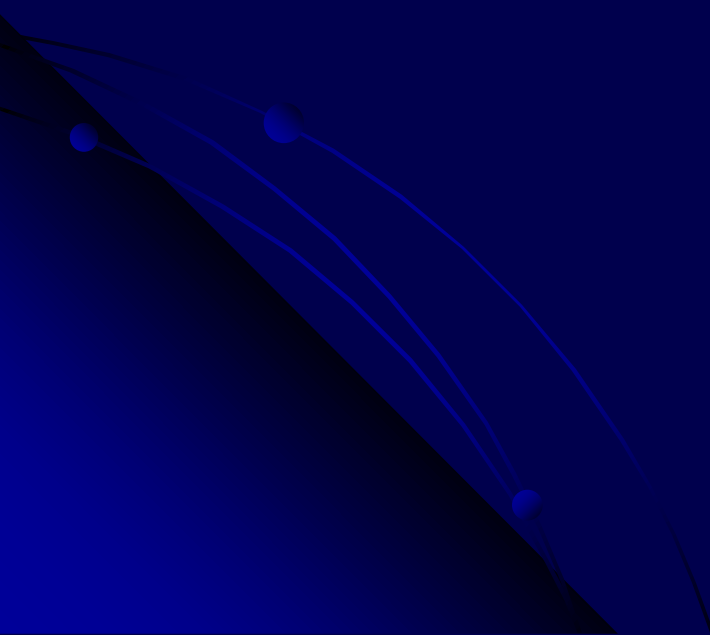


Lecture Title:

RADIOLOGY OF SPINE DISEASES..



Objectives

- Anatomy of spinal cord.
- Anatomy of vertebral column.
- Identify, and distinguish between, common types of radiographic Images.
- Recognize some radiological presentations of spinal cord diseases.

Imaging Methods to Evaluate Spine

1. Plain X-Ray Films - bones
2. Myelogram – injection of contrast medium in CSF followed by x-ray images. Rarely performed now-a-days
3. Computed Tomography (CT Scan)
4. Magnetic Resonance Imaging (MRI)
5. Spinal angiography – to evaluate arteries and veins
6. Ultrasound – more in children
7. Radionuclide Bone Scan – intravenous injection of radioactive material bound to phosphonates which deposit in bones, followed by images by gamma camera.
8. DEXA – radionuclide scan for bone density (osteoporosis)

Imaging the Spine

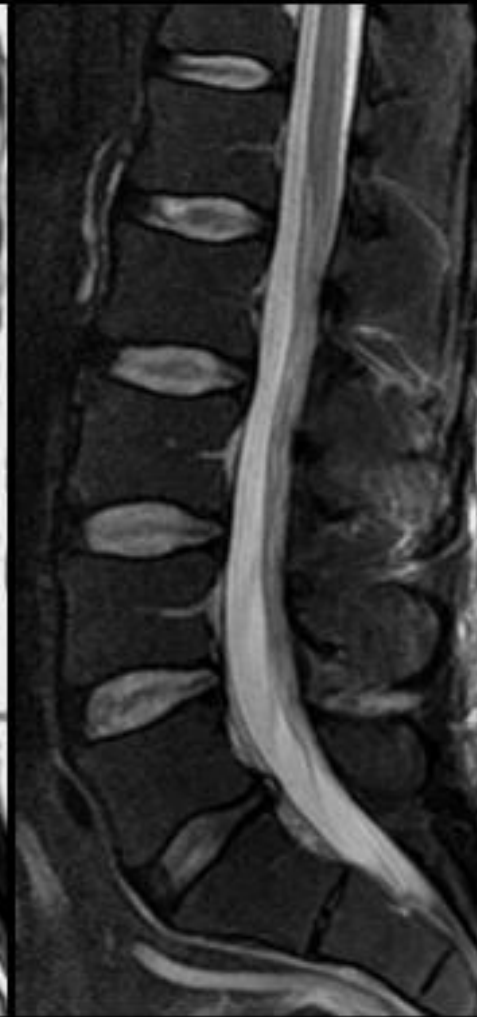
X-Ray



CT



MRI



X-RAYS (RADIOGRAPHS)

- ▶ Often the first diagnostic imaging test
- ▶ Small dose of radiation to visualize the bony parts
- ▶ Can detect:
 - Spinal alignment and curvature
 - Spinal instability – with flexion and extension views
 - Congenital (birth) defects of spinal column
 - Fractures caused by trauma
 - Moderate osteoporosis
 - Infections
 - Tumors



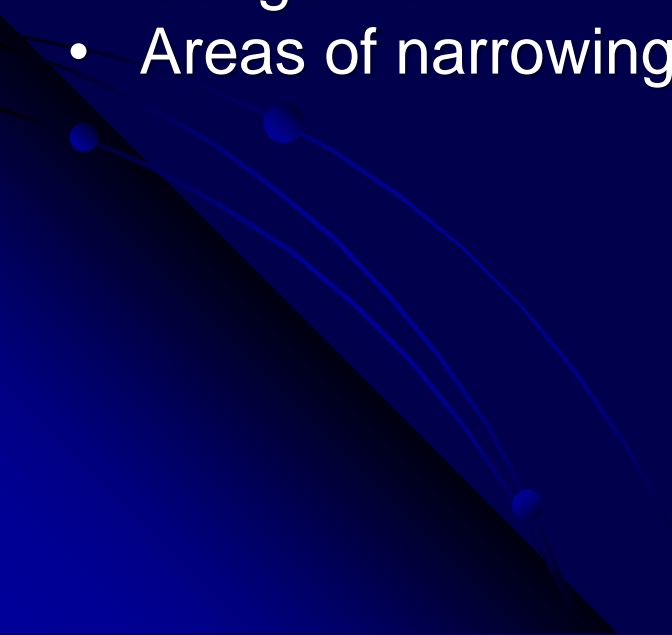


COMPUTERIZED TOMOGRAPHY (CT SCAN)

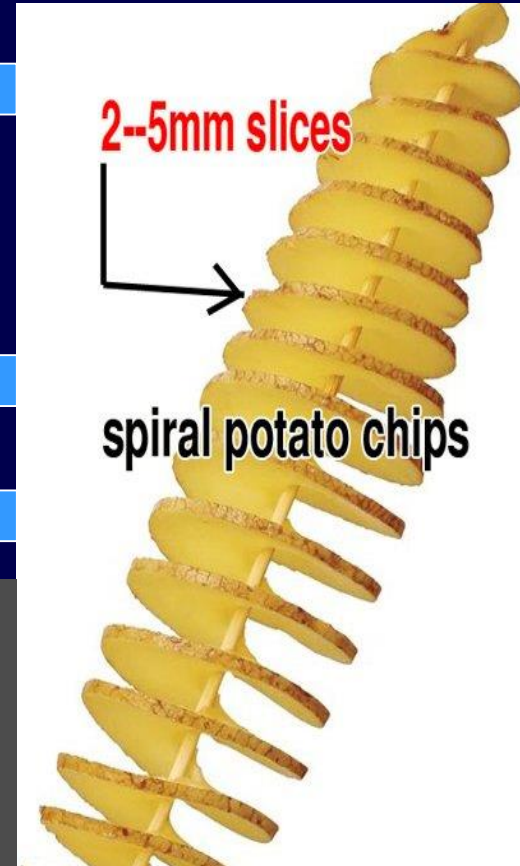
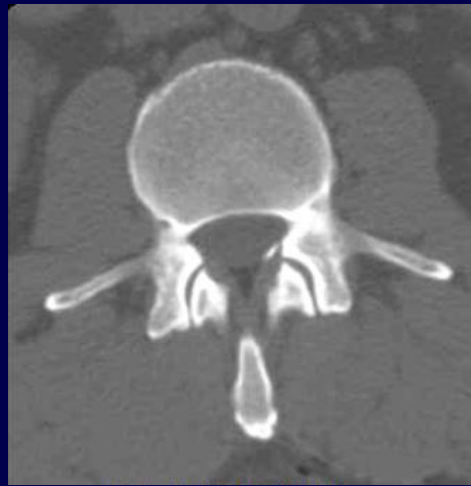
- ▶ Uses radiation
- ▶ Obtain 2-D images → can be processed to 3-D images
- ▶ Entire spine can be imaged within a few minutes
- ▶ Detailed information regarding bony structures
- ▶ Limited information about spinal cord & soft tissues



COMPUTERIZED TOMOGRAPHY (CT SCAN)

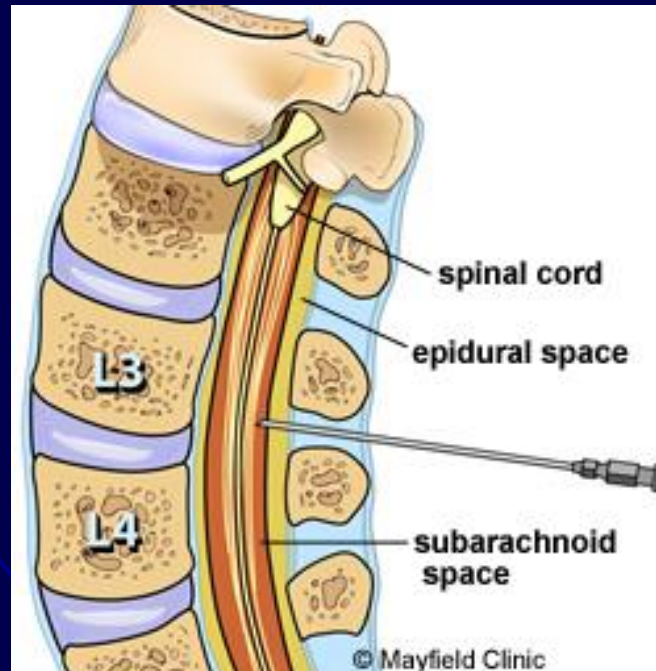
- Degenerative or aging changes, Herniated discs
 - Spinal alignment
 - **Fractures and fracture patterns**
 - Congenital / childhood anomalies
 - Areas of narrowing in spinal canal or neural foramina
- 





MYELOGRAM

A contrast material is injected into CSF to better identify areas where spinal cord or spinal nerves may be compressed



Magnetic Resonance Imaging (MRI)

The gold standard of imaging for spinal disorders

Does not use ionizing radiation

Can identify abnormalities of bone, discs, muscles, ligaments and spinal cord

Intravenous contrast is sometimes administered to better visualize certain structures or abnormalities

Patient lies still in a tunnel like structure for about 25 minutes

MRI SCANNER (closed type)



MRI SCANNER (open type)

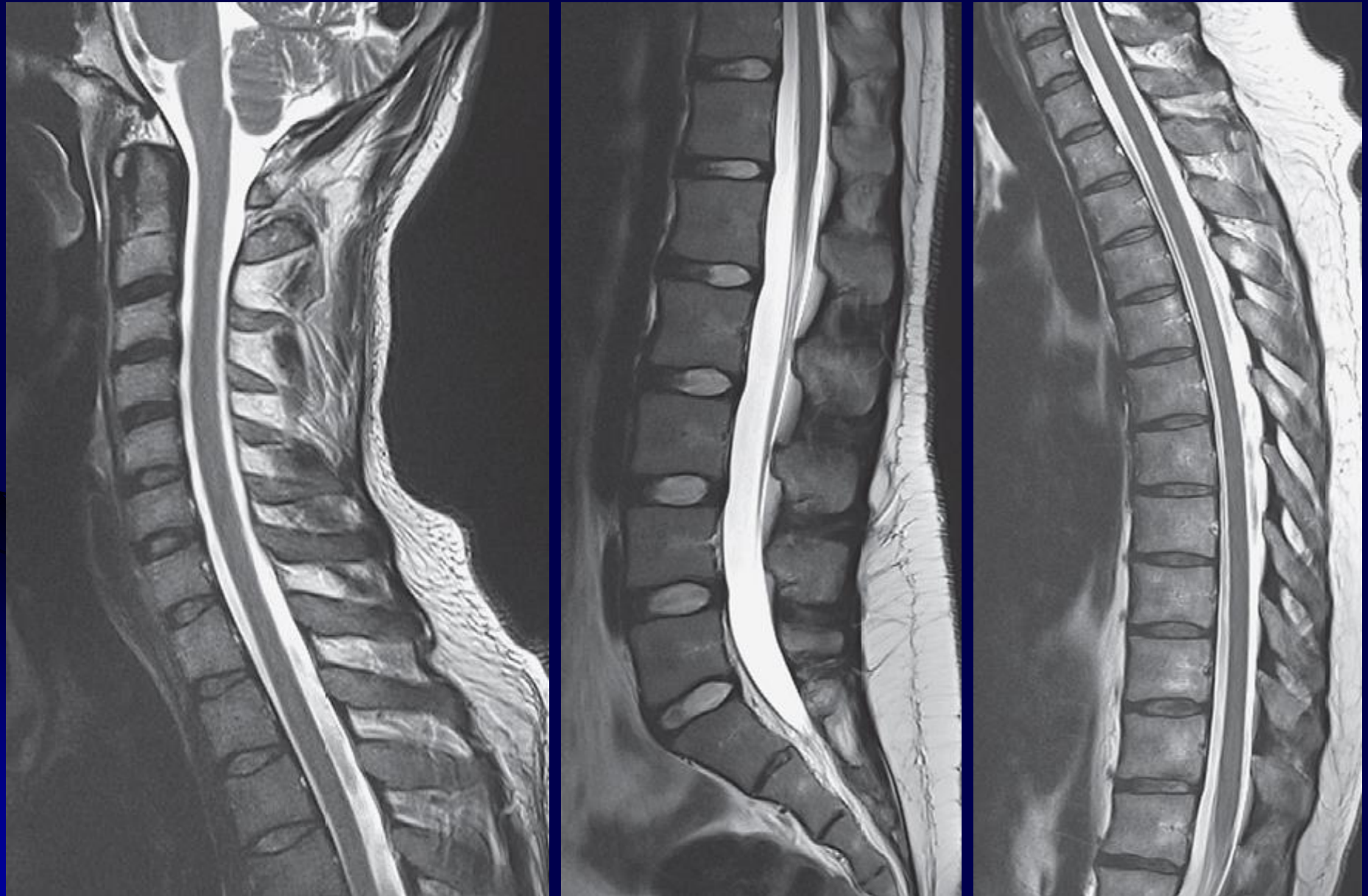


Magnetic Resonance Imaging (MRI)

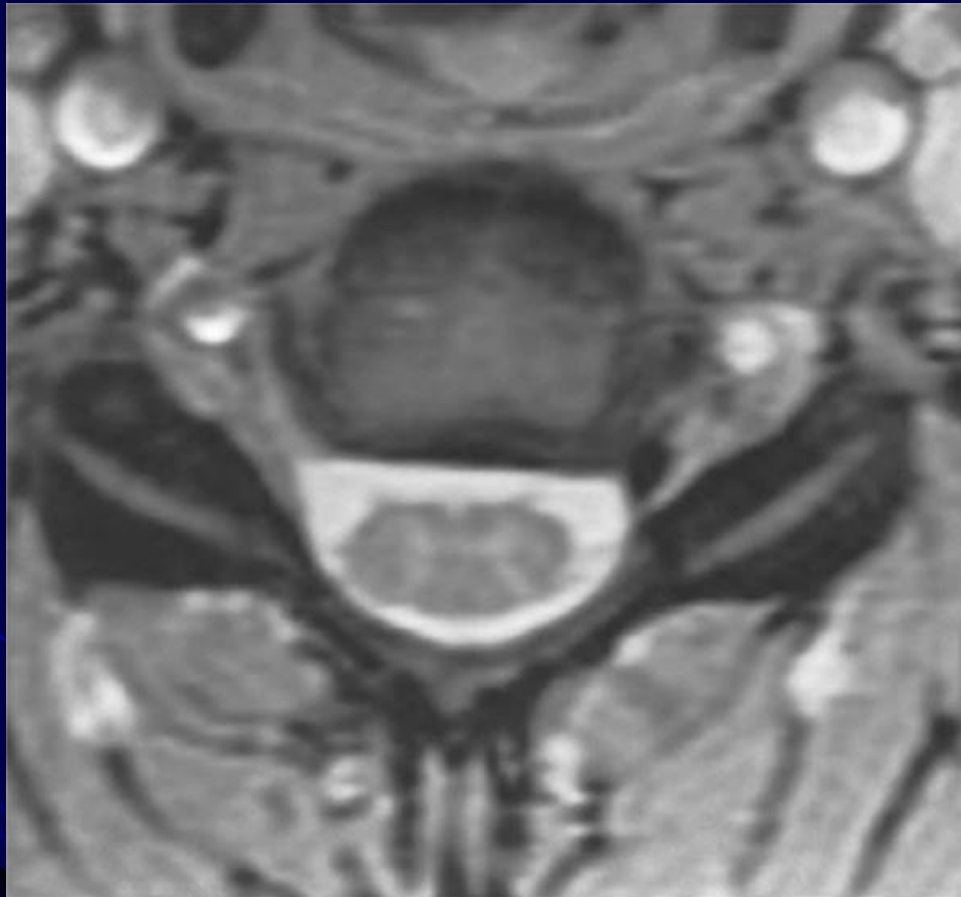
- Gold standard of imaging for spinal cord disorders
- No radiation
- Can identify abnormalities of bone, soft tissues and spinal cord
- Claustrophobic patients, uncooperative and children may need sedation or general anesthesia
- Contraindications include implanted devices e.g. cardiac pacemakers and electromagnetic devices



