Lecture Title:

RADIOLOGY OF SPINE DISEASES..

(RAD 366, Radiology)

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Lecture Date: Jan 2019

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)

X-RAYS (RADIOGRAPHS)

Often the first diagnostic imaging test, quick and cheap

Small dose of radiation to visualize the bony parts of the spine

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 (loss of calcium from the bone)
- Infections
- Tumors

May be taken in different positions (flexion and extension) to assess for instability

COMPUTERIZED TOMOGRAPHY (CT SCAN)

Uses radiation

Obtain 2-D images → can be processed to 3-D images

Patients lies on a table that moves through a scanner

Much detailed information regarding bony structures

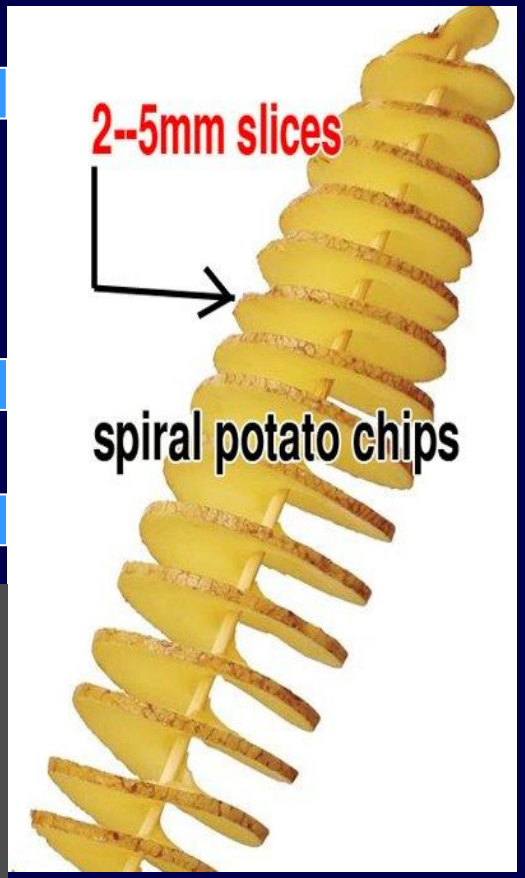
Limited information about spinal cord & soft tissues

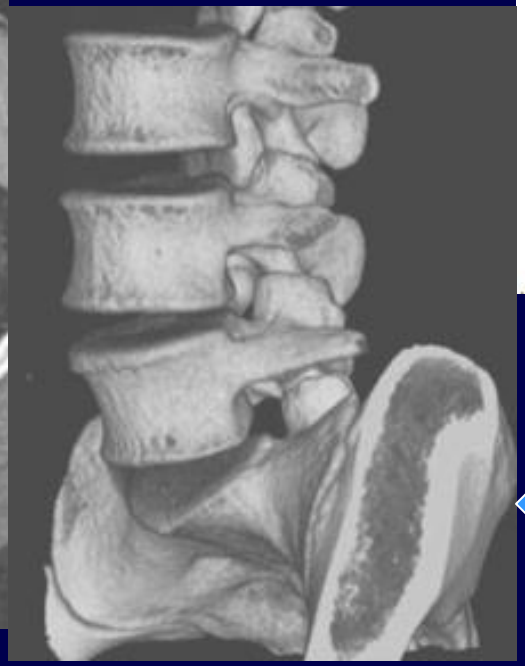
Entire spine can be imaged within a few minutes

COMPUTERIZED TOMOGRAPHY (CT SCAN)

