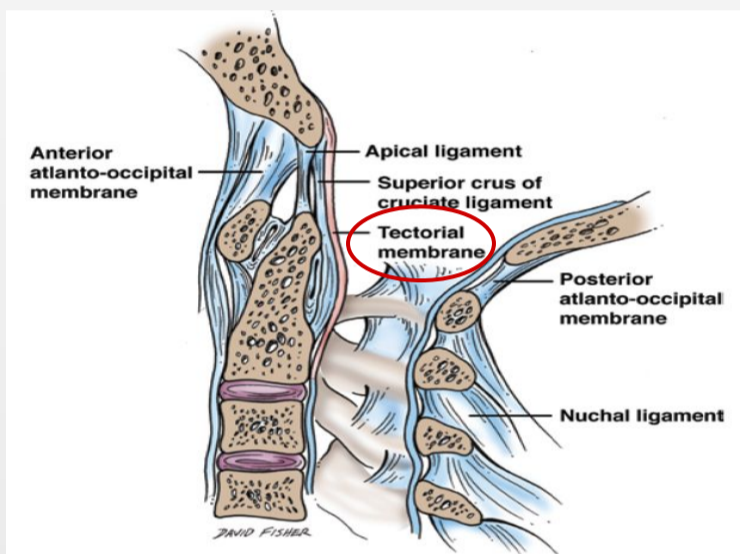


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Yellow: Alar ligament
Green: Transverse ligament
Blue: Tectorial ligament ★

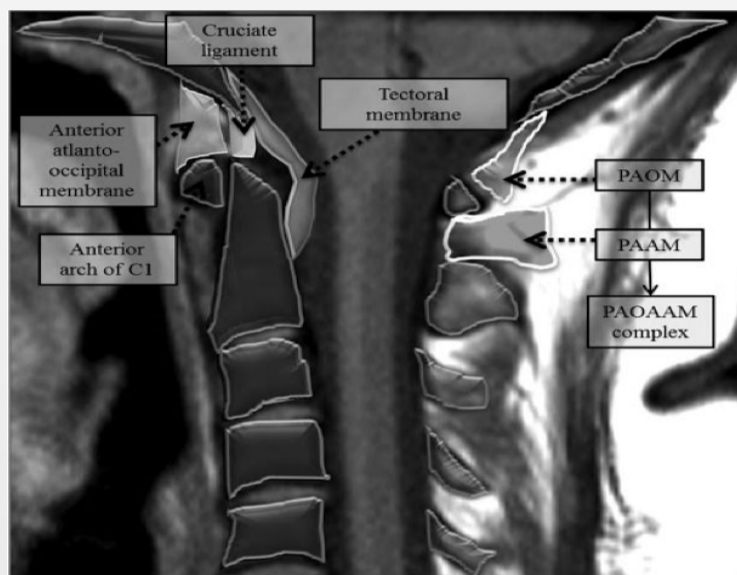


» CRANIOCERVICAL JUNCTION LIGAMENTS

- Anterior atlanto occipital membrane
- Posterior atlanto-occipital membrane
- Apical ligament
- **Tectorial ligament** (If the patient fall on their head this is the first ligament to check)
- Nuchal ligament (ligamentum nuchae)
- Cruciform ligament (cruciate)
- Alar ligaments
- Transverse ligament



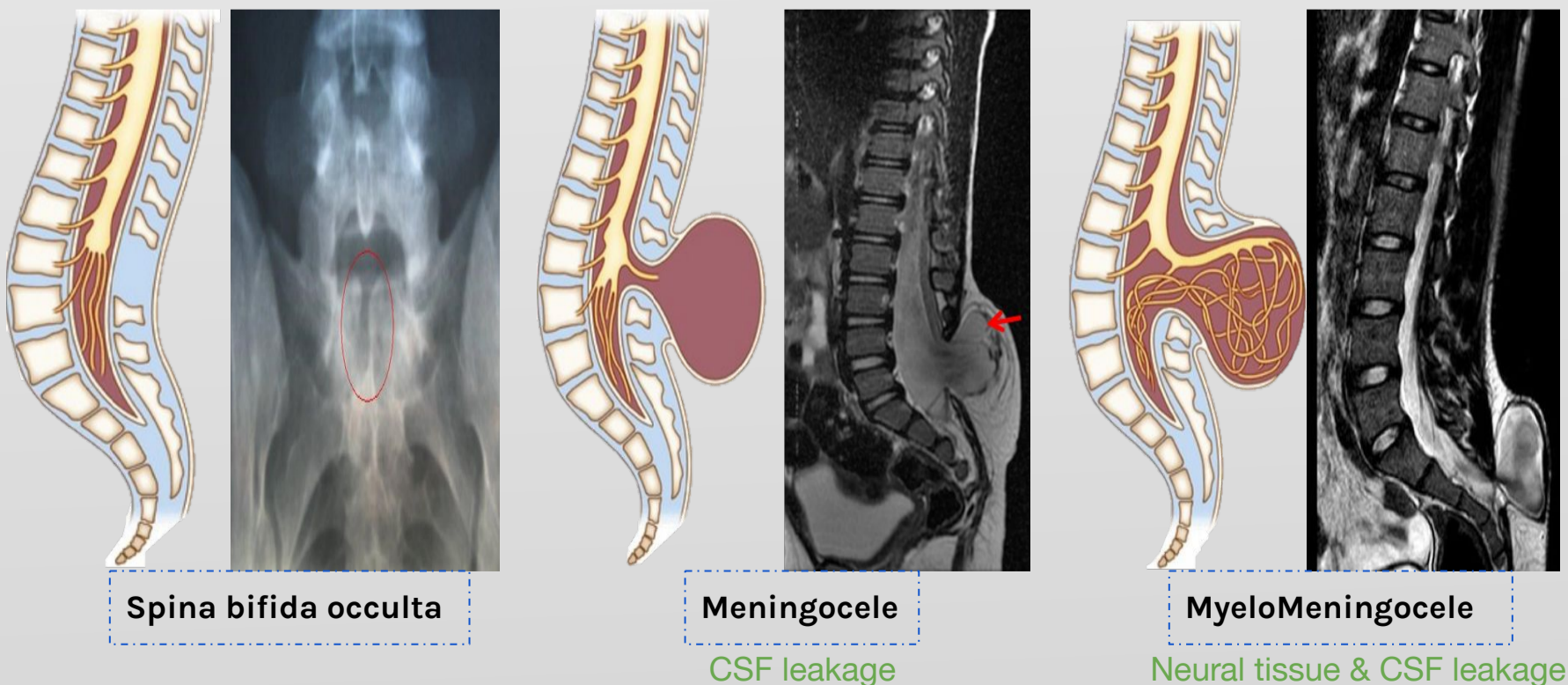
Sagittal drawing of the neck and cranial base depicting the various specialized ligaments of the CCJ region



Abnormalities

» CONGENITAL ANOMALIES

- MRI is the best to assess the contents of the cavity, extent of abnormalities, and spinal cord.
- CT shows bony structures the best and is often used before surgery
- **If the patient has bony defect and soft tissue swelling so the best way to assess it is using MRI, allow you to assess the content of the cavity**