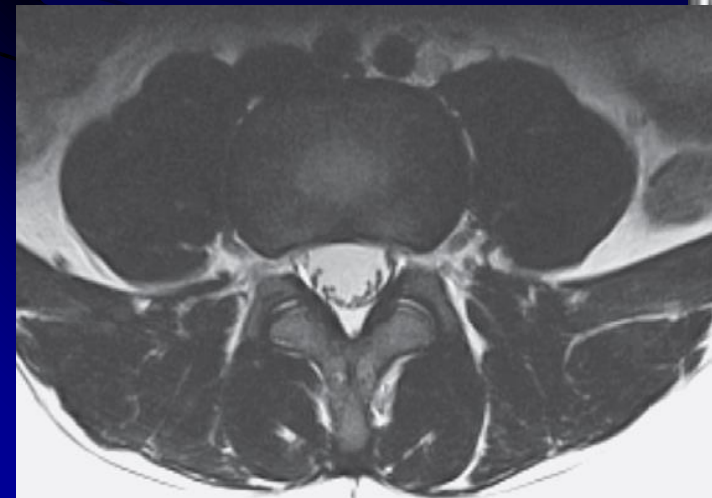
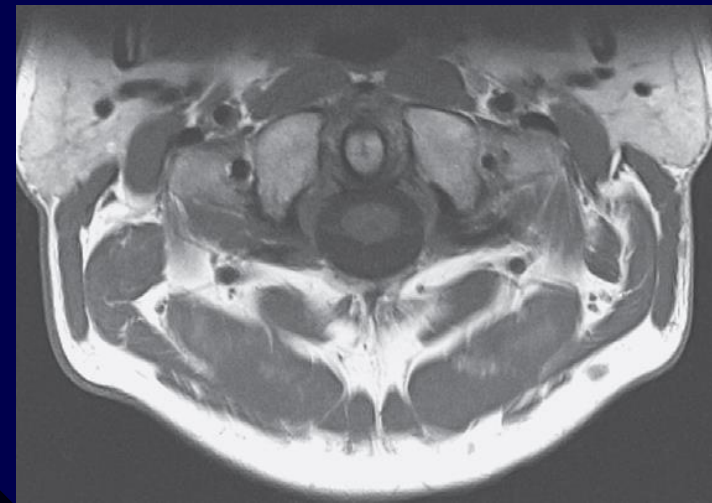
MR images are very high resolution

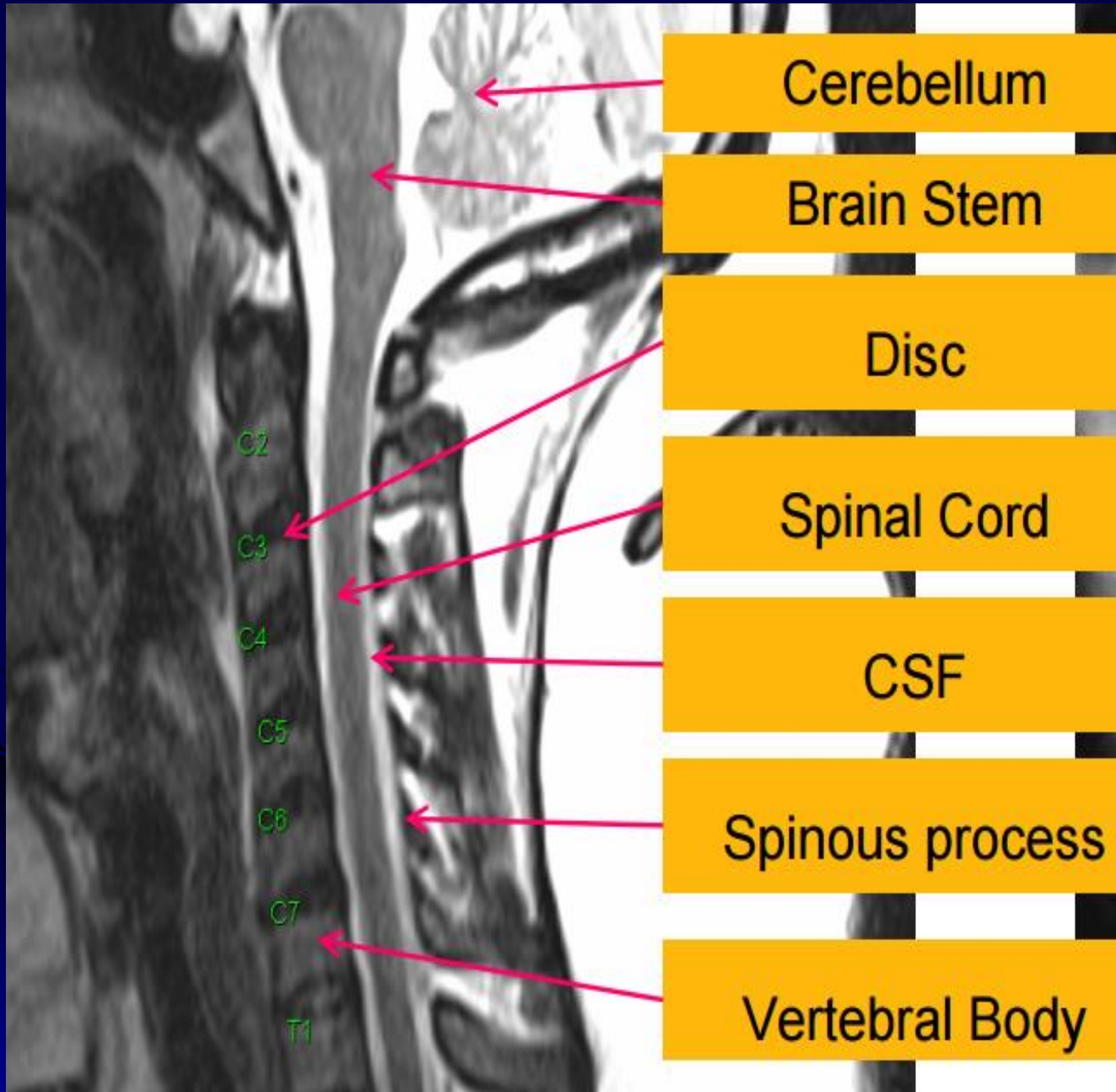


MR images are very high resolution



MR images are multi-planar





Cerebellum

Brain Stem

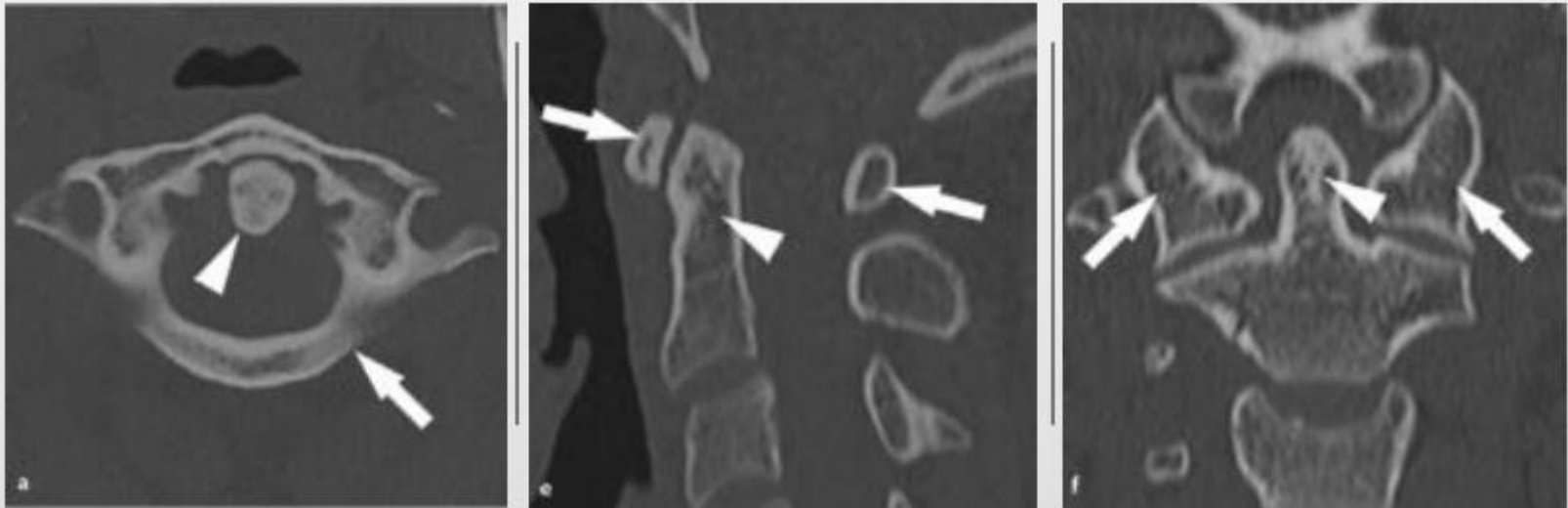
Disc

Spinal Cord

CSF

Spinous process

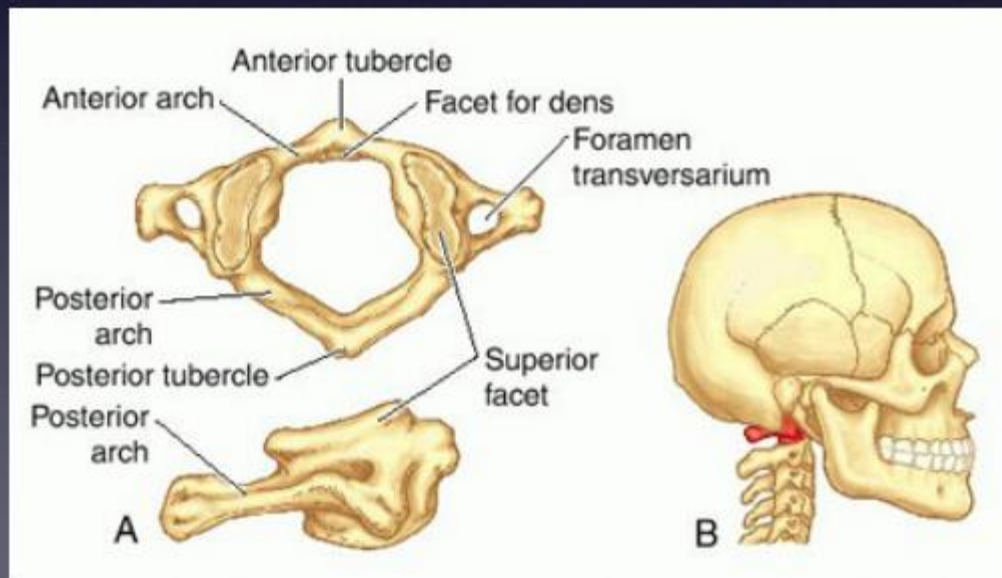
Vertebral Body

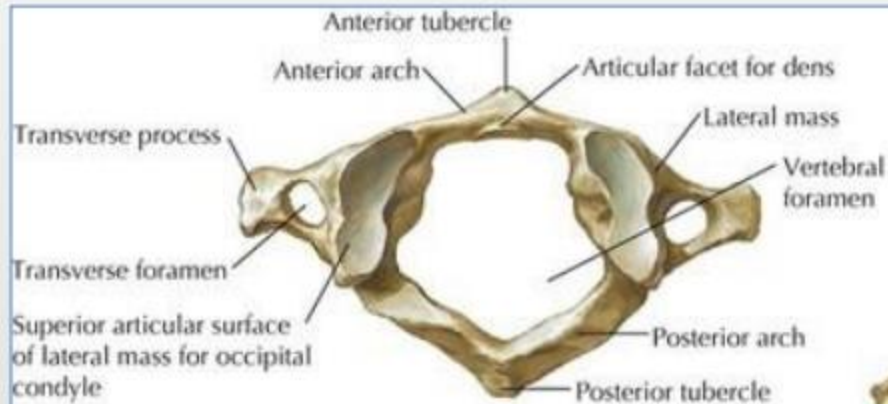


Craniocervical junction

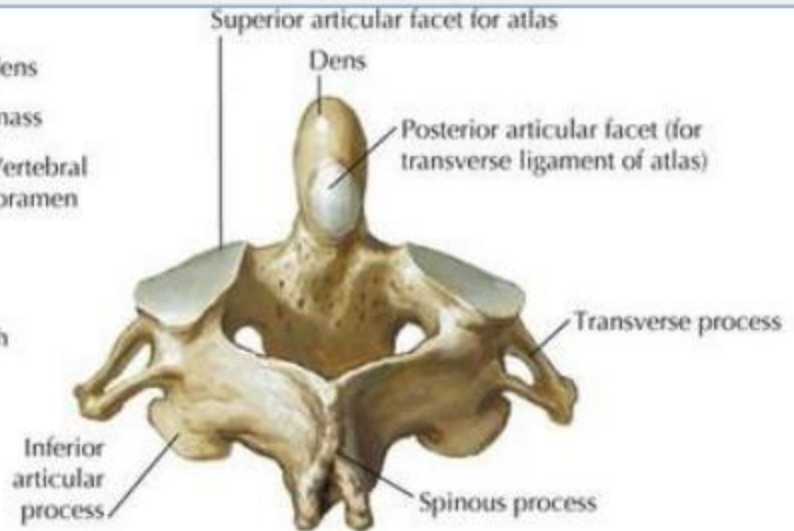
Atlas (C1)

- Atlas was the primordial Titan who supported the heavens
- anterior arch, posterior arch, and 2 bulky lateral masses

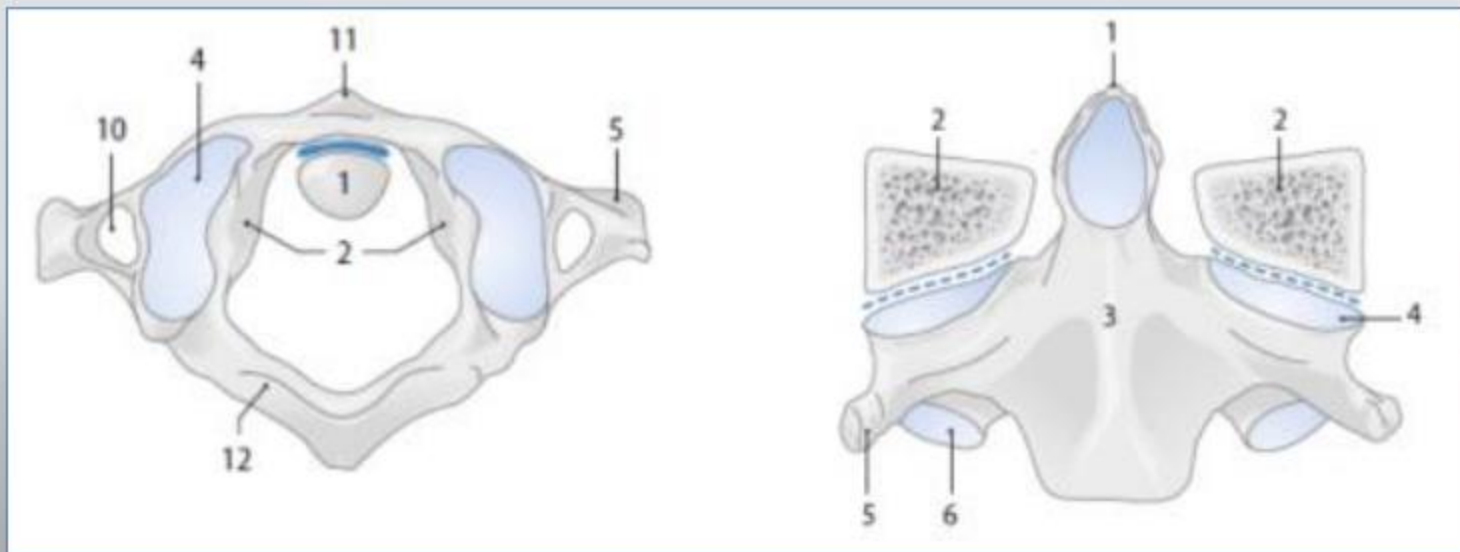


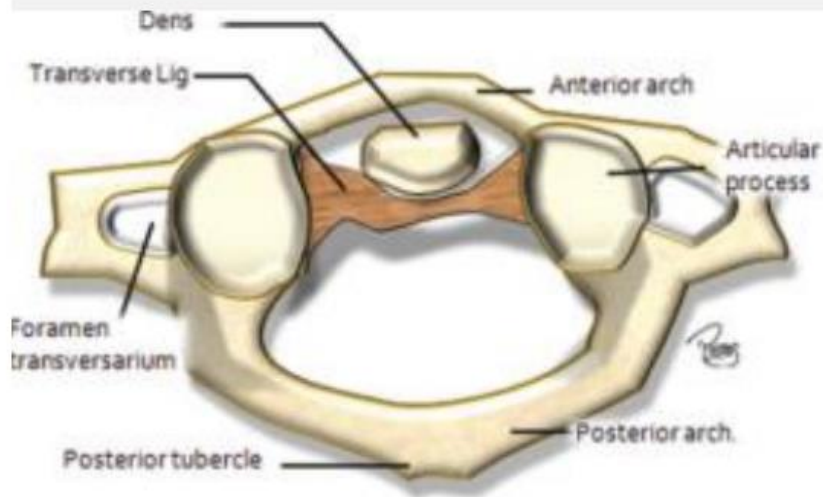


Atlas (C1): superior view



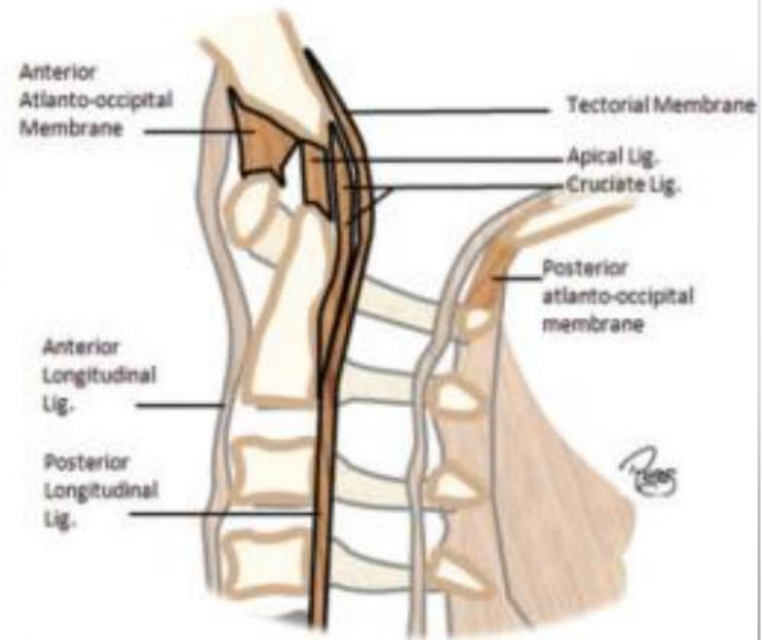
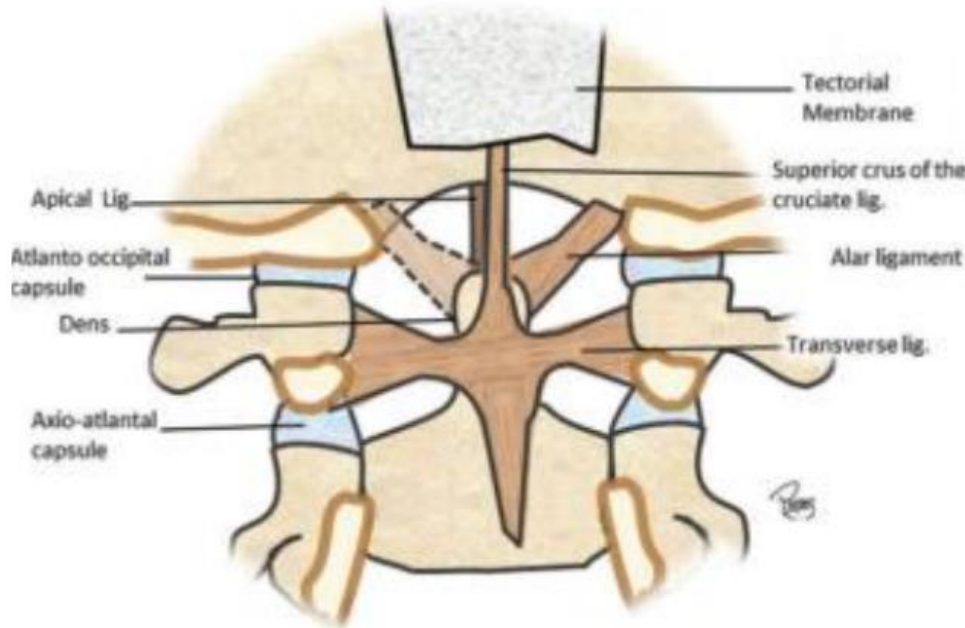
Axis (C2): posterosuperior view



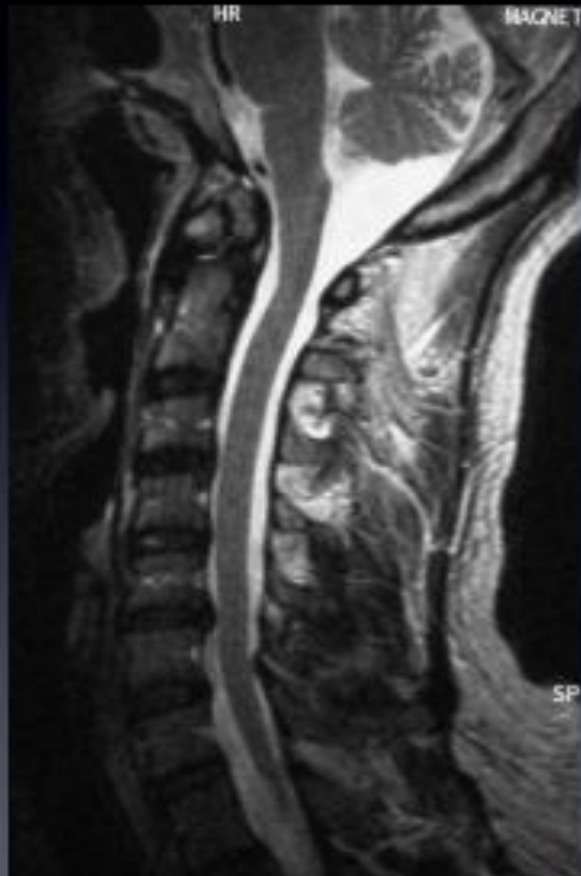


Ligamentous anatomy Of the craniocervical junction

2.



Os odontoideum



OSSEOUS SPINE

Cervical spine:	6-7
Thoracic spine:	11-13
Lumbar spine:	4-6
Sacrum:	4-6
Coccyx:	2-8
TOTAL:	32-35

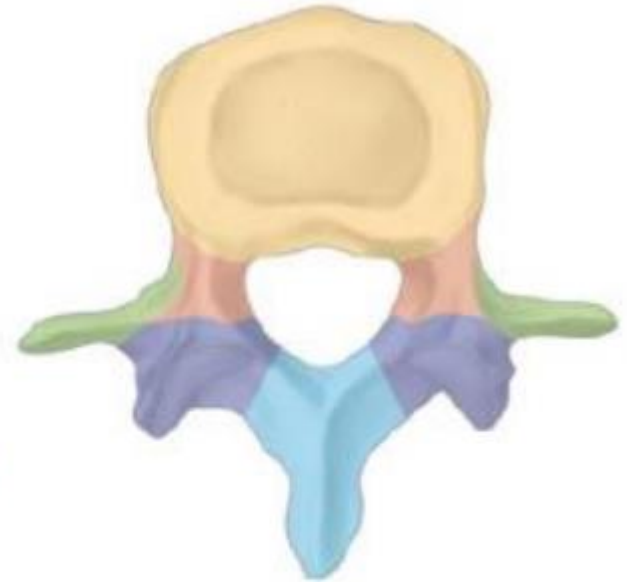
↓
Coccygeal variants
Lumbosacral transitional vertebrae
Hypoplastic ribs Th12
Cervical ribs C7
13th ribs L1



Cervical spine

Thoracic spine

Lumbar spine



Body



Pedicle



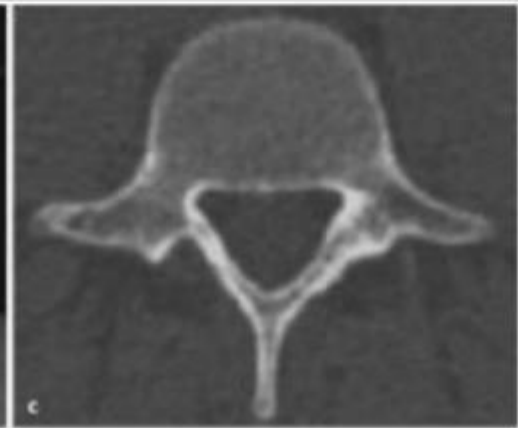
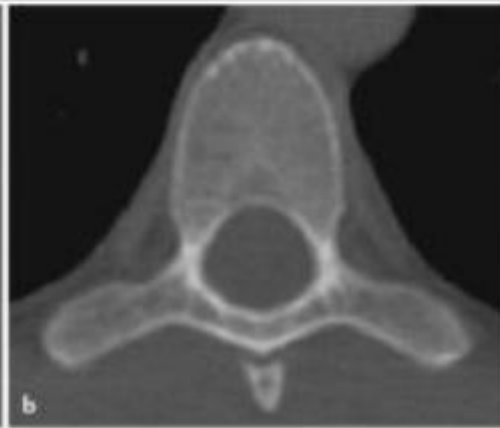
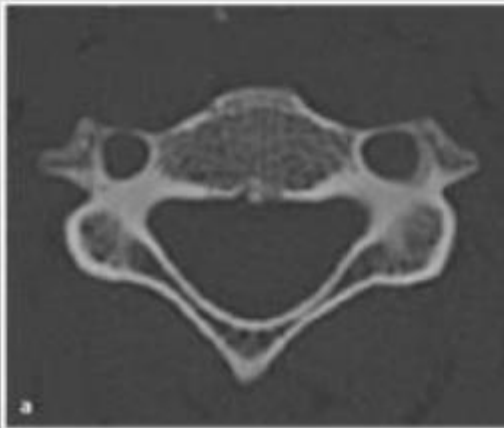
Transverse process



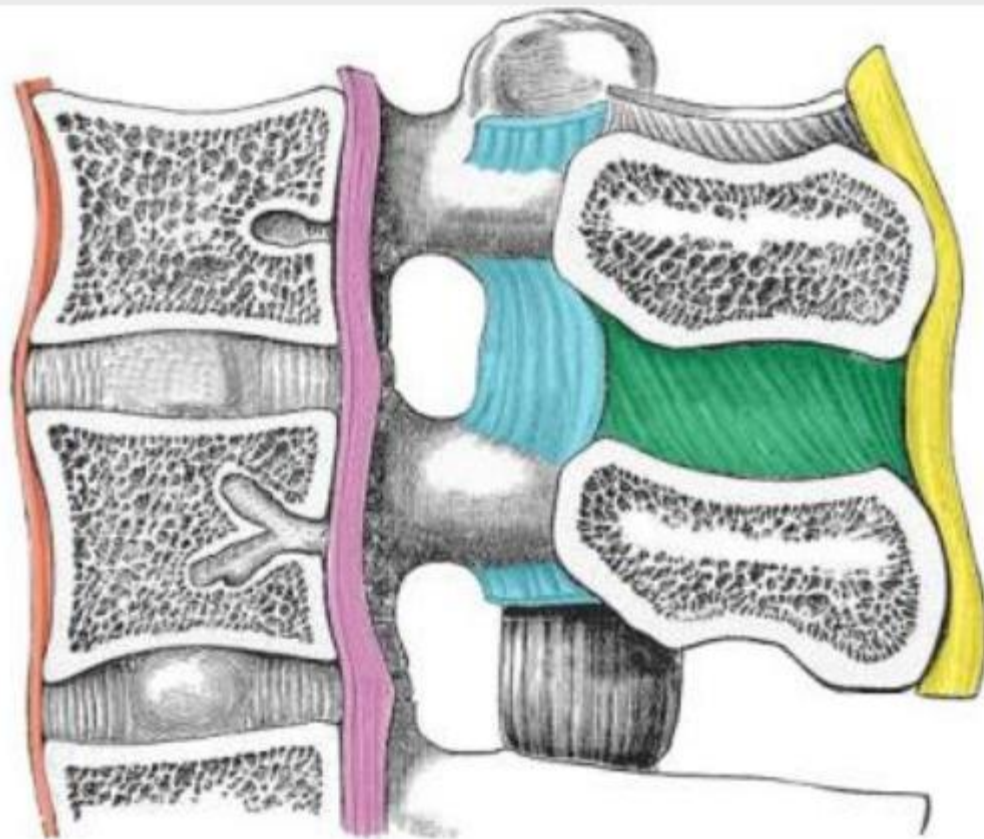
Facets with facet joints



Lamina with spinous process

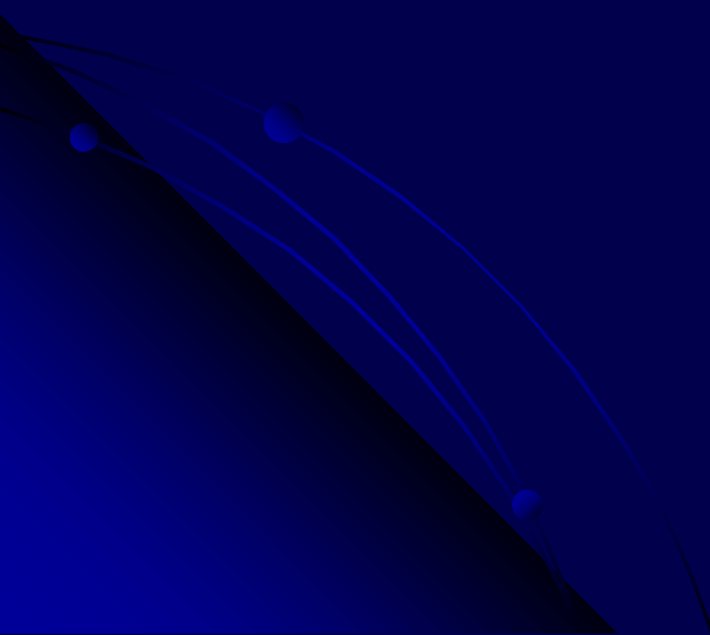


Spinal ligaments



- Anterior longit. ligament
- Posterior longit. ligament
- Ligamentum flavum
- Interspinal ligament
- Supraspinous ligament