Spina bifida occulta

Meningocele

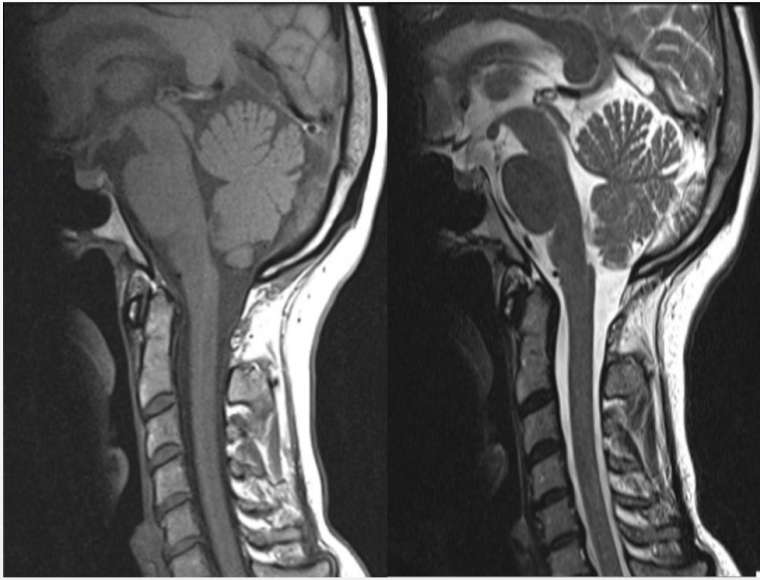
CSF leakage

MyeloMeningocele

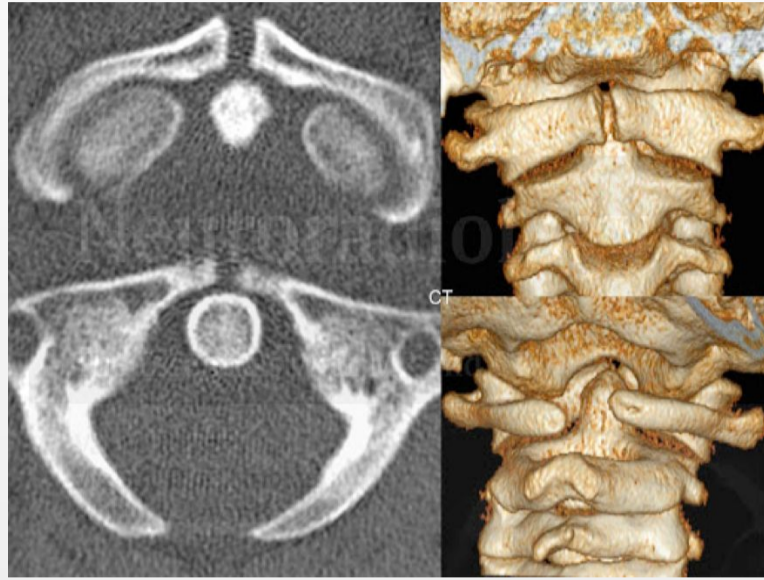
Neural tissue & CSF leakage

Abnormalities

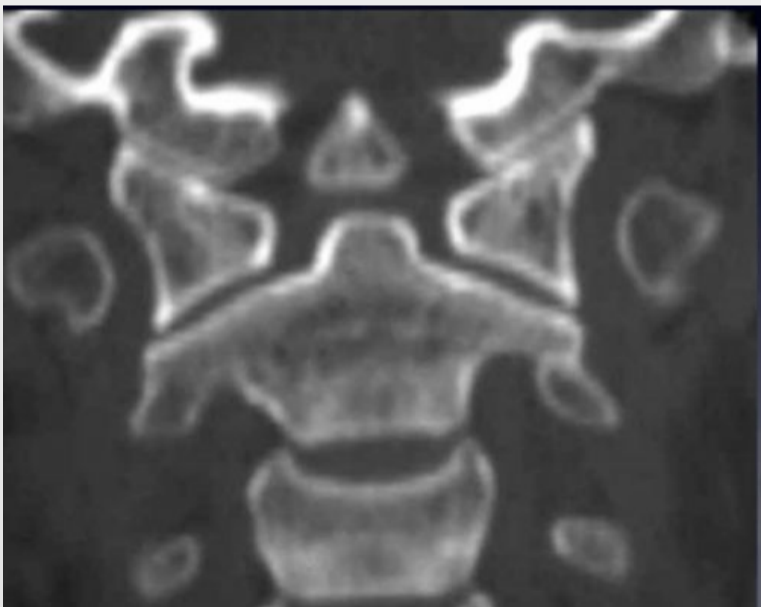
» CONGENITAL ANOMALIES - continued



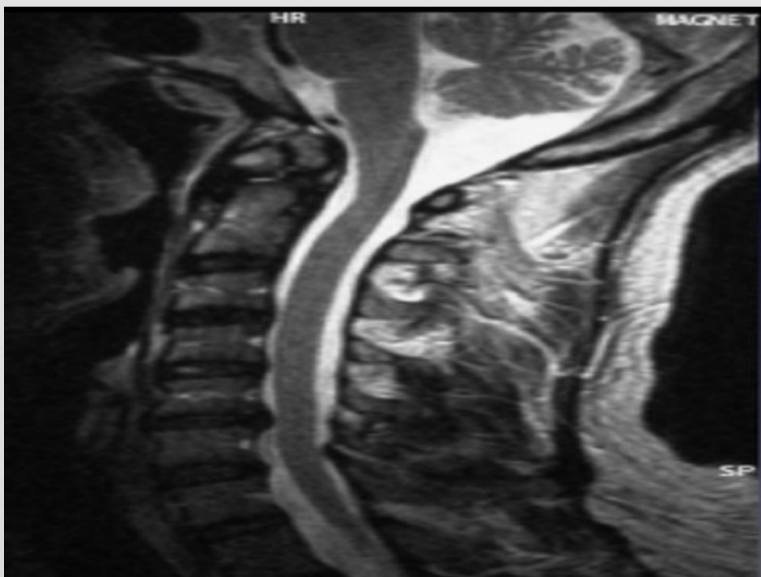
Spina bifida occulta at C1



Anterior and posterior fusion defects of C1



How to differentiate between odontoid fusion defect and fracture? The fusion defect usually well corticated bone and it considered normal variation.

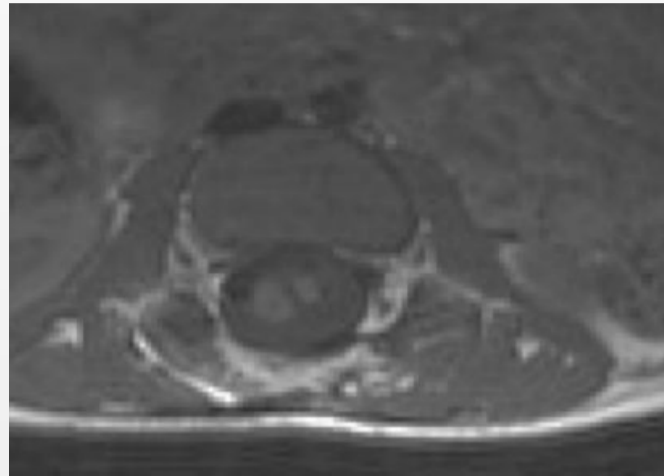
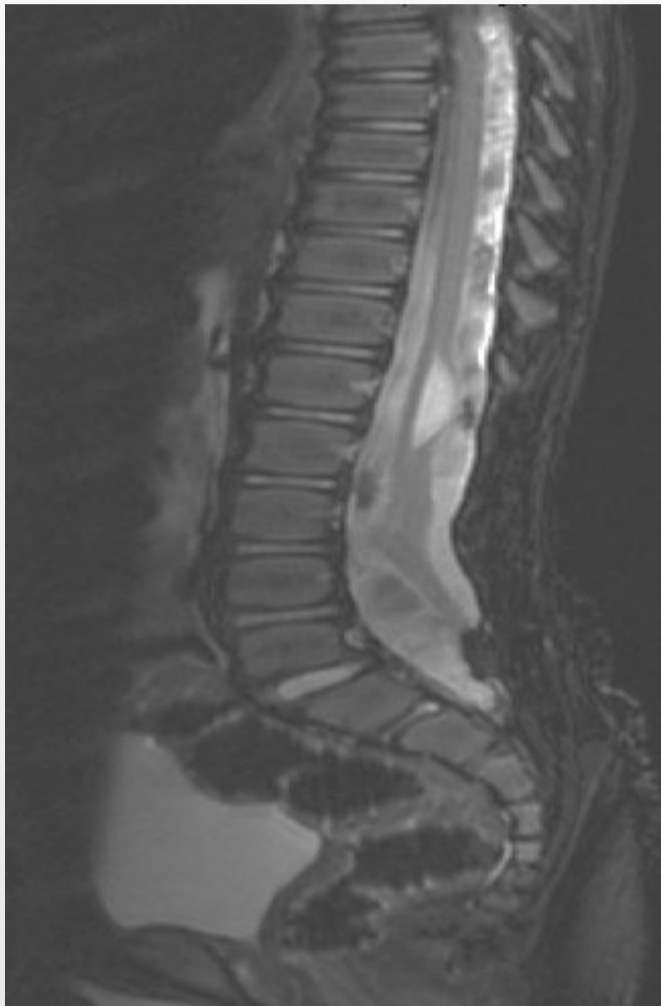


Os odontoideum

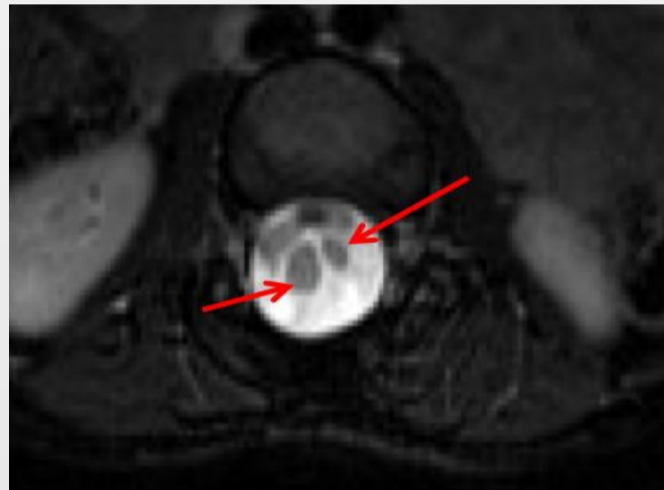
Abnormalities

» CONGENITAL ANOMALIES - continued

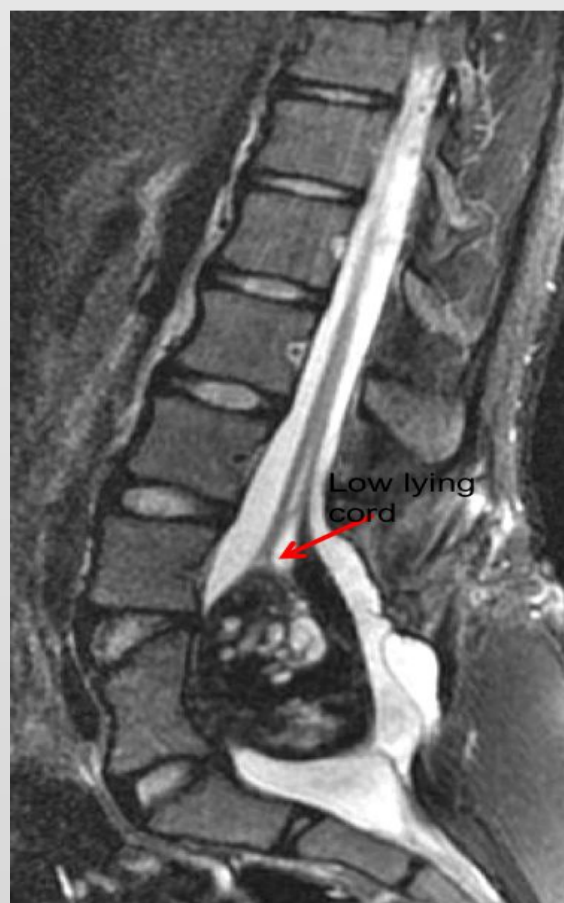
Split low lying cord (Diastematomyelia)



Two focal splittings of the core (two hemi-cores)



Low lying cord tethered to large lipoma



Trauma

TRAUMA

ASSESSMENT OF LATERAL C-SPINE XRAY

1. Is the film adequate?

It should cover the base of skull superiorly and the C7-T1 disc space inferiorly

If not, the C-spine cannot be cleared

2. Is there prevertebral soft tissue swelling?

Look for swelling more than 7 mm above C4 and 21 mm below this point

Swelling suggests an acute fracture or significant dislocation

Naso-pharyngeal space (3mm)

Retro-pharyngeal space (7mm)

Retro-tracheal space (21mm)

3. Assess these three lines

Draw in and follow these three lines making sure they are continuous - if not consider fracture, dislocation or ligament damage

Spino-laminar line
Draw points between the spinous processes and lamina and join these up

Posterior longitudinal line
Join up the posterior cortices of the vertebrae

Anterior longitudinal line
Join up the anterior cortices of the vertebrae

Atlanto-occipital joint
Anterior arch of C1
Posterior arch of C1
DENS
Pre-vertebral space
Spinous process
Lamina
Body of C2

4. Assess C1 and C2 including predental space

Outline the body of C2 and its superior projection, the dens

C1 has no vertebral body - assess its anterior and posterior arches and its communication with the occipital condyles (atlanto-occipital joint)

Assess the predental space - the distance between the dens and anterior arch of C1 - this should be no more than 3 mm in adults

**Q\ What is the normal predental space?
3-5 mm**

Anterior arch of C1
DENS
Harris' ring
C2

5. Assess Harris' ring

Identify a white ring within the body of C2 - 'Harris' ring'

This is a composite shadow formed by the lateral masses of C2

The inferior aspect is allowed to be slightly deficient but otherwise discontinuity of the ring suggests a fracture of C2

Spinous process
Spinous process
Interspinous distance
Spinous process
Spinous process

6. Assess spinous processes

Outline each of the spinous processes

Assess each interspinous distance - a marked increase in a single distance is a sign of an anterior dislocation

Vertebral body
Disc space
Vertebral body
Disc space

7. Assess remaining vertebral bodies and disc spaces

Outline each vertebral body - assess for loss of height that may represent a compression fracture and for small fragments that may represent avulsion

Mastoid air cells
Occipital bone
Mandible

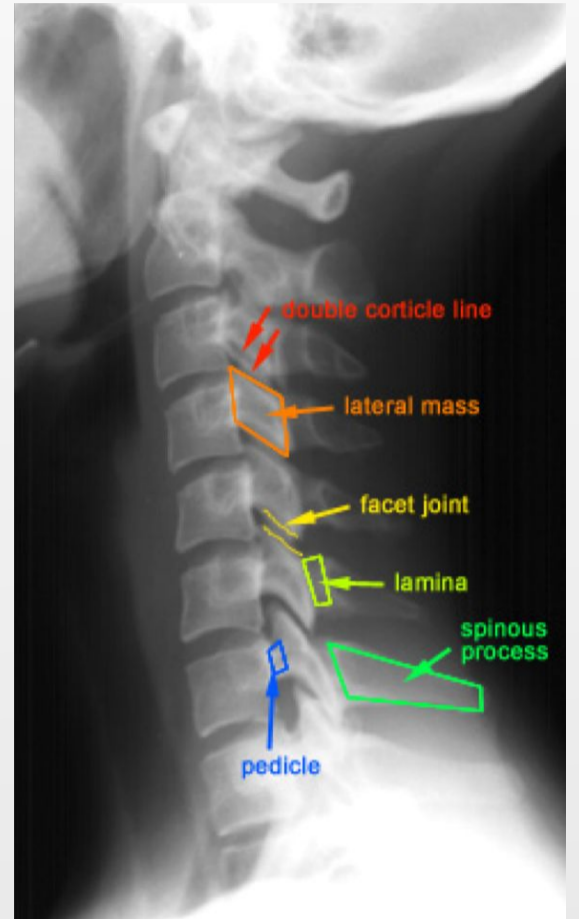
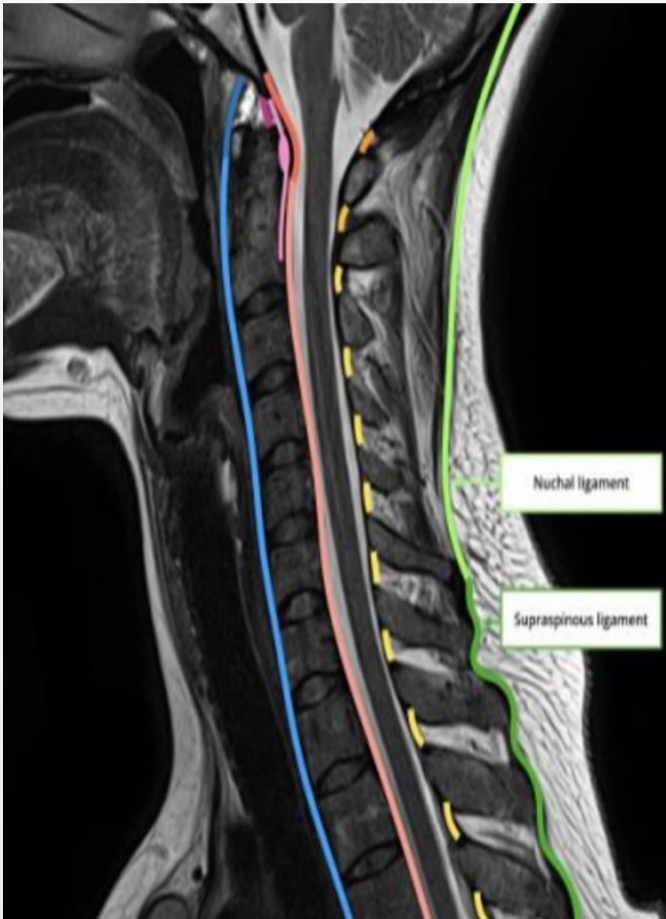
8. Assess for further fracture

Check the occipital bone and mandible for fracture and check the mastoid air cells for a fluid level

Trauma

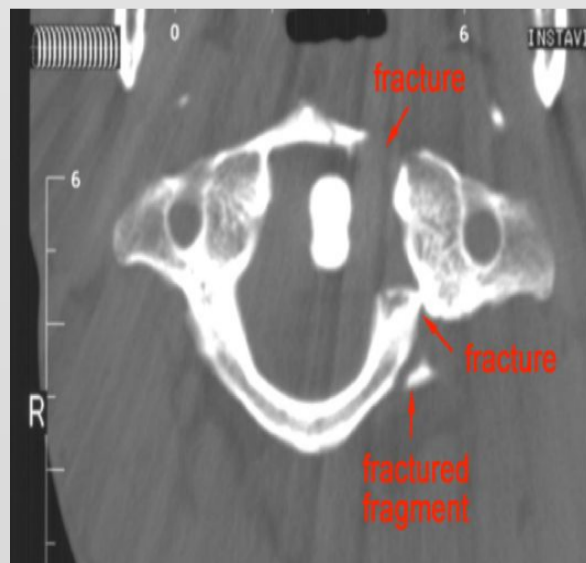
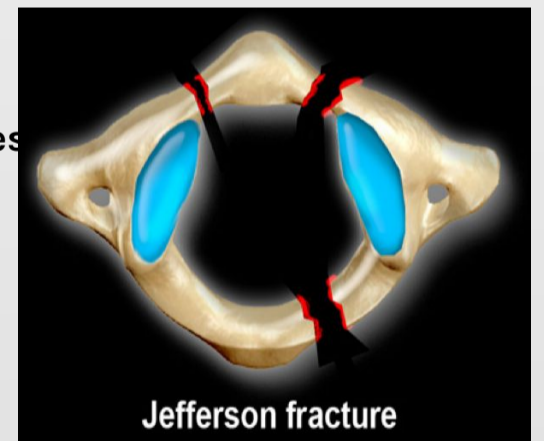
» TRAUMA

» ASSESSMENT OF LATERAL C-SPINE XRAY - continued



» Fractures (JEFFERSON)

- A burst type fracture of C1 due to axial loading with fractures occurring through both the posterior and anterior arches.
- Typically seen in motor accidents.
- A typical mechanism of injury is diving headfirst into shallow water.
- Axial CT clearly shows the location of the fractures of C1

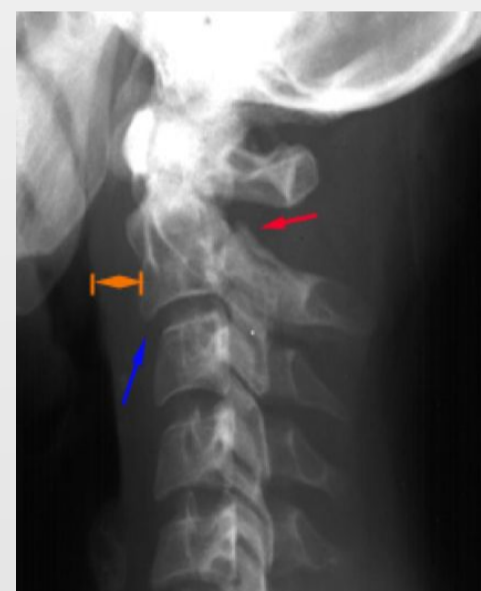
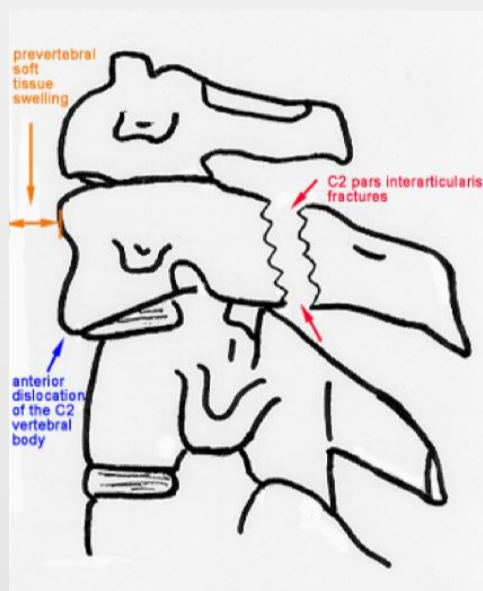
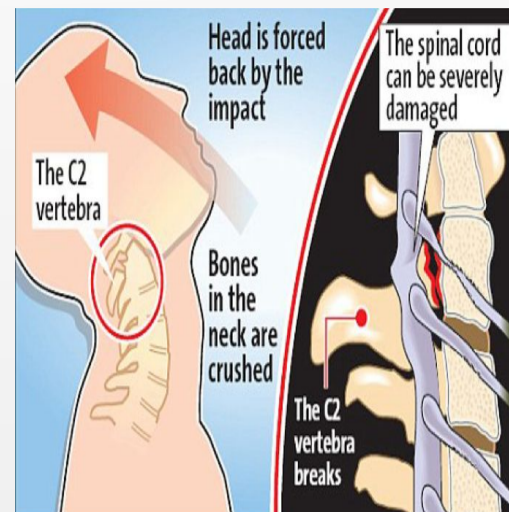