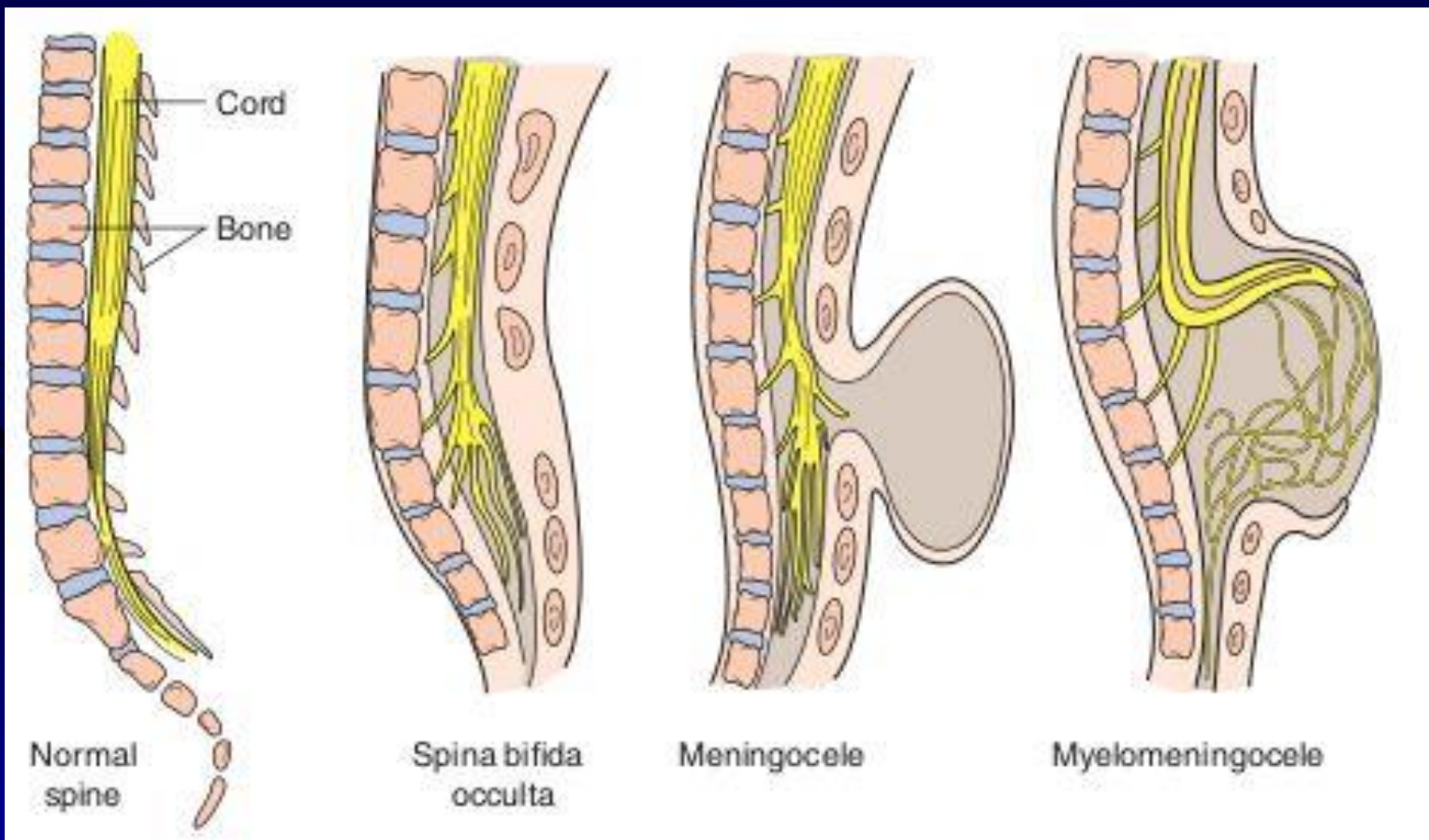
Congenital Anomalies



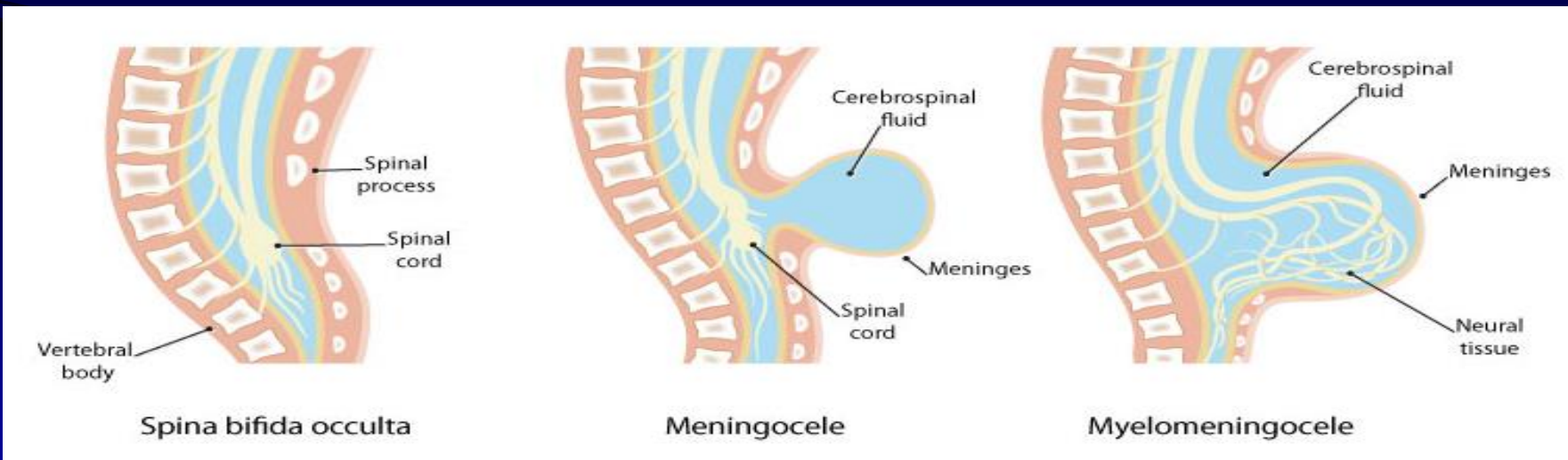
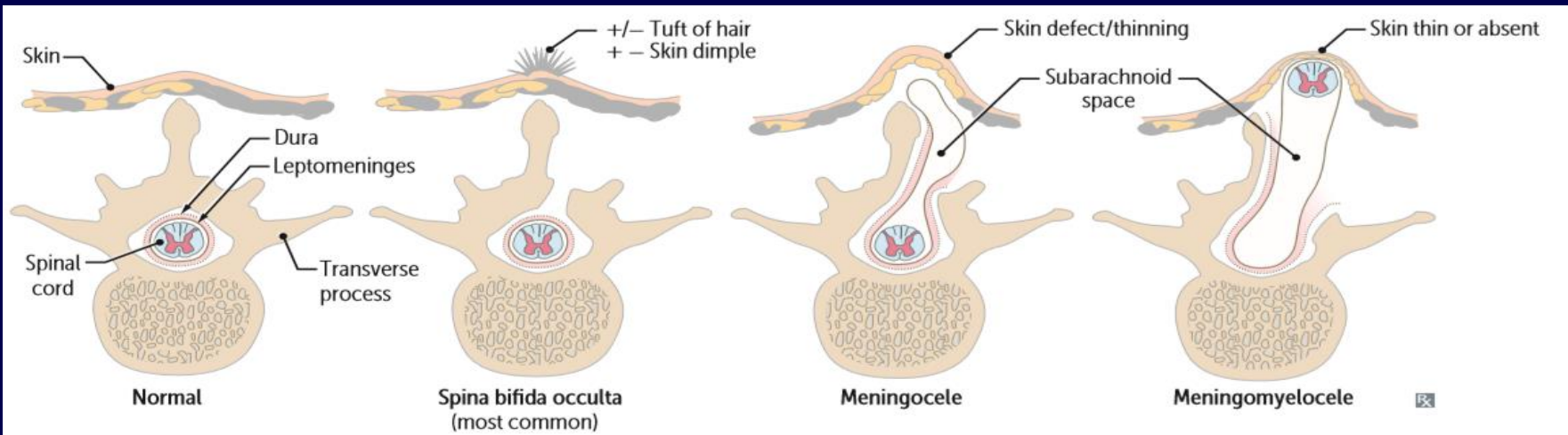
CONGENITAL ANOMALIES

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

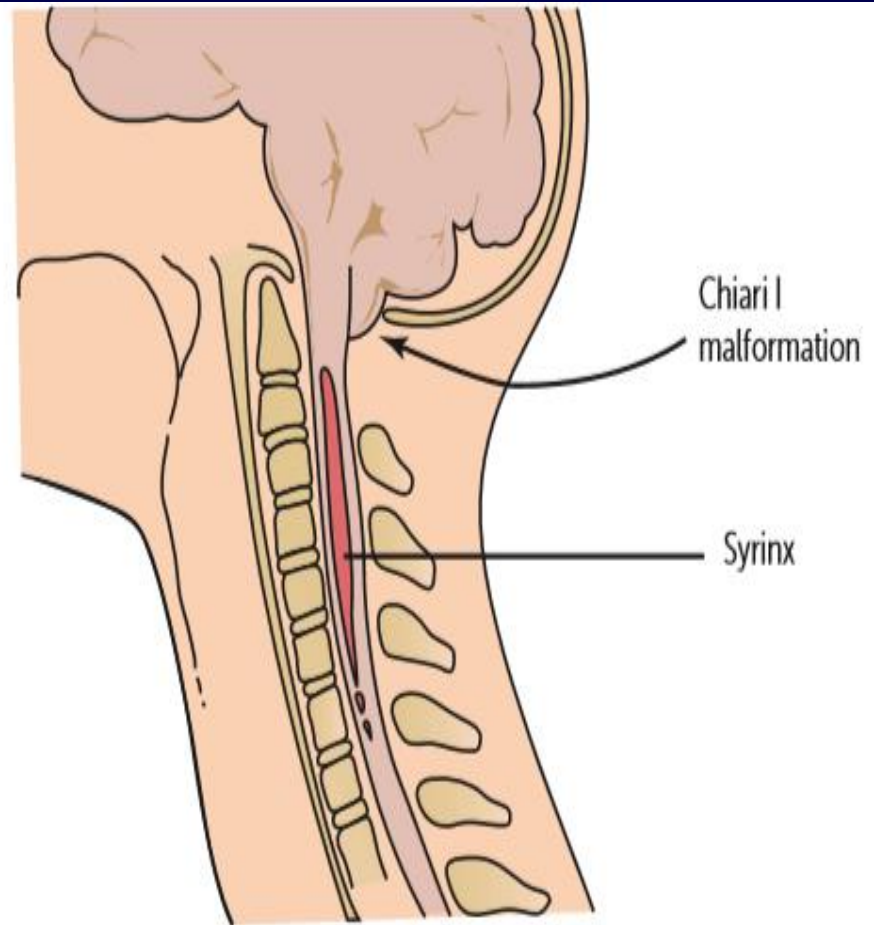


Spina bifida





Syringomyelia

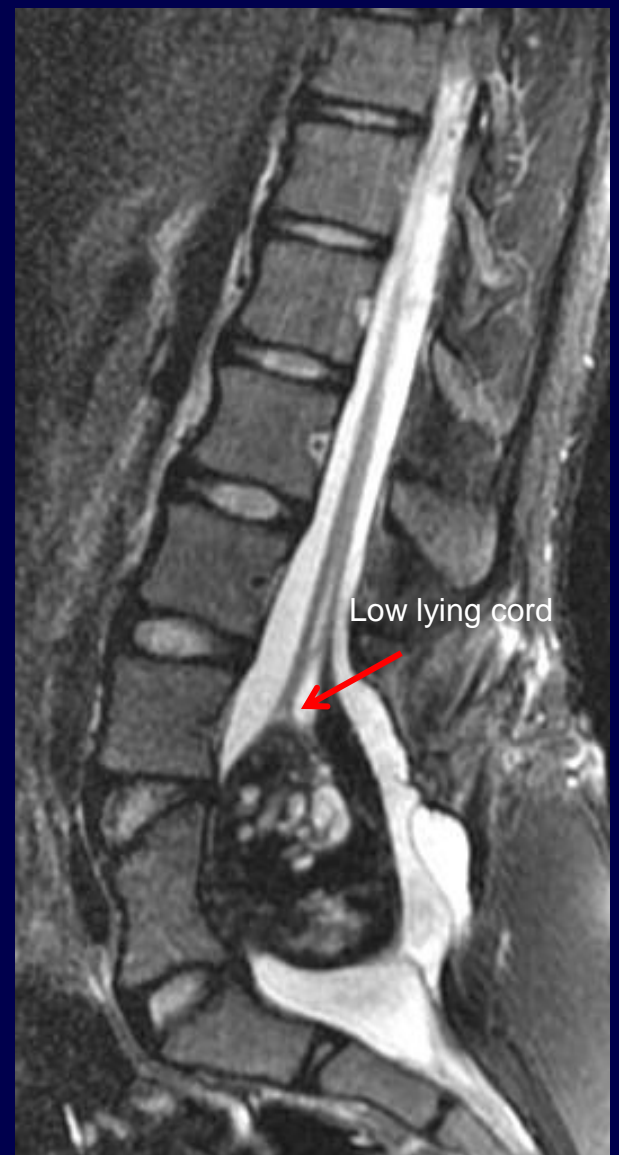


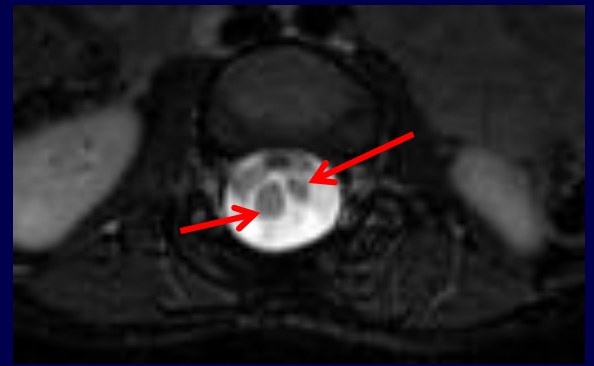
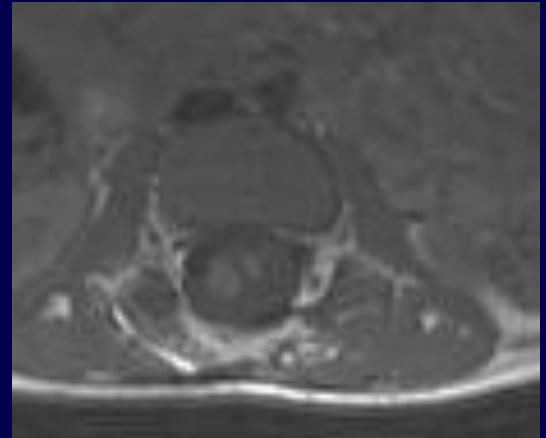
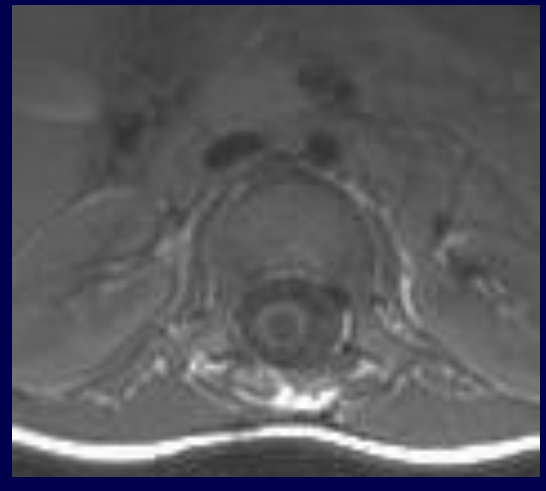
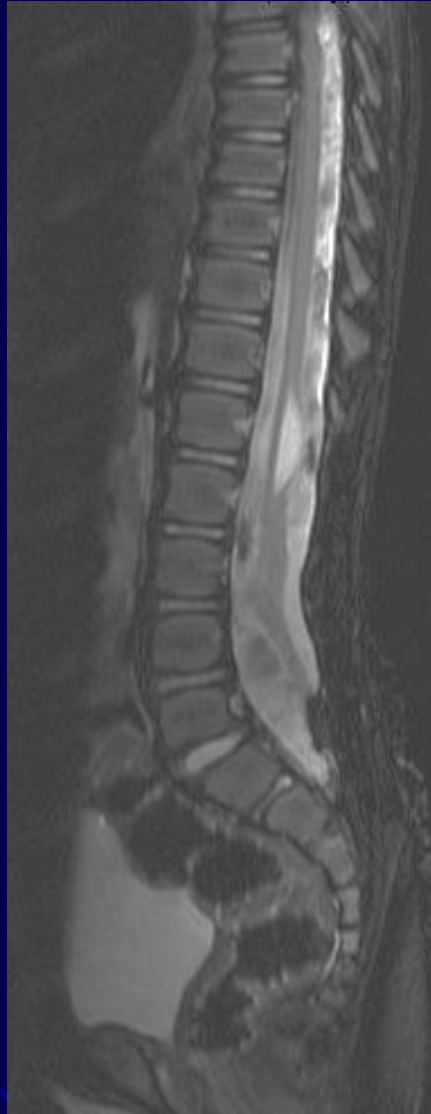