Trauma

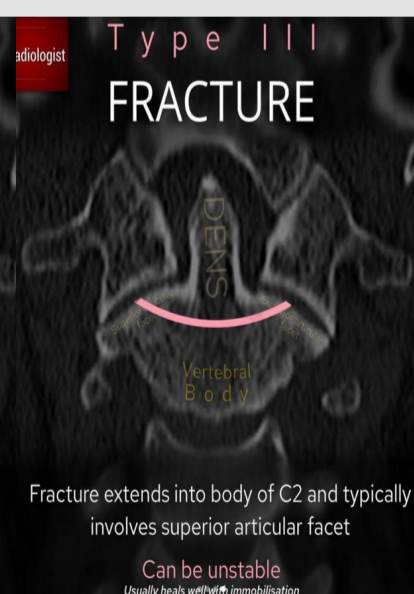
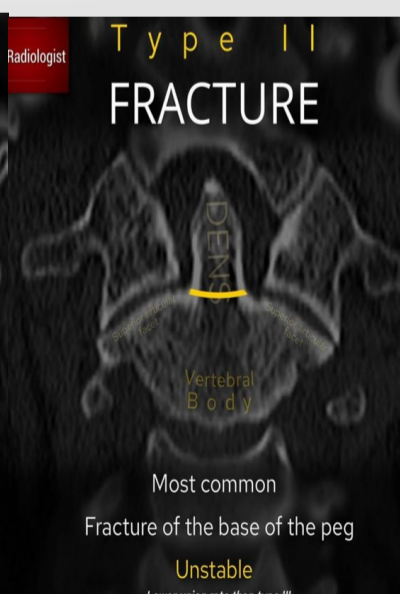
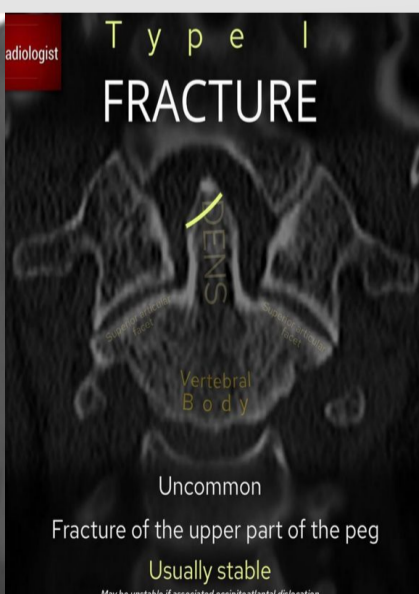
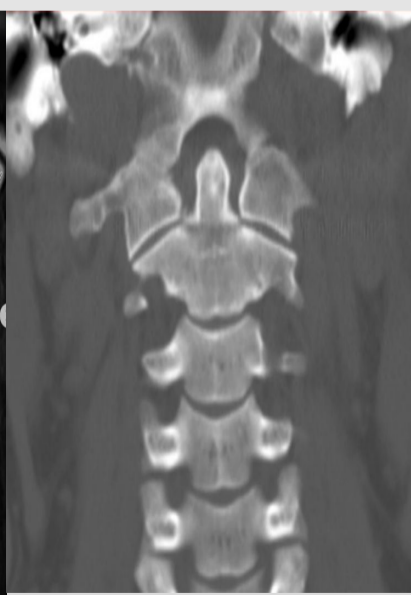
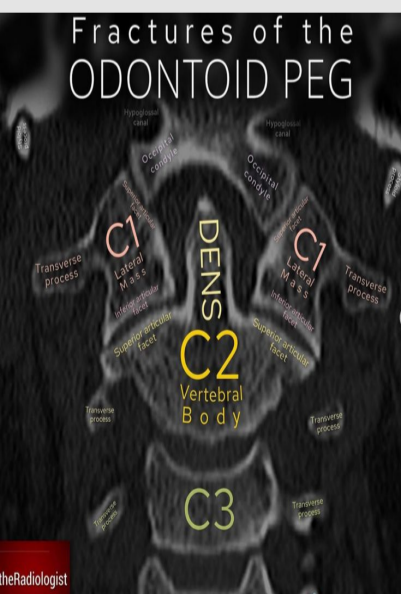
» TRAUMA

» Fractures (HANGMAN'S)

- Also known as traumatic spondylolisthesis of the axis, is a fracture which involves the pars interarticularis of C2 on both sides, and is a result of hyperextension (e.g. hanging, chin hits dashboard in road accident) and distraction.
- Radiographic Features (Best seen in lateral view):
 1. Prevertebral soft tissue swelling.
 2. Avulsion of anterior inferior corner of C2
 3. Associated with rupture of anterior longitudinal ligament.
 4. Anterior dislocation of C2 vertebral body.
 5. Bilateral C2 pars interarticularis fractures



» Fractures (DENS/ODONTOID)



Trauma

» TRAUMA

» Fractures (COMPRESSION AKA: WEDGE FRACTURES)

- They are hyperflexion injuries to the vertebral body resulting from axial loading.
- Most commonly affecting the anterior aspect of the vertebral body
- wedge fractures are considered a single-column (i.e. stable) fracture.
- Differential Diagnosis : Burst Fracture: fracture of the anterior and posterior vertebral body (i.e. two- column injury)



★ Fractures (BURST)

- A type of compression fracture related to high- energy axial loading spinal trauma that results in disruption of the posterior vertebral body cortex with retropulsion into the spinal canal.

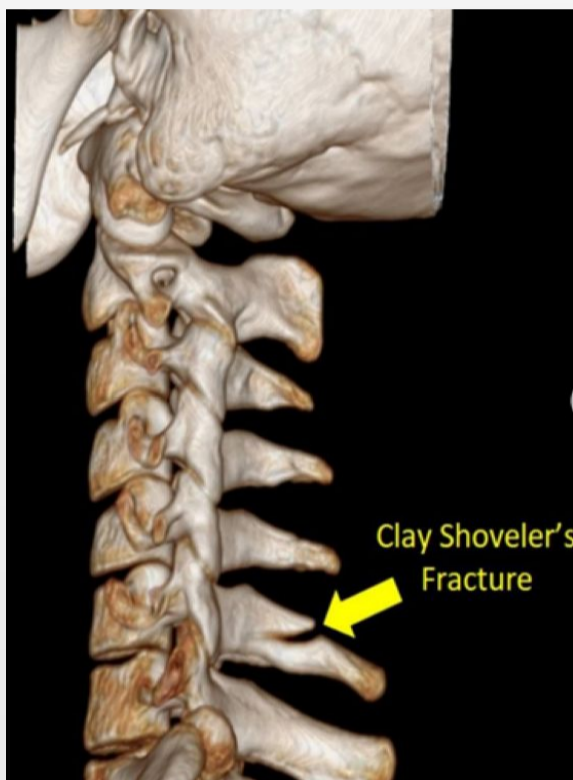


Trauma

» TRAUMA

» Fractures (CLAY-SHOVLER'S)

- Fractures of the spinous process of a lower cervical vertebra, usually C7.
- Acutely they tend to be associated with :
 1. motor vehicle accidents
 2. sudden muscle contraction
 3. direct blows to the spine



» Fractures (CHANCE)

- Chance fractures, also referred to as seatbelt fractures, are flexion- distraction type injuries of the spine that extend to involve all three spinal columns. These are unstable injuries and have a high association with intra- abdominal injuries.
- Imaging Differential Diagnosis : Vertebral burst fracture.

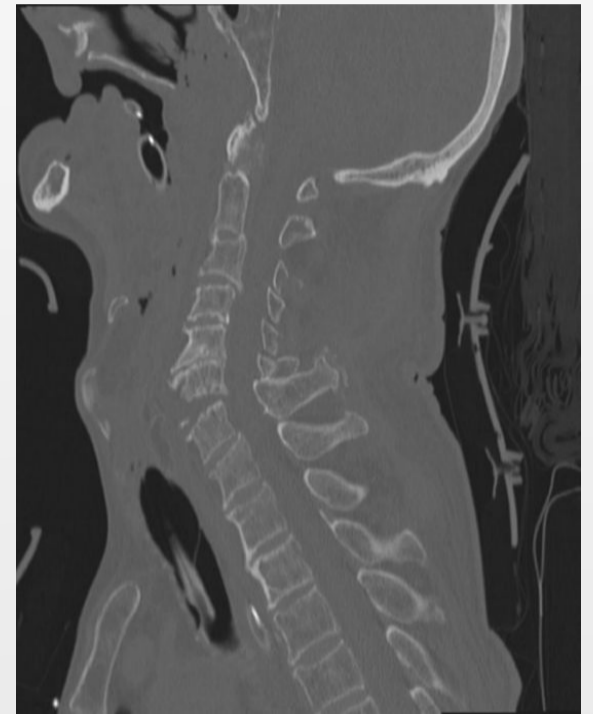
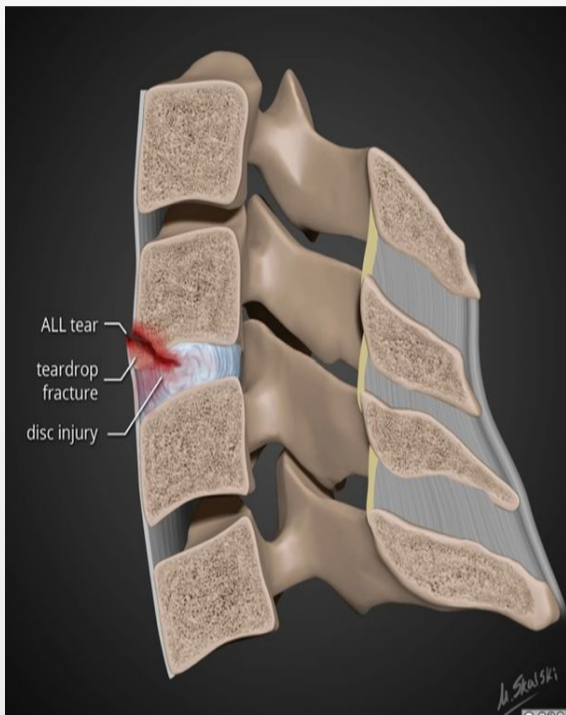


Trauma

» TRAUMA

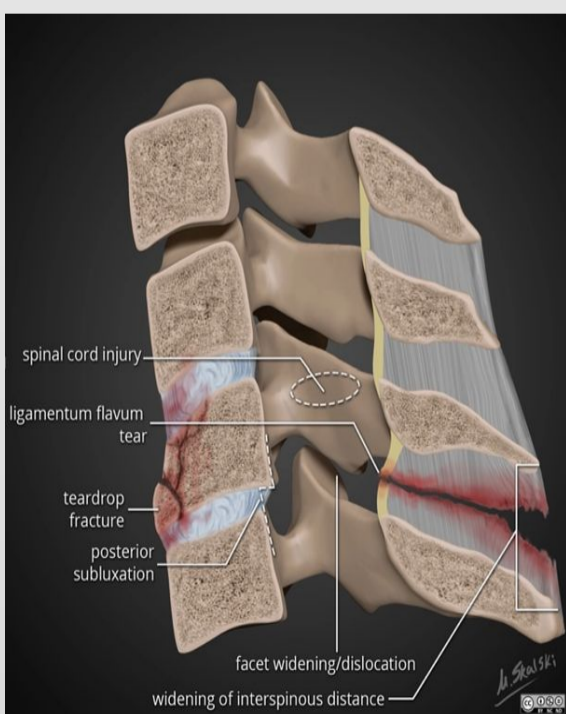
» Fractures (TEAR DROP “EXTENSION”)

- They occur due to forces extension of the neck (i.e. is a hyperextension injury) with resulting avulsion of the anteroinferior corner of the vertebral body.
- Stable in flexion and unstable in extension as the anterior longitudinal ligament.



» Fractures (TEAR DROP “FLEXION”)

- The injury typically occurs from severe flexion and compression forces (e.g. diving impact, deceleration during motor vehicle collision).
- Extensive underlying ligamentous injury and spinal instability.
- Associated spinal cord injury is common.
- More severe than extension teardrop.



Infections

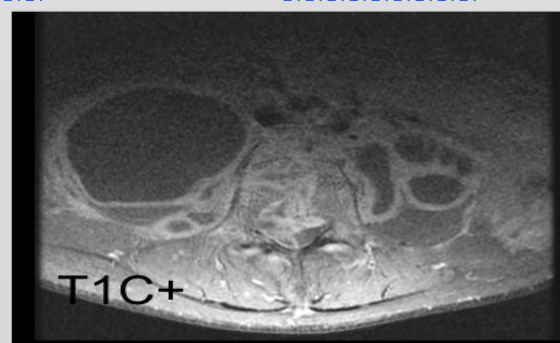
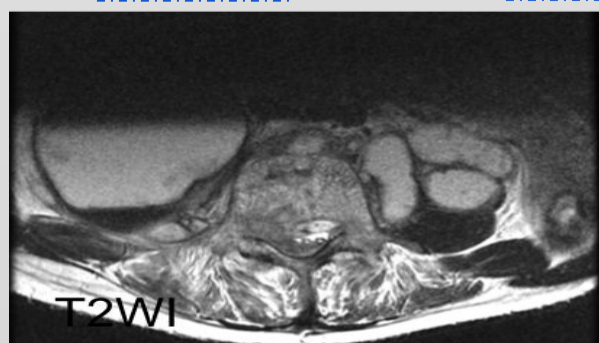
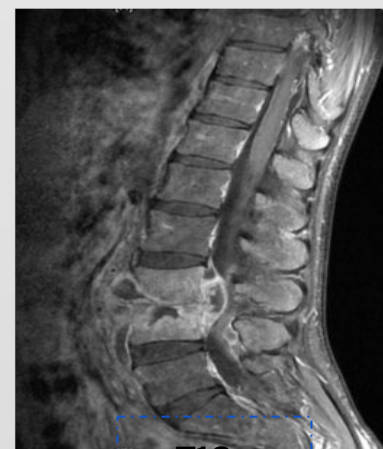
» INFECTIONS

» SPONDYLODISCITIS

- Also referred to as discitis-osteomyelitis, is characterized by infection involving the intervertebral disc and adjacent vertebrae.
- Usually the result of blood-borne agents :
 1. Staphylococcus (More common)
 2. Streptococcus (Less common)
 3. Gram-negative rods in IV drug abusers or immunocompromised patients
 4. Others : E. Coli, proteus, non-pyogenic, tuberculosis, brucellosis.
- May occur after invasive procedure like surgery, discography, myelography.
- In children, infection begins in vascularized disc.
- In adults, in anterior inferior corner of vertebral body with spread across disk to adjacent vertebral endplate.
- **PLAIN FILM :**
 - Narrowing and destruction of an intervertebral disk.
 - Indistinct adjacent endplates with destruction
 - Often associated with bony sclerosis of the two contiguous vertebral bodies
 - Paravertebral soft tissue mass
 - Endplate sclerosis (during healing phase beginning anywhere from 8 weeks to 8 months after onset)
 - Bone fusion after 6 months to 2 years.
- **MRI :**
 - Bone marrow edema in infected vertebrae, discs and paraspinal soft tissues.
 - Dark on T1 and bright on T2 images.
 - Enhancement of inflamed tissues after contrast.
 - Fluid collections (abscesses) are common.



Narrow and destruction of L3-L4 disc space with irregular erosions of opposing endplates

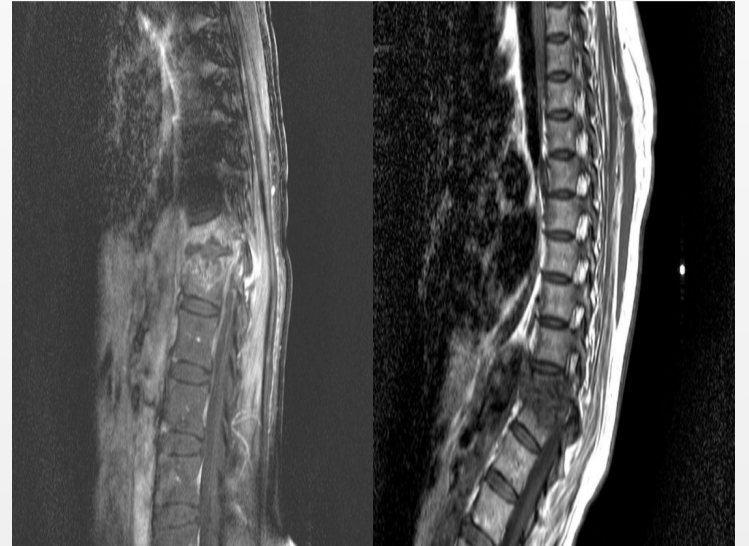


Infections

» INFECTIONS

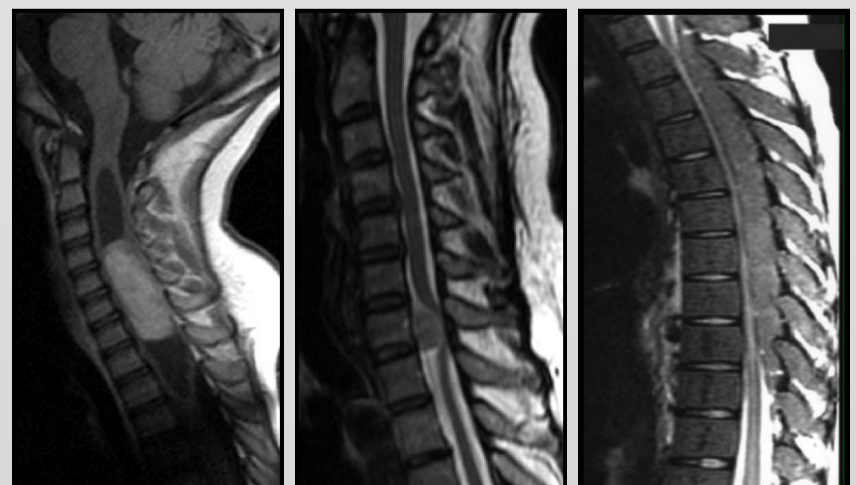
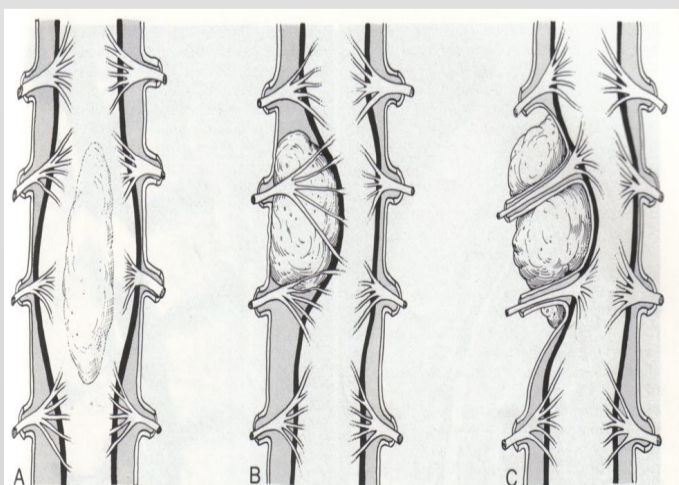
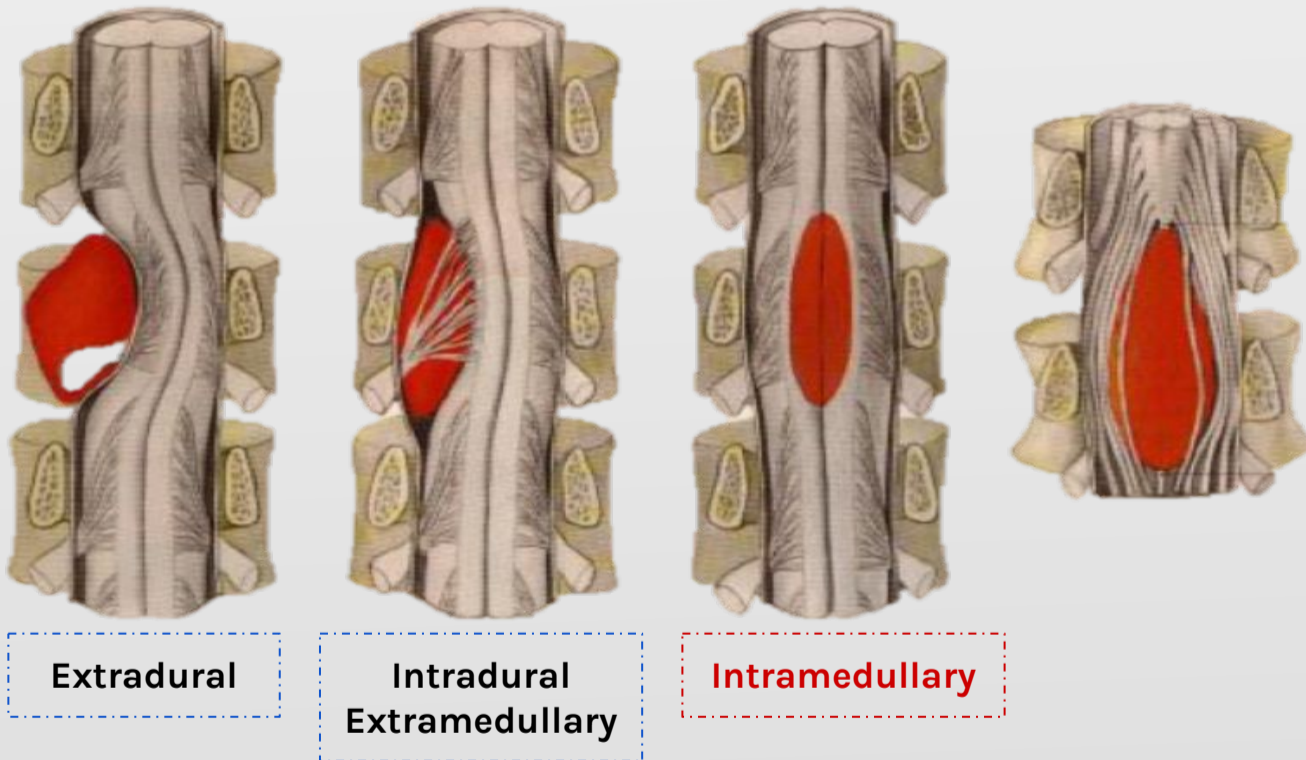
» TUBERCULOUS SPONDYLITIS (POTT DISEASE)

- Also known as Pott disease, refers to vertebral body osteomyelitis and intervertebral diskitis from tuberculosis (TB).
- The spine is the most frequent location of musculoskeletal tuberculosis, and commonly related symptoms are back pain and lower limb weakness/paraplegia.