Meningocele



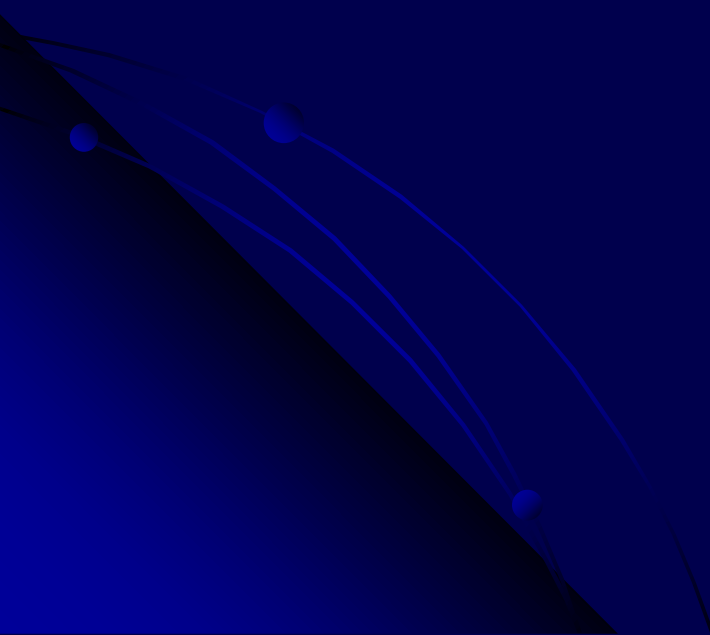
Low lying cord tethered to large lipoma





Split low lying cord (diastematomyelia)

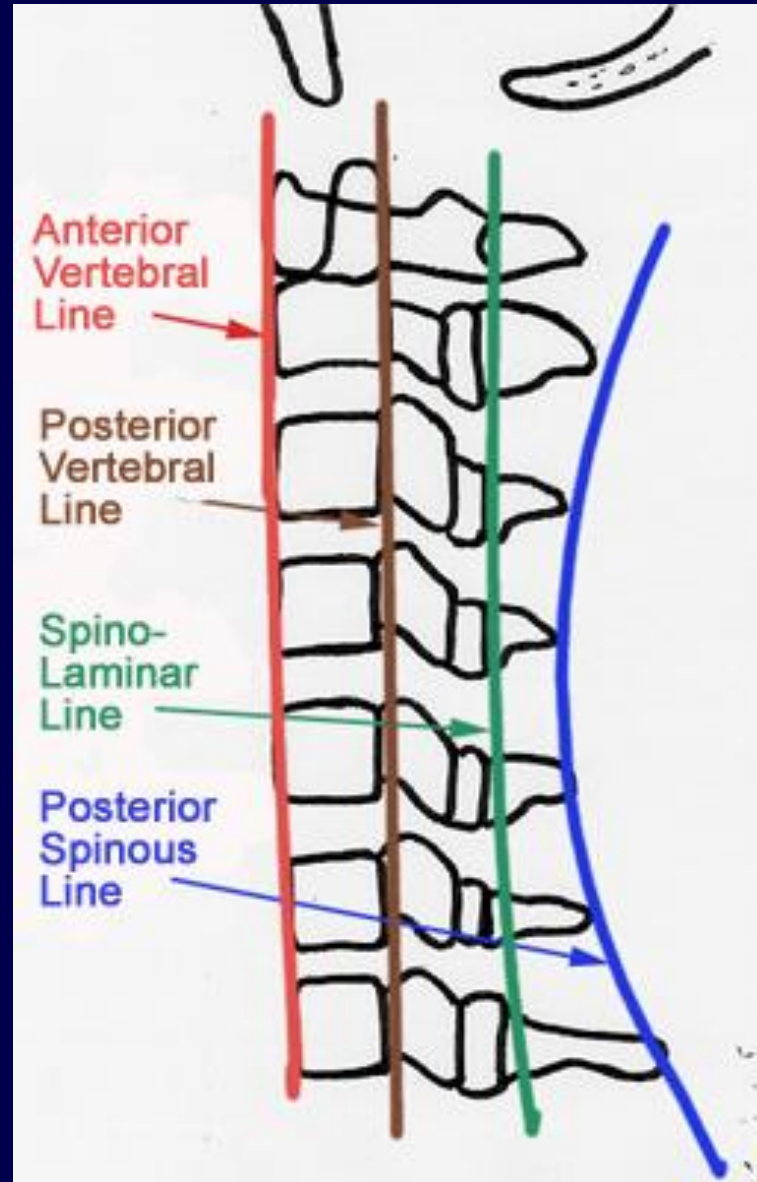
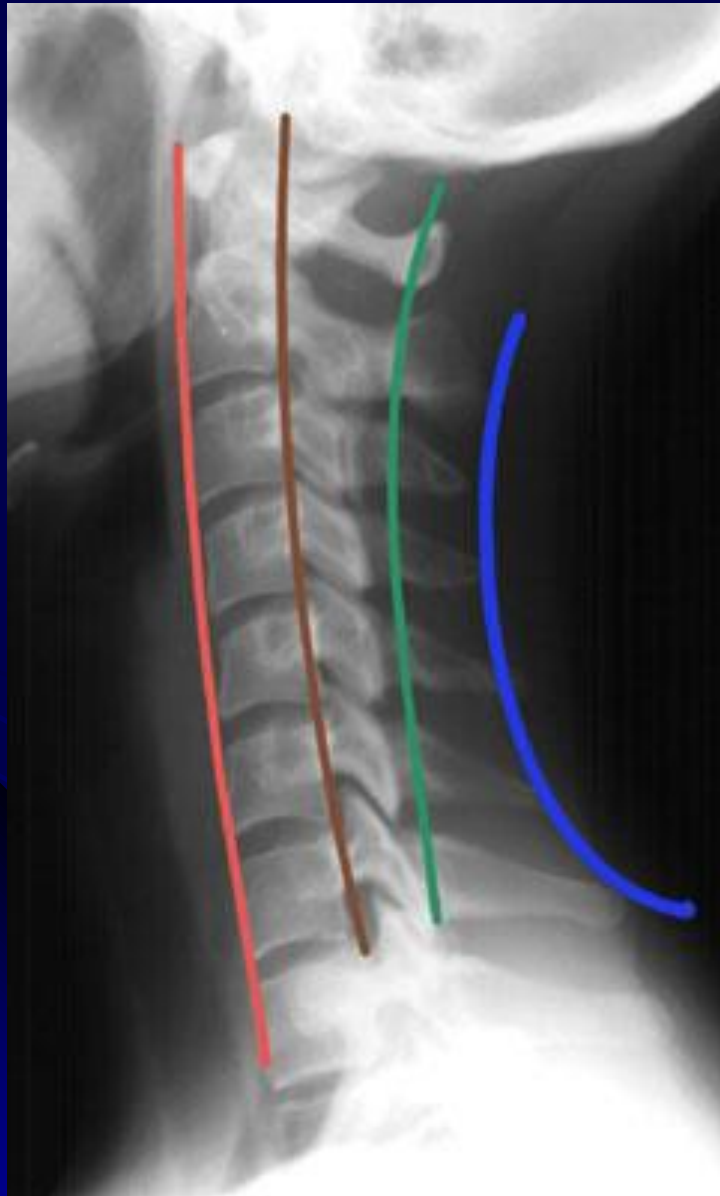
TRAUMA

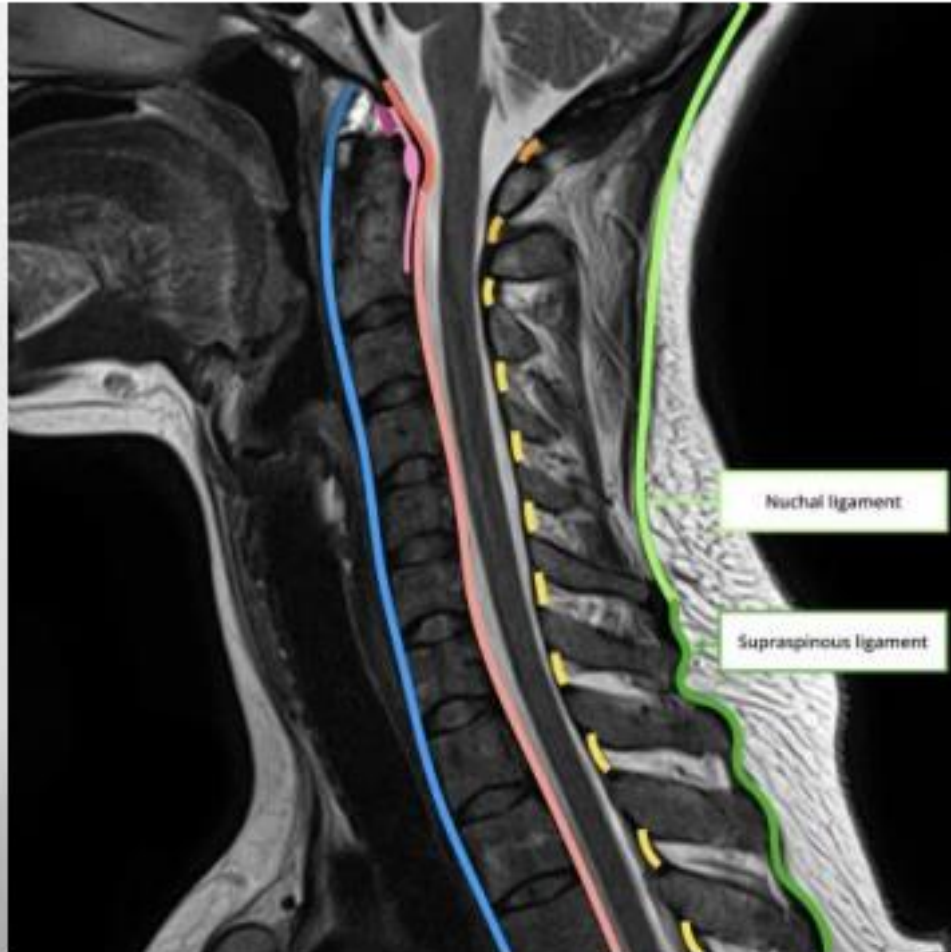


Plain film assessment of trauma – the first imaging method



Alignment should be normal – check by drawing lines





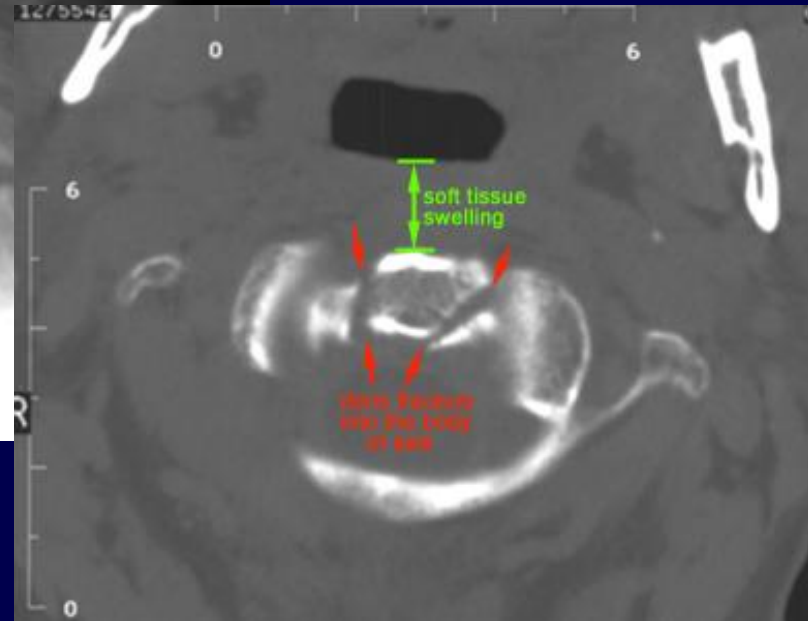
Nuchal ligament

Supraspinous ligament





Soft tissue anterior to spine is very important

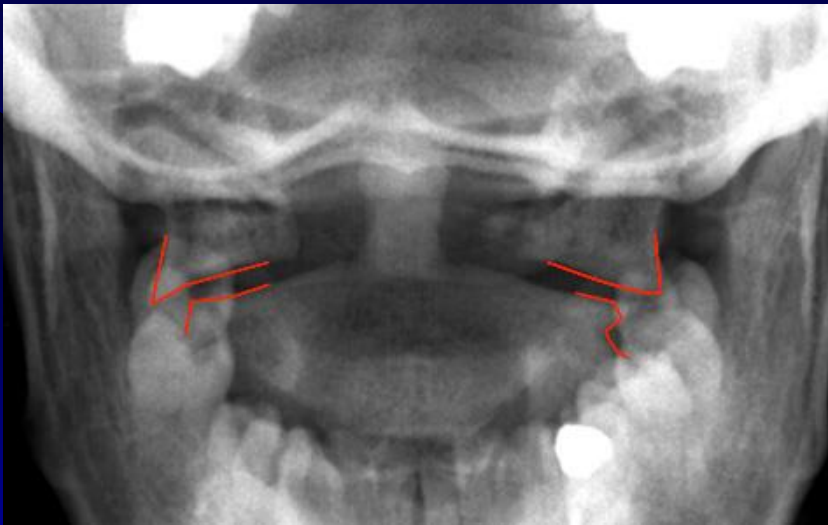
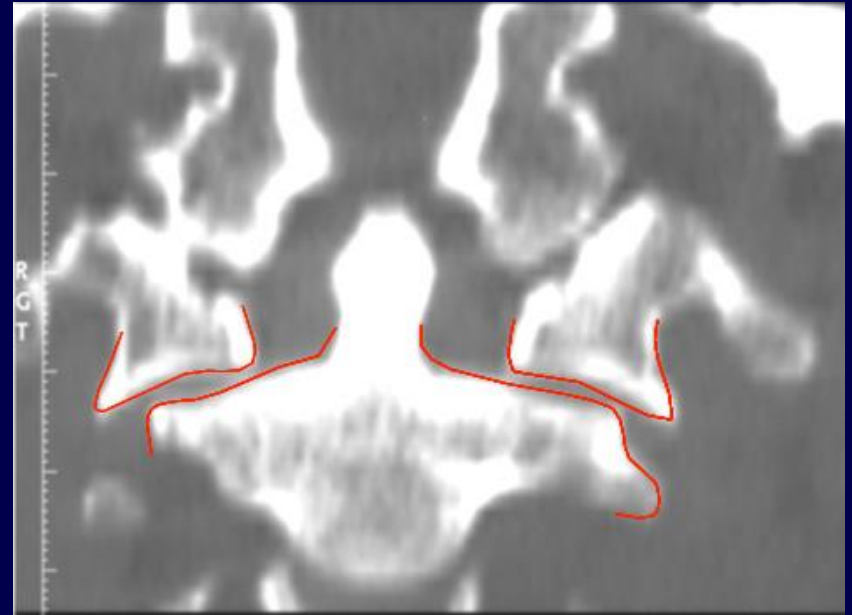


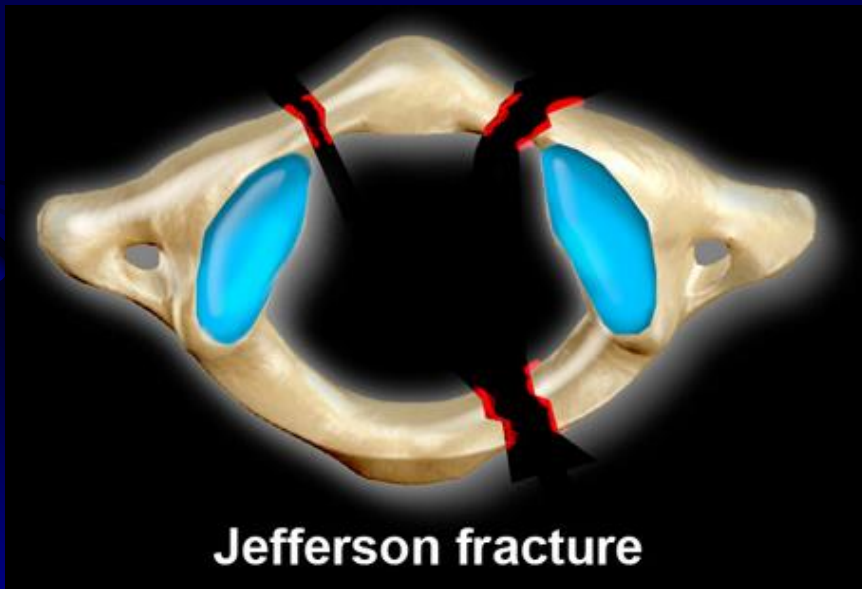
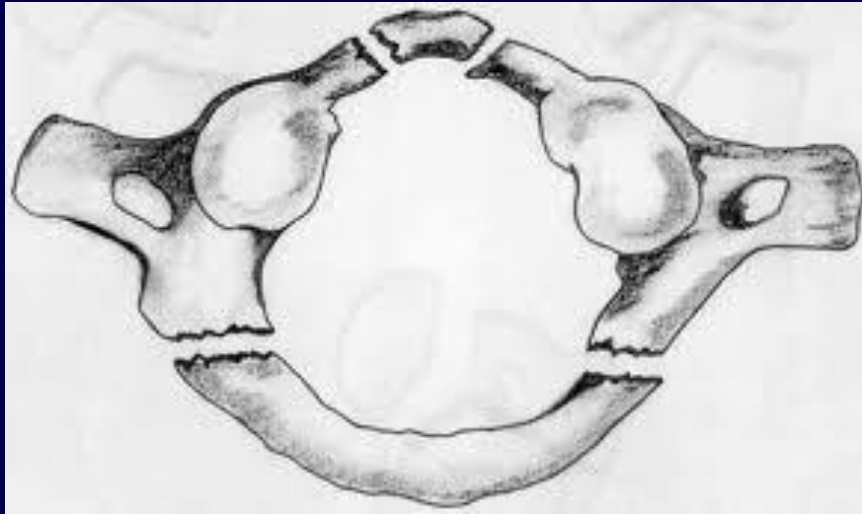
Jefferson Fracture