Tumors

» Spinal compartments



Tumors

» TUMORS Q\ Mention intramedullary tumors?

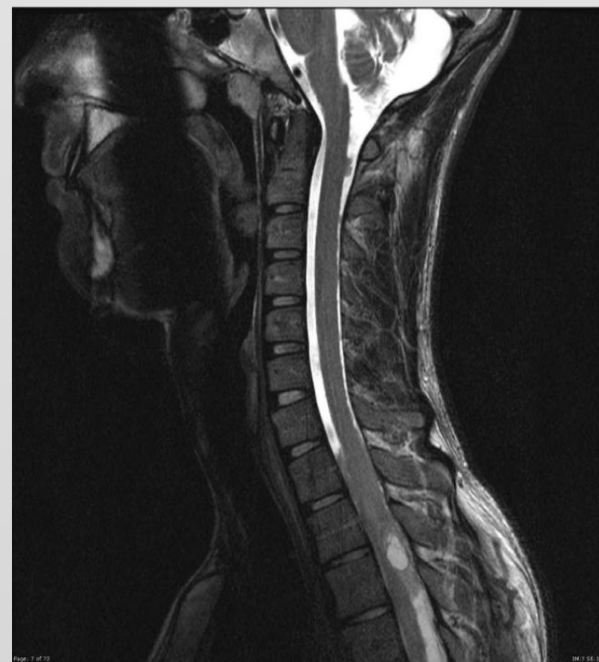
» EPENDYMOMA

- Most common spinal cord tumor
- Intramedullary
- Histological subtypes : Cellular, papillary, clear cell, tanycytic, melanotic
- They arise from the central canal, distribution is uneven with majority being within cervical cord.
- Best seen in sagittal images
- Adjacent Syrxinx extending above or below the tumor.
- Hemosiderin Cap : Due to bleeding of lesions



» ASTROCYTOMA

- Second most common spinal cord tumor.
- Intramedullary
- They arise from the cord parenchyma, they typically have an eccentric location within the spinal cord.



Tumors

» TUMORS

» SCHWANNOMA

- Most common nerve sheath tumor within the spinal canal.
- Intradural Extramedullary
- They arise from the spinal nerve roots.
- Frequently associated with hemorrhage, intrinsic vascular changes (thrombosis), cyst and fatty degeneration.



» IVORY VERTEBRA

- Most common cause of ivory vertebra in pediatric is Lymphoma.
- Most common cause of ivory vertebra in adults is metastatic disease.
- Fig 2 shows ivory vertebra due to metastatic prostate cancer



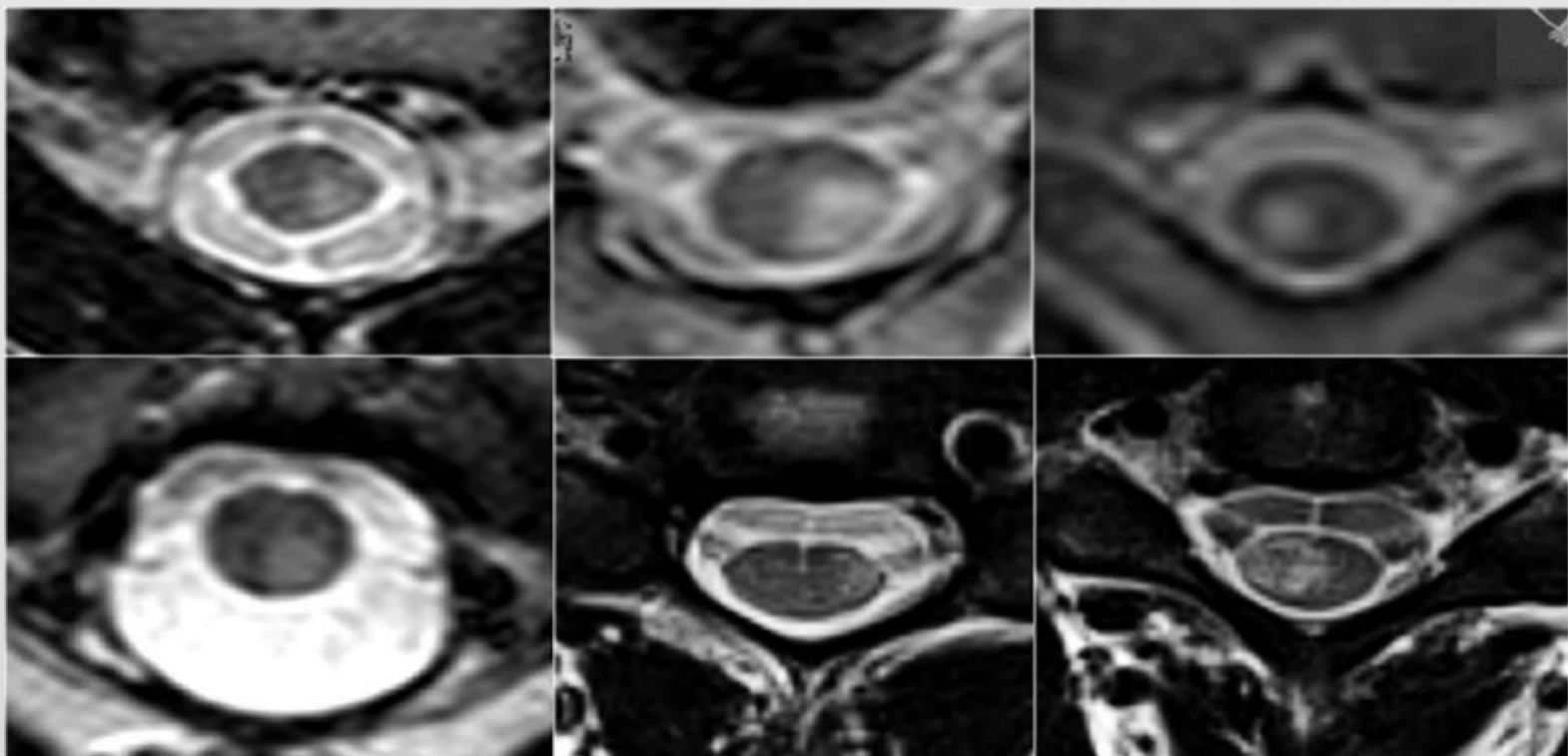
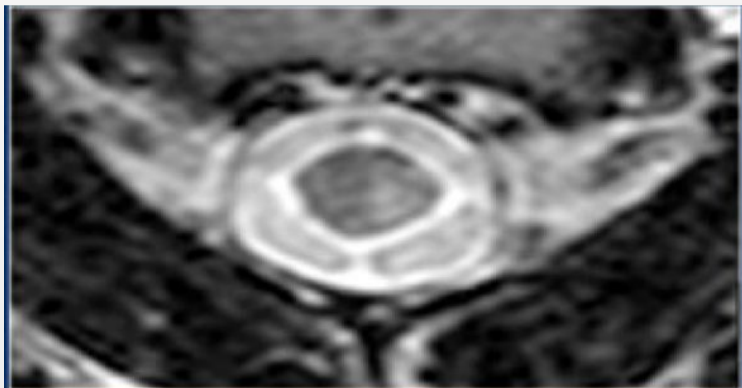
Figure 2

Inflammation

» INFLAMMATION

» Multiple sclerosis

- An immune-mediated inflammatory demyelinating disease of the brain and the spinal cord.
- The most common demyelinating disease and there is overlap between these diseases:
 - NMO was first thought to be a form of MS, but is now considered to be a distinct form.
 - ADEM can relapse and progress to MS.
 - The partial form of transverse myelitis

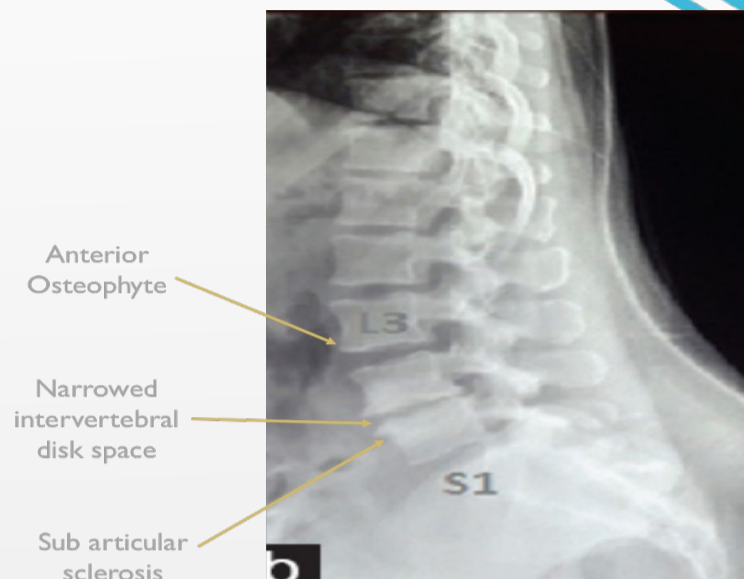


Non inflammatory

» NON INFLAMMATORY

» Spondylosis

- Spondylosis is used as a broad descriptive term referring to degeneration of the spinal column from any cause; it is usually further qualified by the part of the spine affected.
- The key parameters are :
 - osteophyte formation
 - Intervertebral disc height narrowing
 - Vertebral end-plate sclerosis