Lateral displacement of C1 in plain film (A)

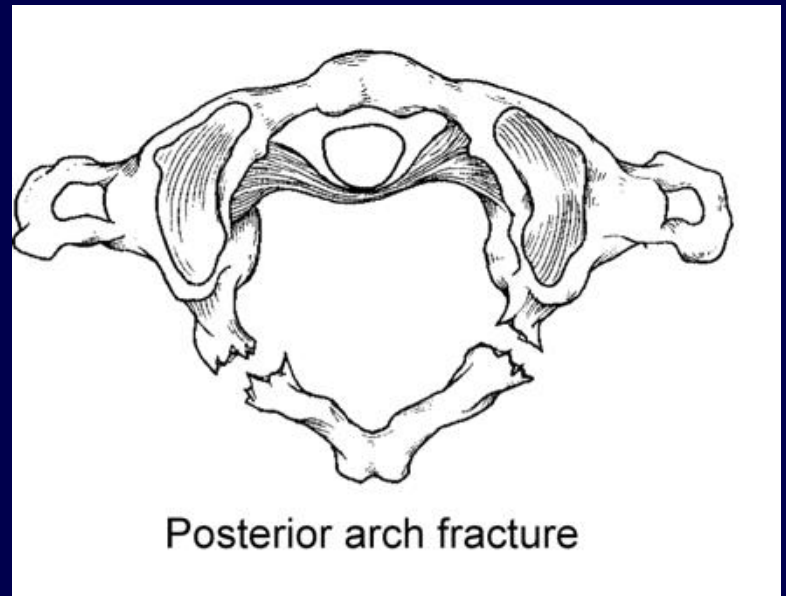
Coronal reconstruction from a CT confirms the findings from the odontoid view

Axial CT clearly shows the location of the fractures of C1



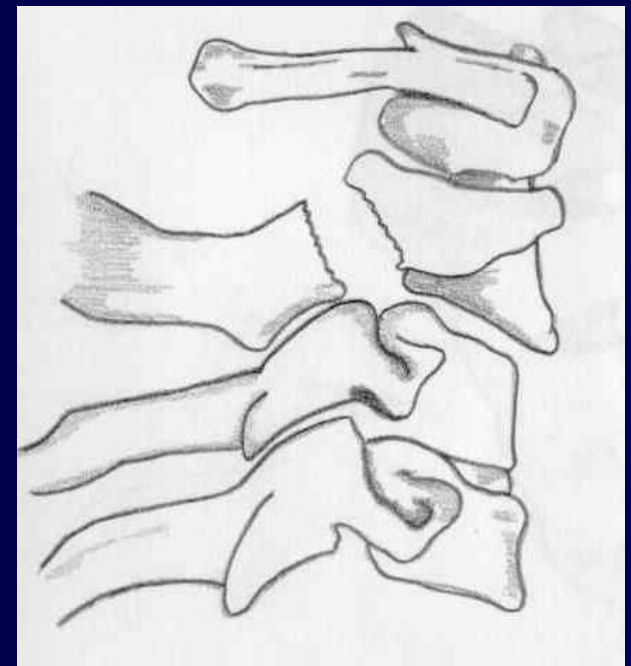
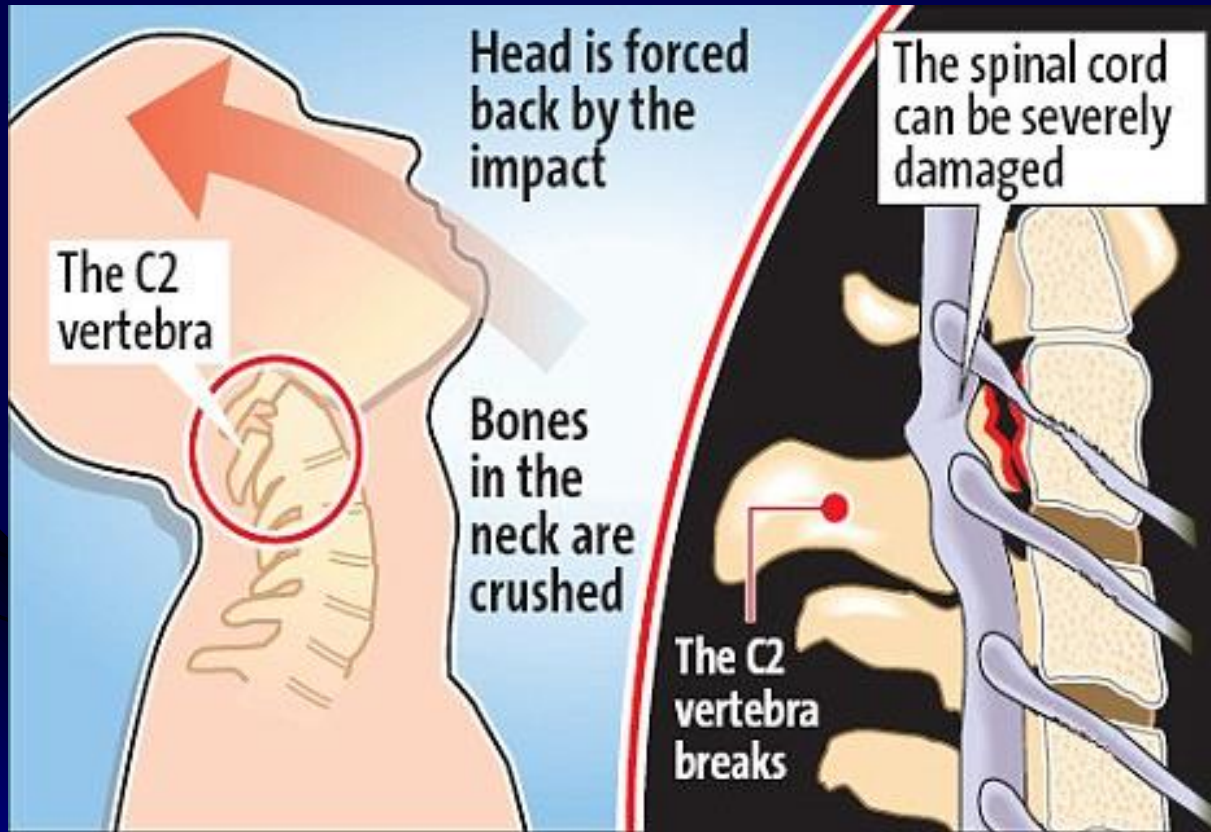


Jefferson fracture



Posterior arch fracture

Hangman's Fracture



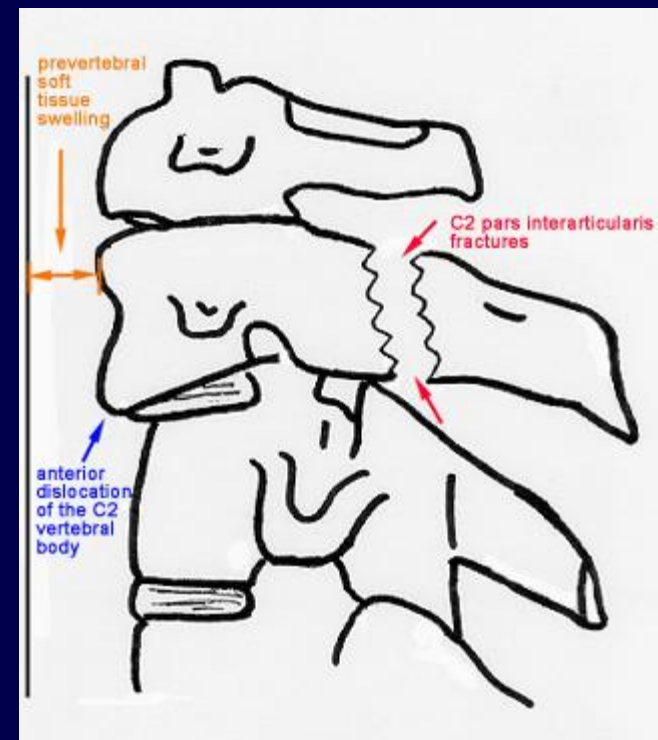
Hangman's Fracture

Fractures through the pars interarticularis of C2 resulting from hyperextension and distraction

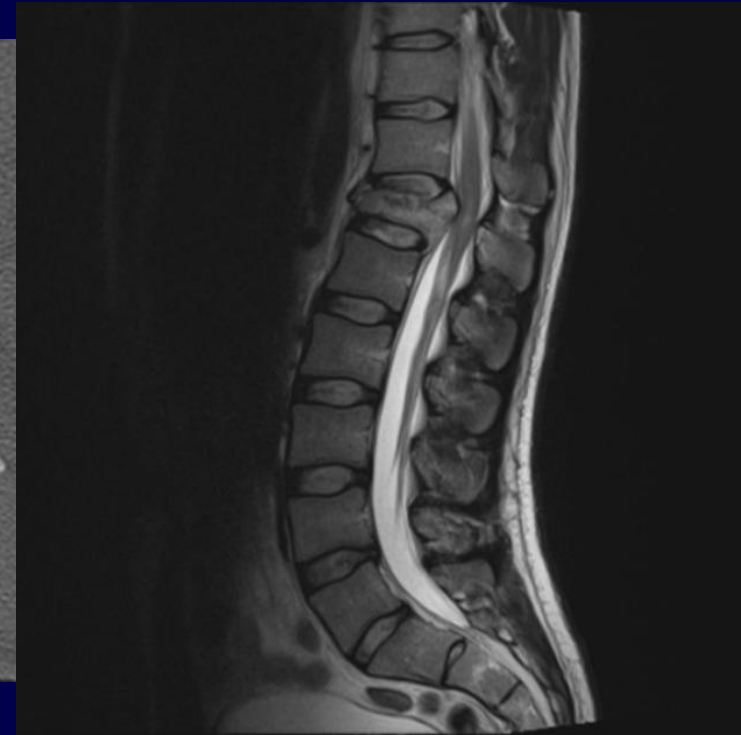
Hyperextension (e.g. hanging, chin hits dashboard in road accident)

Radiographic features: (best seen on lateral view)

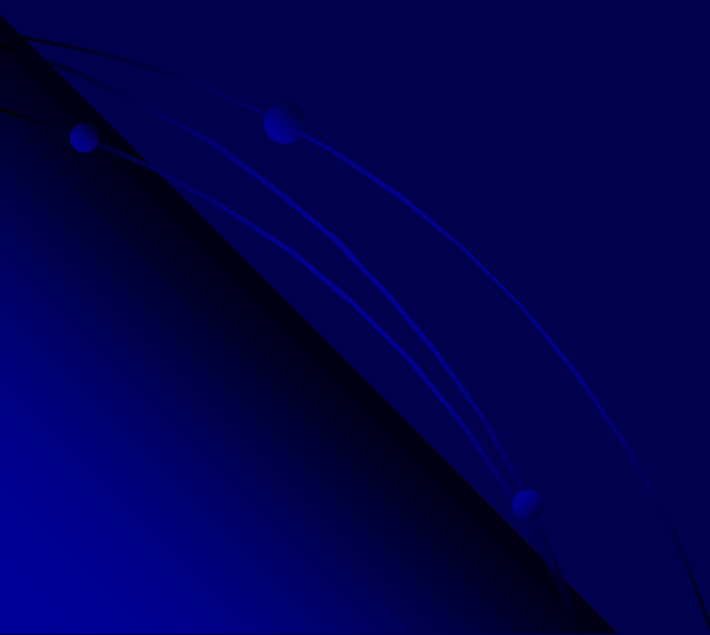
1. Prevertebral soft tissue swelling
2. Avulsion of anterior inferior corner of C2 associated with rupture of anterior longitudinal ligament.
3. Anterior dislocation of C2 vertebral body
4. Bilateral C2 pars interarticularis fractures



Burst fractures are 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.



INFECTIONS



Discitis and Osteomyelitis

Usually the result of blood-borne agents

Most common pathogen is staphylococcus, Streptococcus less common
Gram-negative rods in IV drug abusers or immunocompromised patients

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

Discitis and Osteomyelitis

IMAGING FINDINGS

PLAIN FILMS

- 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

Spondylo-discitis

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

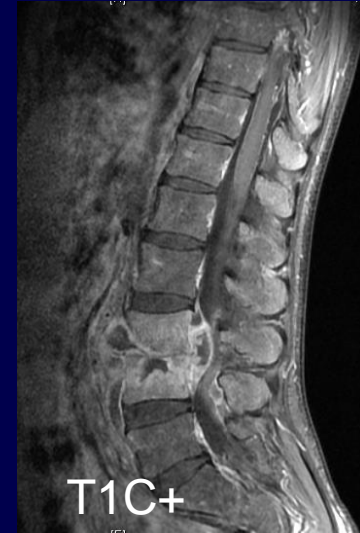
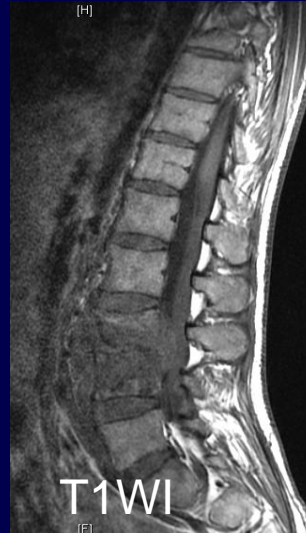


Spondylo-discitis

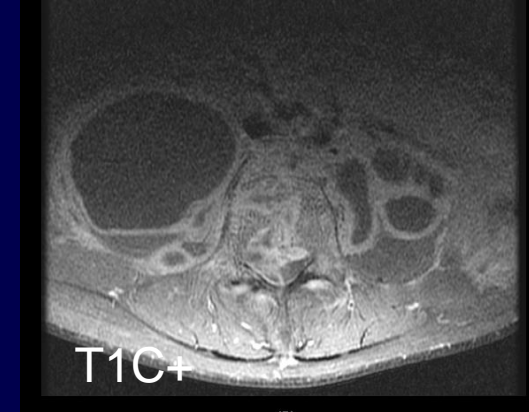
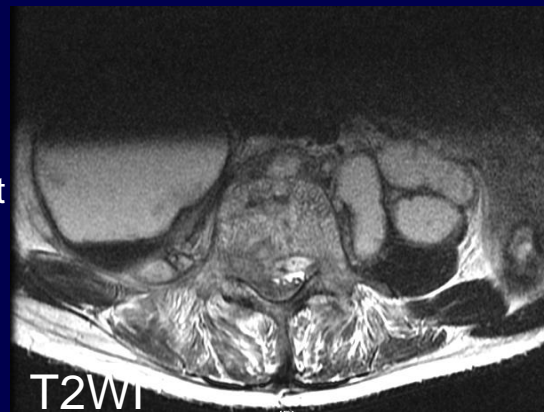
Sagittal T1WI shows decreased signal of vertebral bodies and disc with end plate destruction.

Sagittal T2WI shows increased signal in corresponding areas with anterior subligamentous and intraspinal epidural abscess.

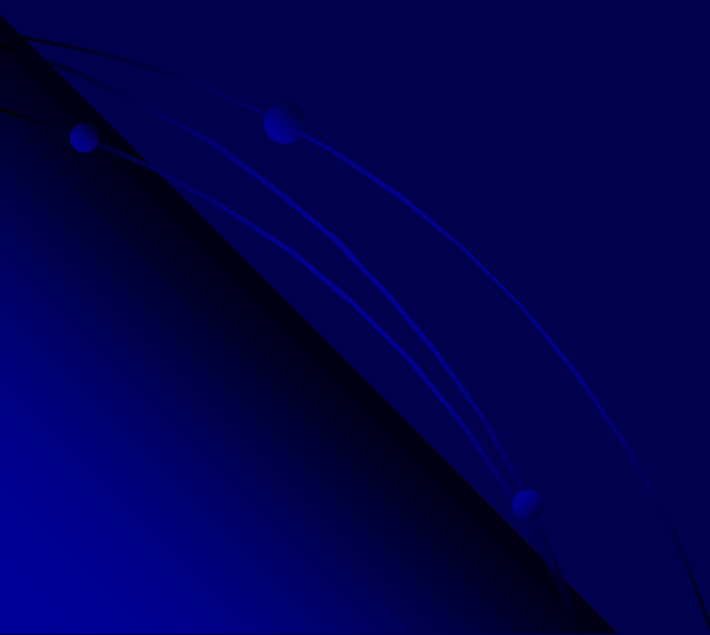
Sagittal contrast-enhanced T1-fat sat shows intense enhancement the involved area



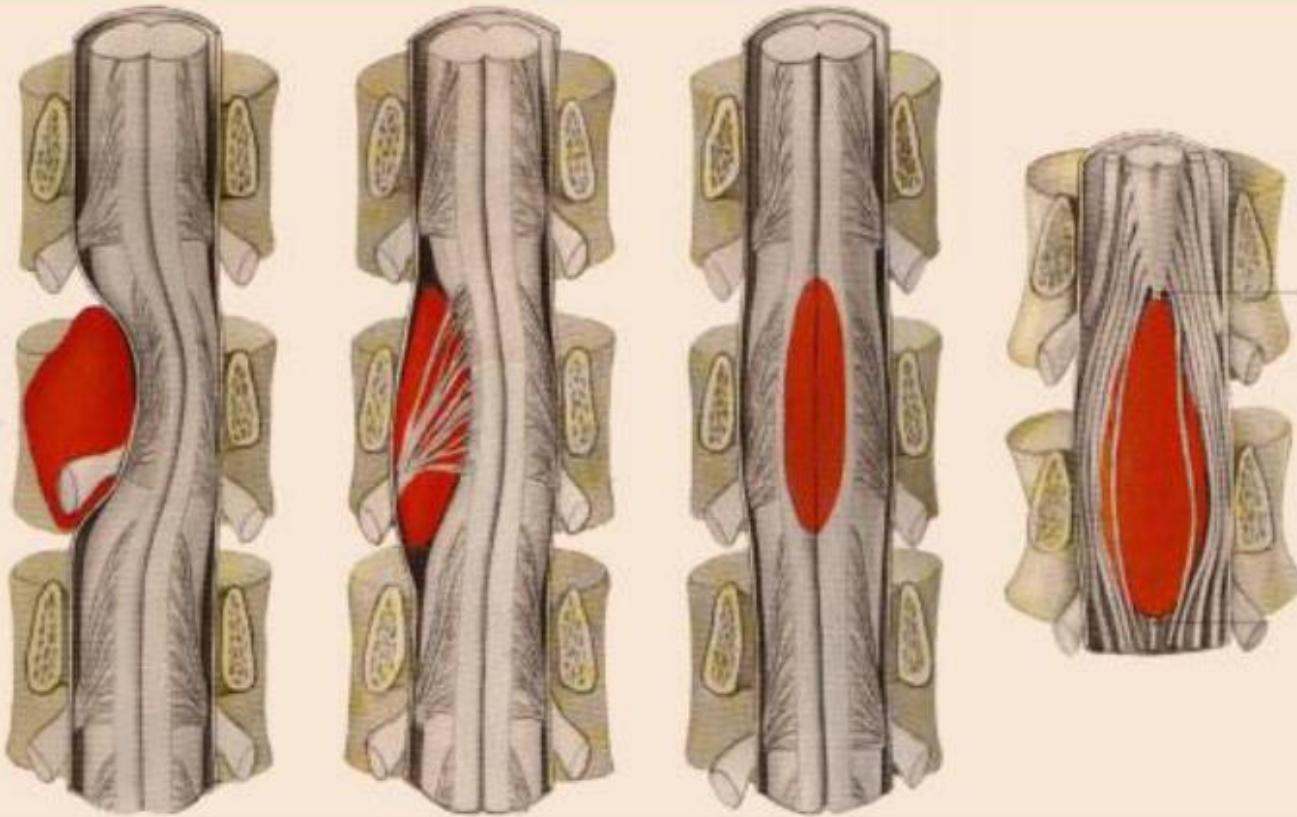
Axial T2WI and axial contrast-enhanced T1 fat sat show the para spinal large abscesses



TUMORS



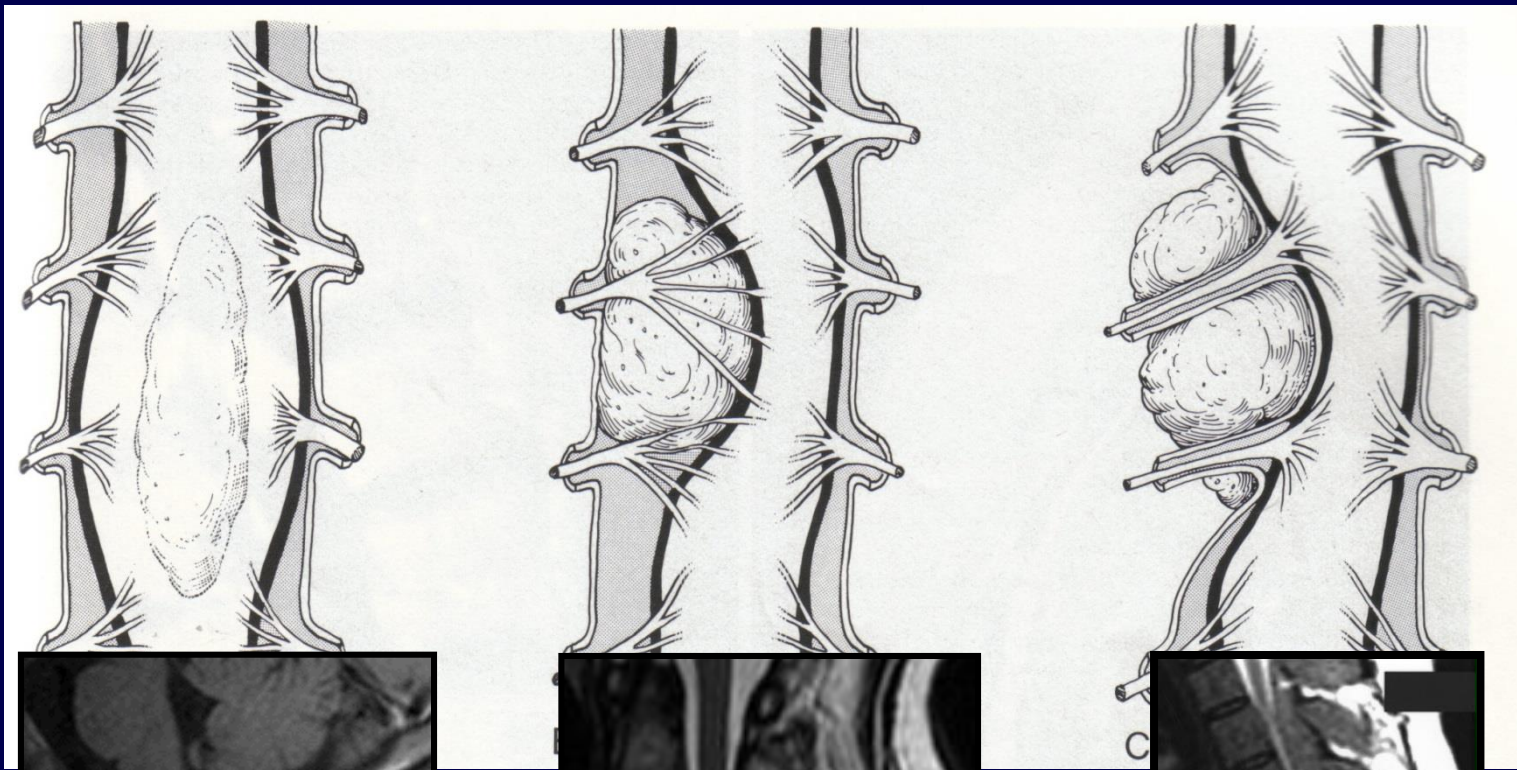
Spinal compartments

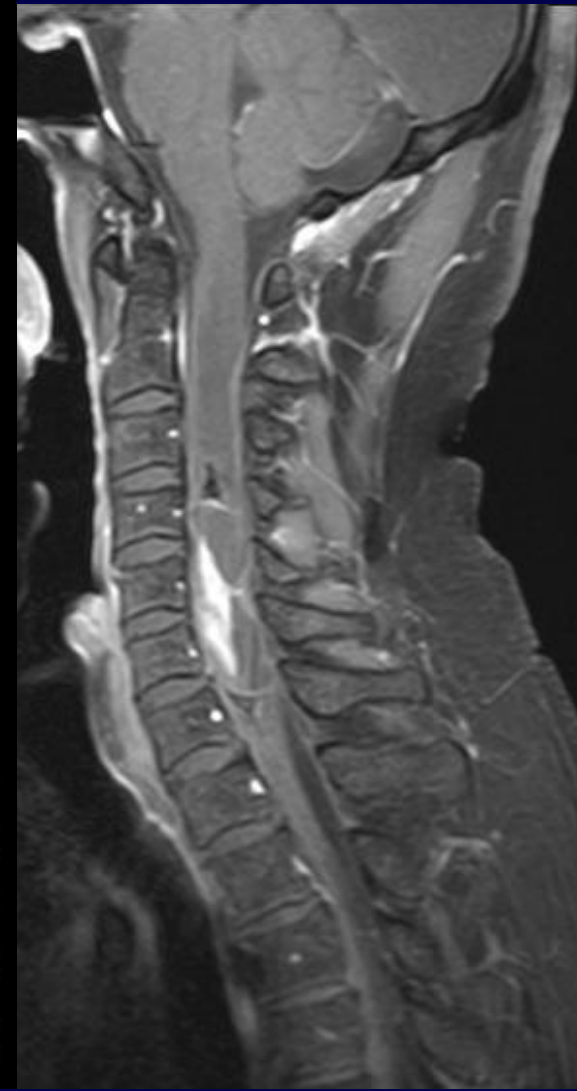
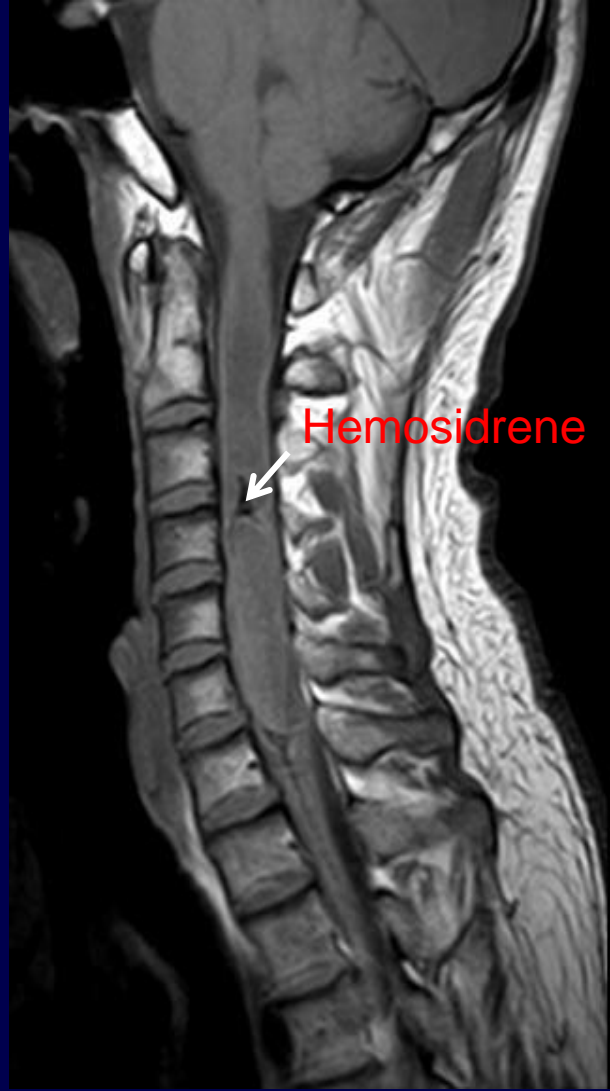


Extradural

Intradural
extramedullary

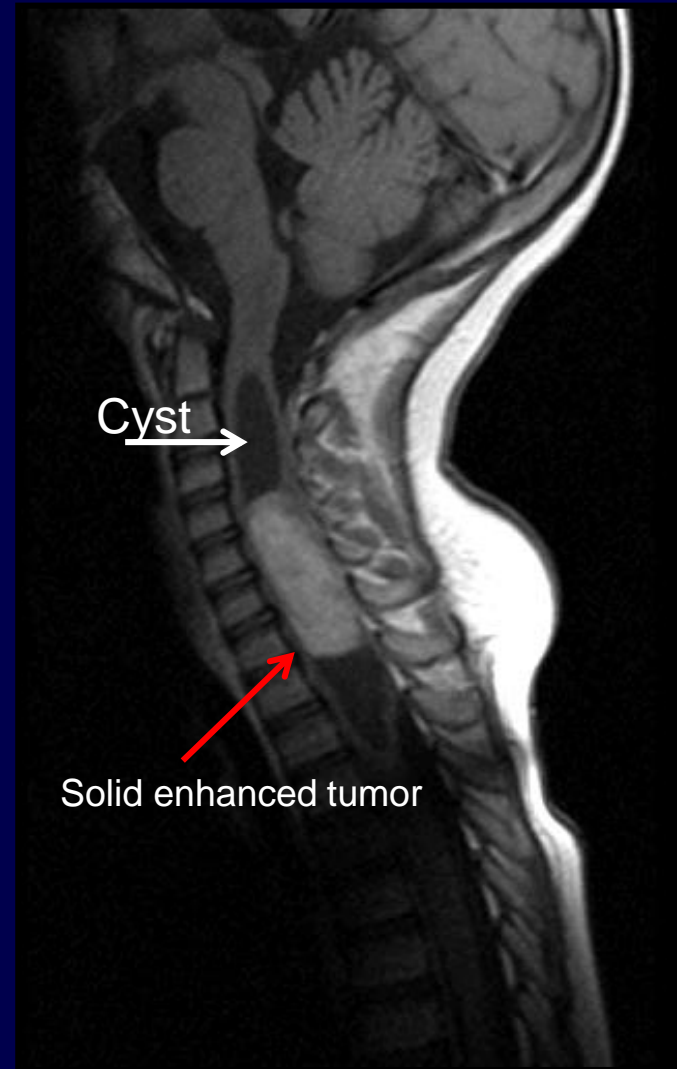
Intramedullary



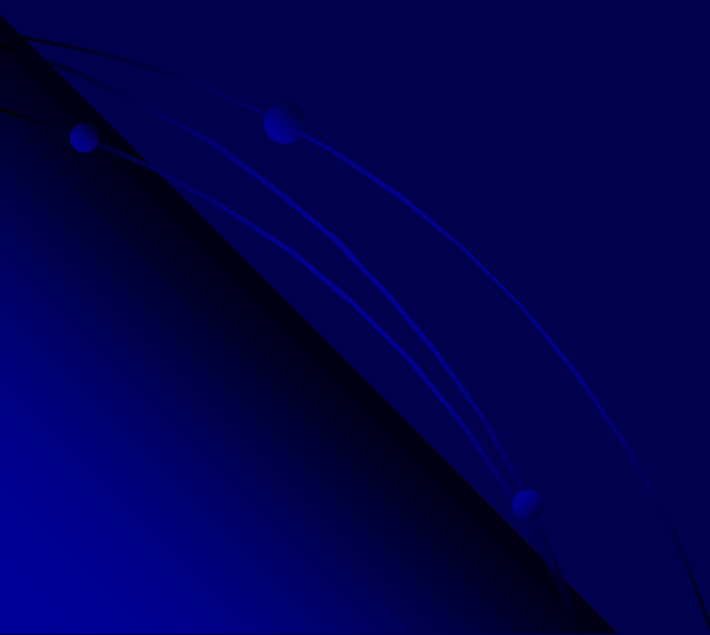


Ependymoma

Astrocytoma



INFLAMMATORY



Multiple Sclerosis

MS is an immune-mediated inflammatory demyelinating disease of the brain and the spinal cord.