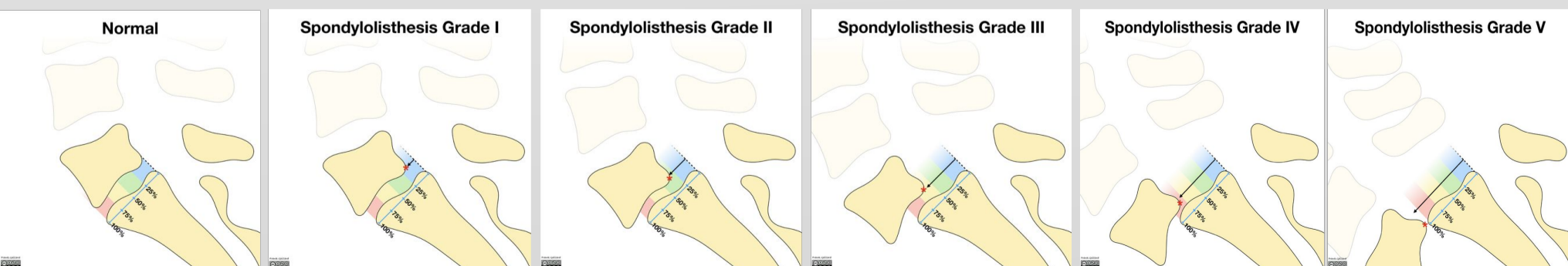
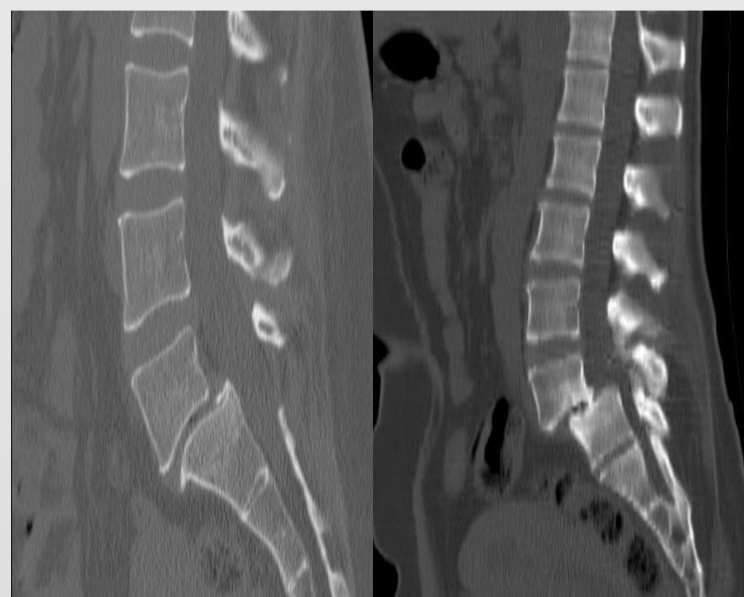
» Spondylolysis

- Defect in the pars interarticularis of the neural arch, the portion of the neural arch that connects the superior and inferior articular facets. It is commonly known as pars interarticularis defect or more simply as pars defect.
- Believed to be caused by repeated microtrauma, resulting in a stress fracture of the pars interarticularis
- 90% of cases of spondylolysis occur at the L5 level.



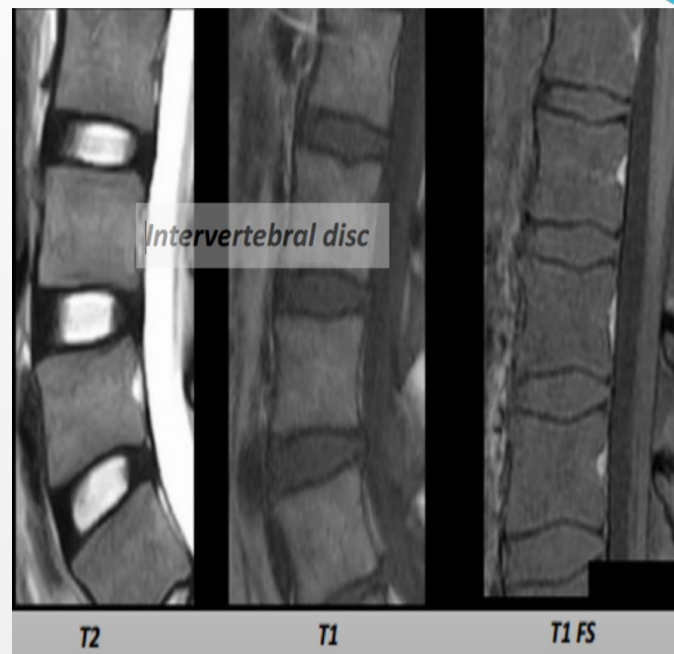
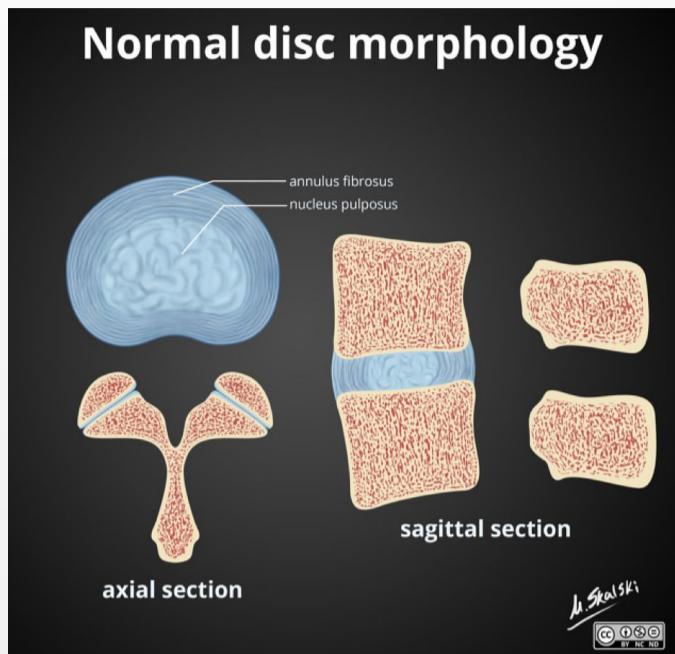
» Spondylolisthesis

- Spondylolisthesis (plural: spondylolistheses) denotes the slippage of one vertebra relative to the one below.
- It can occur anywhere but is most frequent, particularly when due to spondylolysis, at L5/S1 and to a lesser degree L4/L5



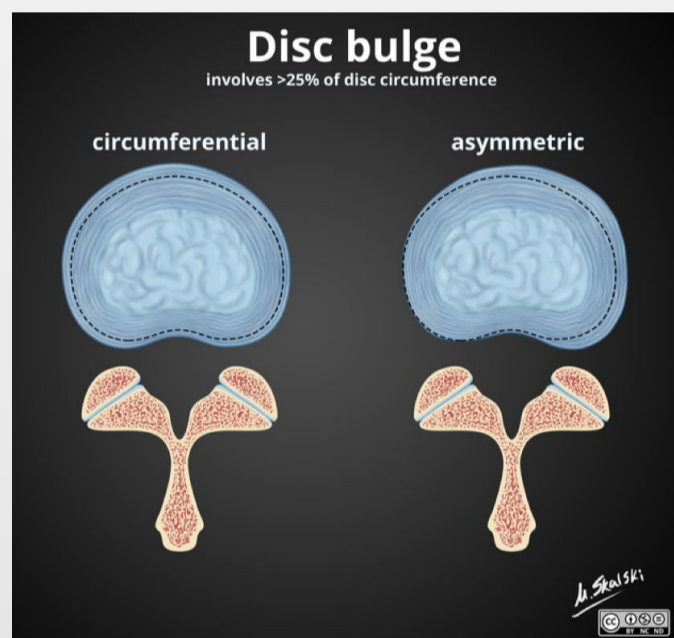
Disk diseases

» DISK DISEASES

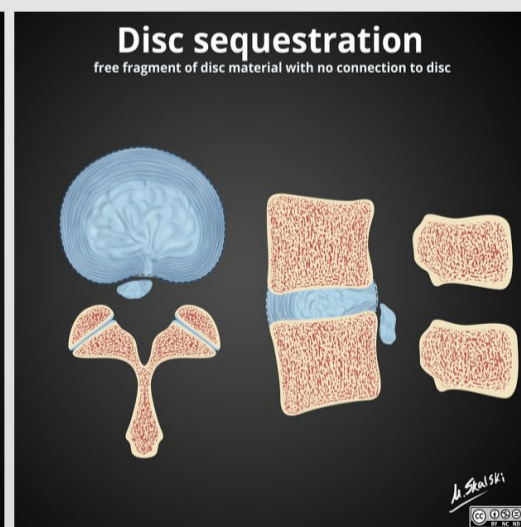
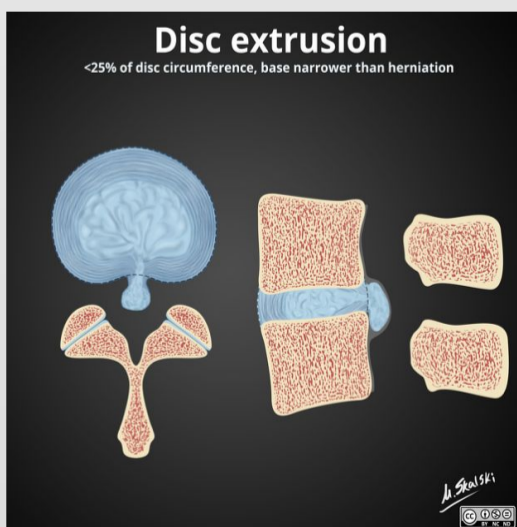
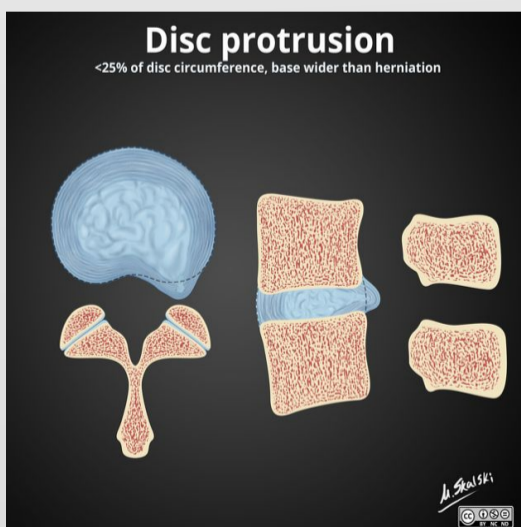


» DISK BULGE

- Displacement of the outer fibers of the annulus fibrosus beyond the margins of the adjacent vertebral bodies.
- Involving more than one-quarter (25% or 90 degrees) of the circumference of an intervertebral disc.
- Divided into :
 - Circumferential bulge: involves the entire disc circumference.
 - Asymmetric bulge : does not involve the entire circumference, but nonetheless more than 90 degrees.



» DISK HERNIATION

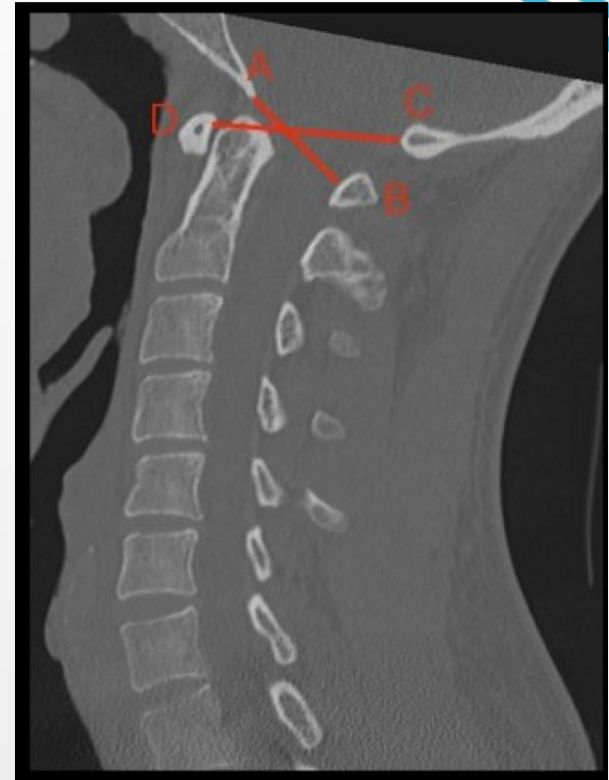


Craniocervical measurements

» CRANIOCERVICAL MEASUREMENTS

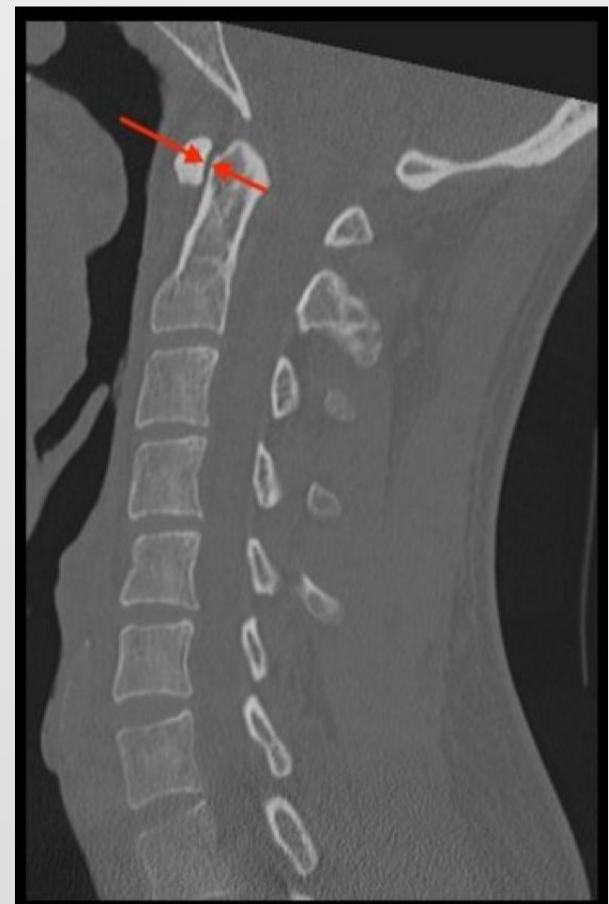
» POWERS RATIO

- The Powers ratio is a measurement of the relationship of the foramen magnum to the atlas, used in the diagnosis of atlanto-occipital dissociation injuries.
- Powers Ratio= AB/CD , is measured as the ratio of the distance in the median (midsagittal) plane between the: - basion (A) and the posterior spinolaminar line of the atlas (B) - Opisthion (C) and the anterior arch of the atlas (D)
- Normal values are <1 on plain radiographs and <0.9 on CT .
- If this ratio is >1 , then it suggests cranio-cervical junction instability.
- Usually used in assessing trauma cases.



» ATLANTO -DENTAL INTERVAL

- The Atlantodental interval (ADI) is the horizontal distance between the anterior arch of the atlas and the dens of the axis, used in the diagnosis of atlanto-occipital dissociation injuries and injuries of the atlas and axis.
- Normal values:
 - Radiograph:
 1. Adults: Male $<3\text{mm}$
 2. Female $<2.5\text{mm}$
 3. Children: $<5\text{ mm}$
 - CT: Adults: $<2\text{ mm}$
- Hence, abnormal ADI value may suggest rupture/injury of (alar ligament, apical ligament, transverse ligament).
- ADI $>3\text{mm}$ also suggests narrowing of the spinal canal (spinal cord compression).
- Abnormal ADI is usually seen in - Rheumatoid Arthritis - Down Syndrome - Os odontoideum.



Summary of dr. Fahad notes

» Make sure you answer:

1. Which modality is better for bone fracture? (CT scan)
2. Vertebral body fracture? (non-contrast CT)
3. Spinal cord trauma? (non-contrast MRI)
4. Spinal cord mass? (MRI with contrast)
5. If there is narrowing of the spinal canal and you suspect spinal cord injury which modality you need?
6. What is the localization of basion and opisthion?
7. What is the Tectorial ligament?
8. What is meningocele and what is its imaging findings?
9. What is Myelomeningocele?
10. What is the definition of Diastematomyelia? two focal splitting of the core (two hemi-cores)
11. What is the normal predental space? (3-5 mm) What are the causes of widening?
12. What is JEFFERSON fracture? (A burst type fracture of C1 due to axial loading with fractures occurring through both the posterior and anterior arches) **Stable?** Yes
13. What is the mechanism of JEFFERSON fracture?
14. What is HANGMAN'S fracture? (Also known as traumatic spondylolisthesis of the axis, is a fracture which involves the pars interarticularis of C2 on both sides, and is a result of hyperextension e.g. hanging, chin hits dashboard in road accident, and distraction)
15. What is BURST fracture? (A type of compression fracture related to high-energy axial loading spinal trauma that results in disruption of the posterior vertebral body cortex with retropulsion into the spinal canal)
16. What is Chance fractures? (also referred to as seatbelt fractures, are flexion-distraction type injuries of the spine that extend to involve all three spinal columns. These are unstable injuries and have a high association with intra-abdominal injuries)
17. Mention Intramedullary tumours?
18. What is the sequestered disc?

» Make sure you know:

- Anterior longitudinal ligament
- Posterior longitudinal ligament
- Tectorial ligament
- CT disadvantages
- MRI advantages AND disadvantages
- Myelogram: for spinal canal imaging
- DEXA scan: for osteoporosis
- Ultrasound: for spinal neonates imaging (first modality)
- The Craniocervical junction (CCJ) is comprised of the inferior surface of the skull, the atlas and axis, as well as muscles and connective tissues that attach the skull to the cervical spine.
- Myelomeningocele: neural tissue + CSF leakage
- Diastematomyelia: Two hemi-cores
- Nasopharyngeal space: 3 mm
- Retro-pharyngeal space: 7 mm
- Retro-tracheal space: 21 mm
- DENS/ODONTOID fracture
- SPONDYLODISCITIS meaning and imaging findings
- Meaning of disc bulge and disc protrusion

438 Quiz

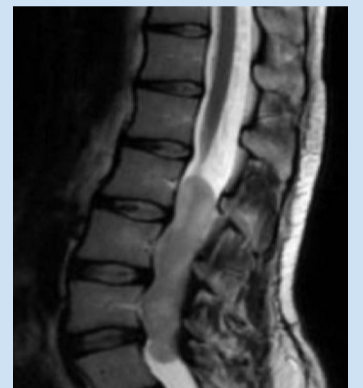
1- What is the name of fracture seen in the X-Ray?

- a. Hangman's Fracture.
- b. Burst Fracture.
- c. Jefferson Fracture.
- d. there is no fracture



2- Locate the following abnormality

- a. Intramedullary
- b. Extramedullary intradural.
- c. Extradural
- d. Normal



3-What is seen in MRI?

- a. Astrocytoma
- b. schwannomas
- c. Ependymoma
- d. diastematomyelia

4-If the CSF space is narrowed and the spinal cord diameter becomes big this is?

- a. Normal spinal cord
- b. intramedullary tumor
- c. Intradural extramedullary
- d. extra dural

5-Which one of the following is the best to assess the contents of the cavity, extent of abnormalities, and spinal cord IN CONGENITAL ANOMALIES

- a. MRI
- b. CT
- c. X-RAYS
- d. Myelogram

6-What is the etiology of Jefferson Fracture?

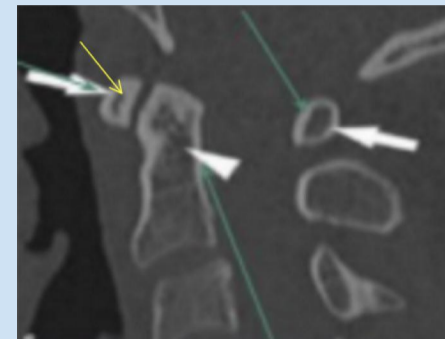
- a. lateral displacement of C1
- b. Fracture of pars interarticularis
- c. TB of spine
- d. Disc prolapse of C3

Answers
1)A
2)A
3)A
4)B
5)A
6)A

439 Quiz

1- Identify the pointed structure in yellow?

- a. Posterior arch of C1
- b. Lateral mass of C1
- c. Anterior arch of C1
- d. DENSE



2- What is the best modality for vertebral body fracture?

- a. X-rays
- b. MRI
- c. CT with contr
- d. Ct without contrast

3- What is the best modality for spinal cord mass?

- a. CT with contrast
- b. CT without contrast
- c. MRI with contrast
- d. MRI without contrast

4- Identify the pointed structure?

- a. Meniongocele
- b. Astrocytoma
- c. Ependymoma
- d. Meningioma



Answers
1)C
2)D
3)C
4)D

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- Alwateen Alaradi 
- Abdulaziz Alamri   

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- Duaa Alhumoudi
- Norah Almasaad
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- Ibrahim Alabdulkarim
- Mohamed Albabtain
- Abdulrahman Alswat
- Munib Alkhateb
- Mohammed Alkathiri
- Omar Alhalabi
- Homoud Algadheb 
- Nasser Almutawa
- Omar alsulaiman 



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