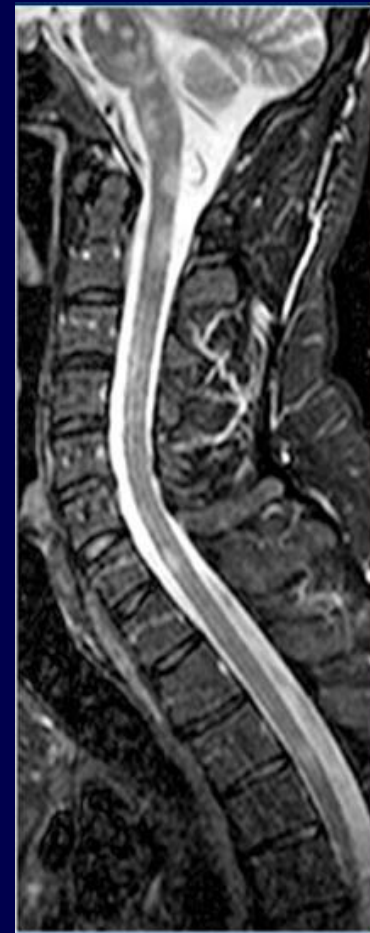
MS is the most common demyelinating disease and there is overlap between these diseases:

- 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.

Multiple Sclerosis

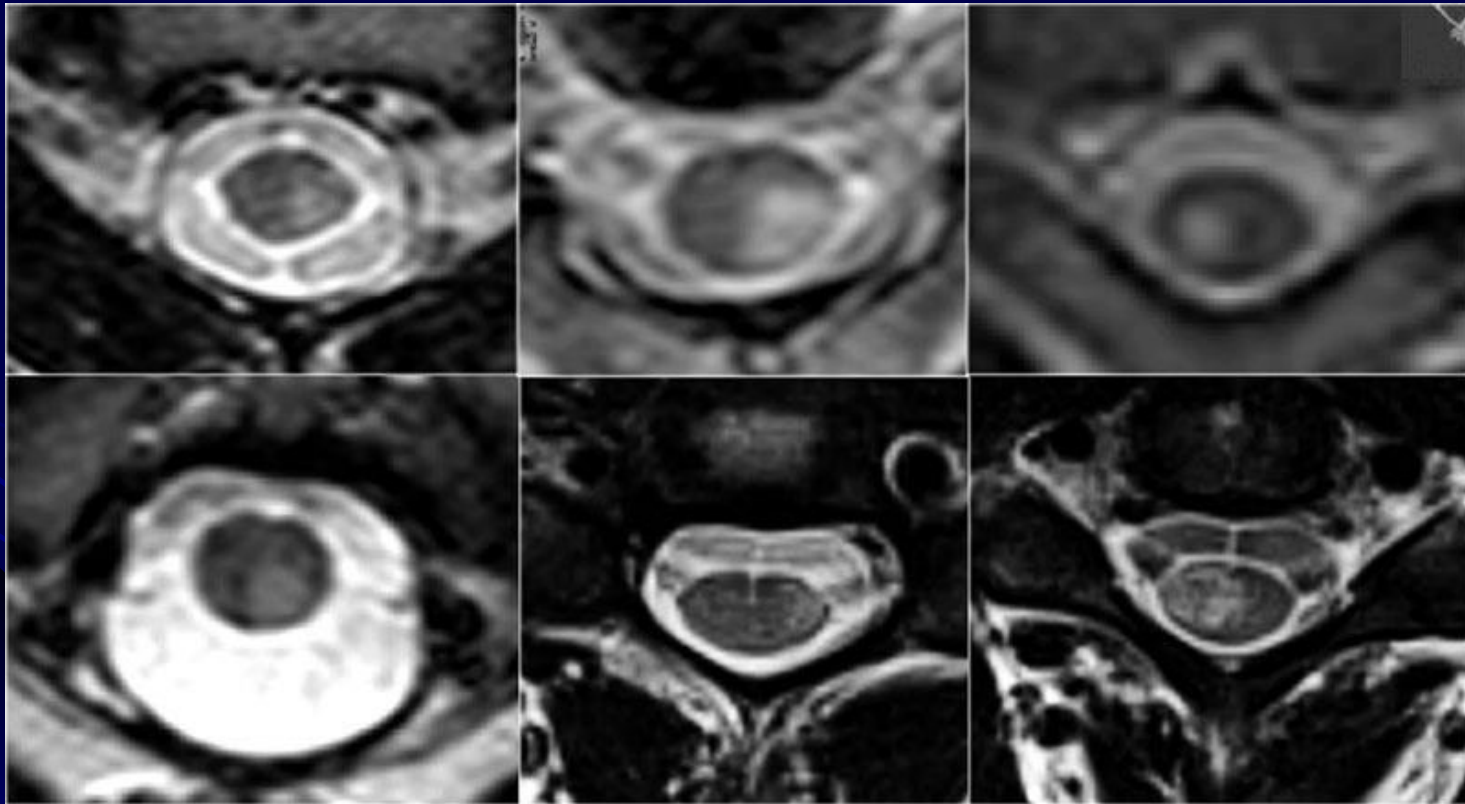
SPINAL CORD LESIONS

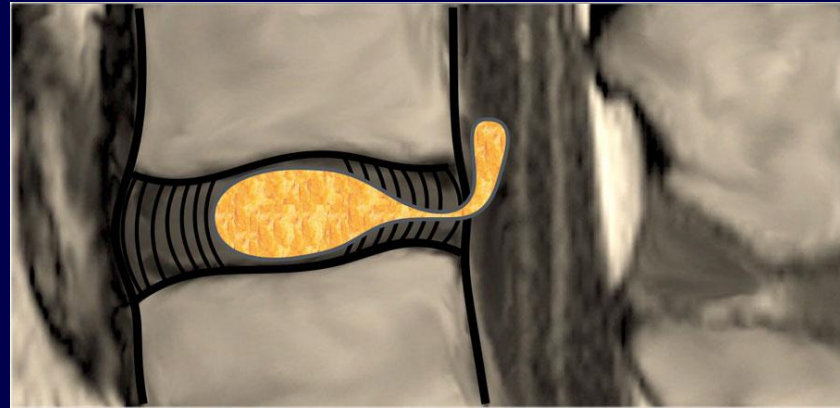
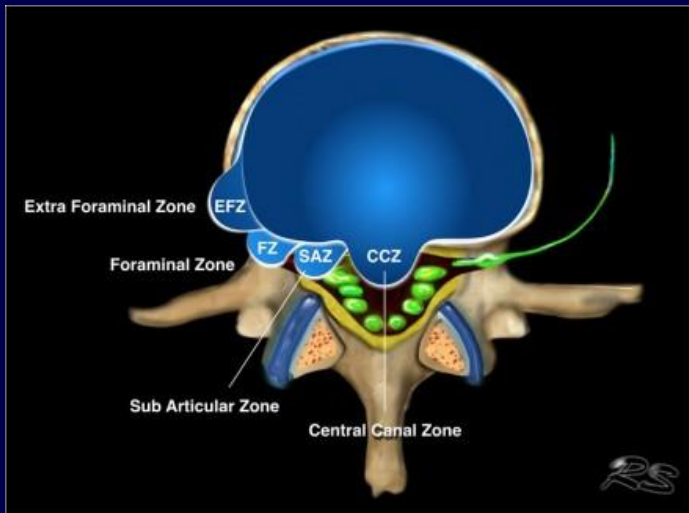
- Mostly in cervical cord (60%) and conus
- Less commonly in thoracic region
- More than 1 lesion in 55%
- <2 segments (2-60mm) in craniocaudal length
- Eccentric
- No or very little mass effect or cord swelling
- Lesions only in spinal cord in 5-24%
- May result in cord atrophy → Disability



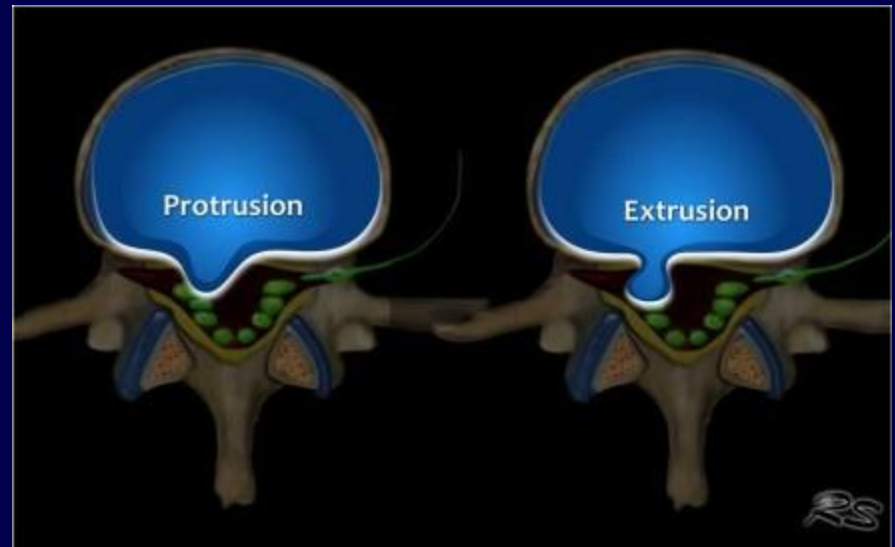
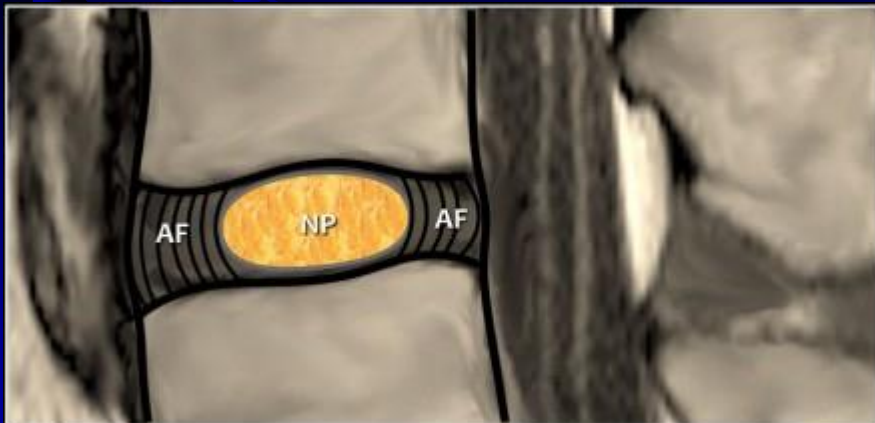
Multiple Sclerosis

On transverse images MS lesions typically have a round or triangular shape and are located posteriorly or laterally.

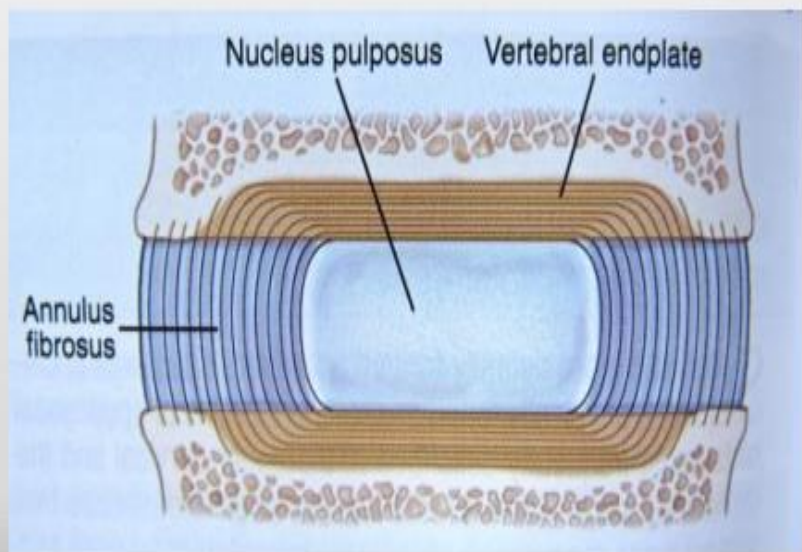




DISC DISEASE



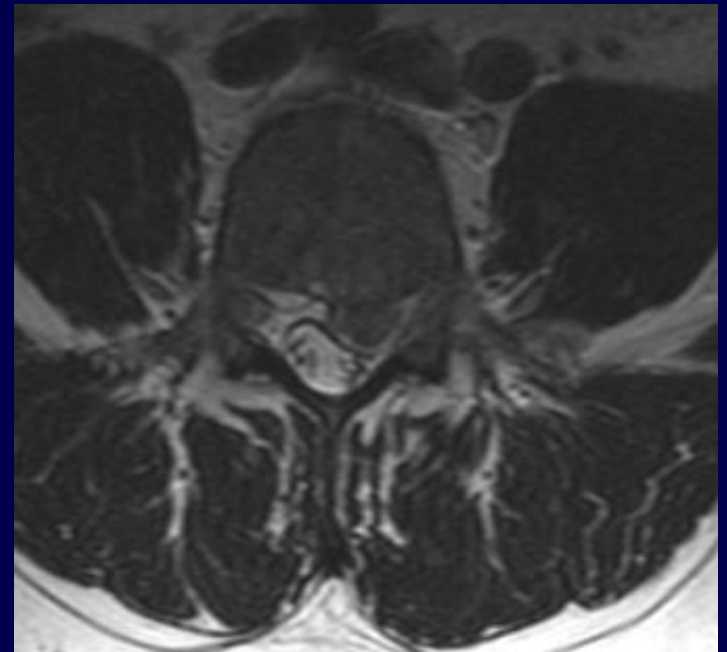
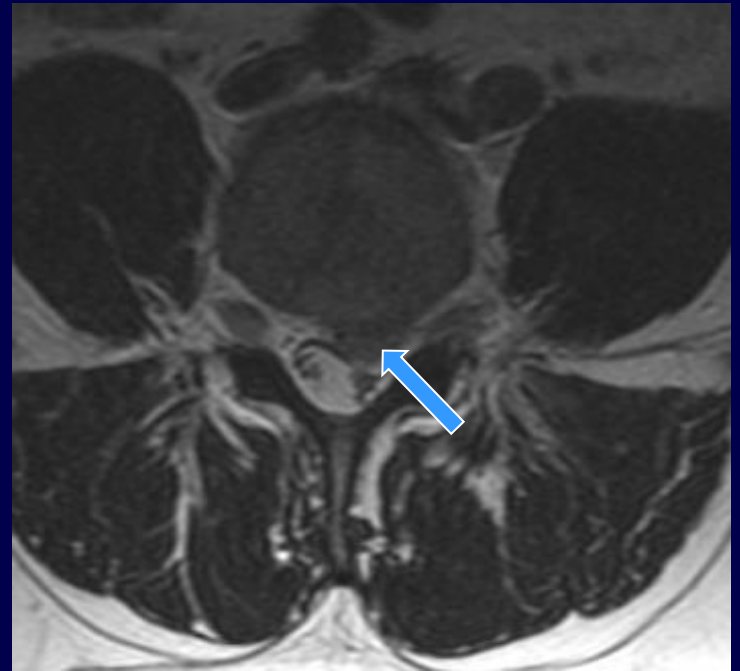
Intervertebral disc



T2

T1

T1 FS



Disc herniation with sequestered disc fragment

	Indications	Advantages	Disadvantages
X-Ray	Trauma Intra-operative localization	Inexpensive Widely available Quick Portable	Radiation exposure Difficulty in interpretation High rate of false-positive findings
CT	Trauma	Visualization of bony structures Widely available Quick	Less useful at visualizing soft tissue structures Radiation exposure Cost
MRI	Pts with "red flags" case Radiculopathy Tumor Myelopathy	Visualization of soft tissue structures (e.g. relationship of disc to nerve) No radiation exposure	Contraindications: presence of ferromagnetic implants, cardiac pacemakers, intracranial clips, Claustrophobia Not widely available

thank you