Better in visualizing

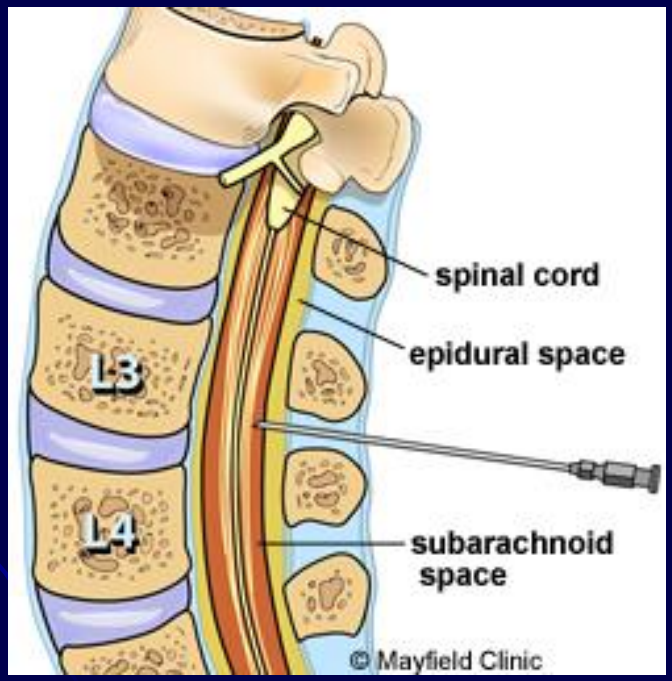
- Degenerative or aging changes, Herniated discs
- Spinal alignment
- Fractures and fracture patterns
- Congenital / childhood anomalies
- Areas of narrowing in spinal canal through which spinal cord and spinal nerve roots pass


2--5mm slices
spiral potato chips



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

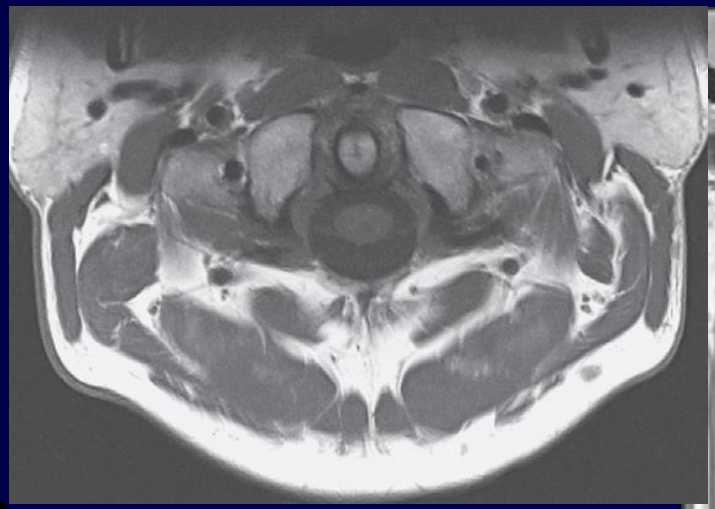
Intravenous contrast is sometimes administered to better visualize certain structures or abnormalities

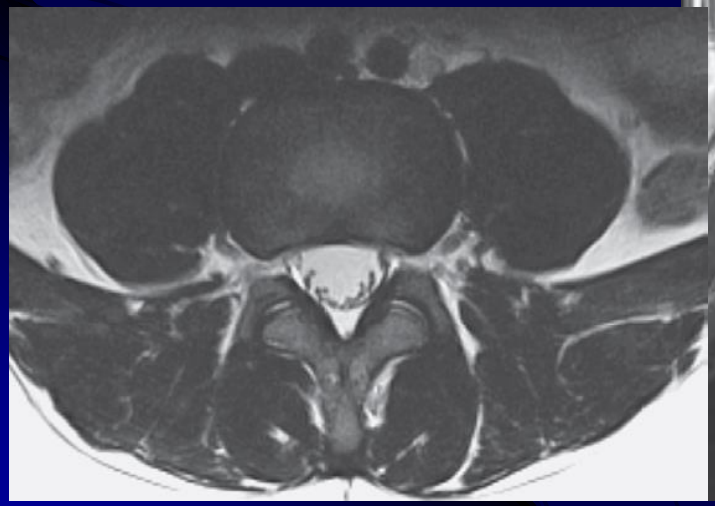
Patient lies still in a tunnel like structure for about 25 minutes

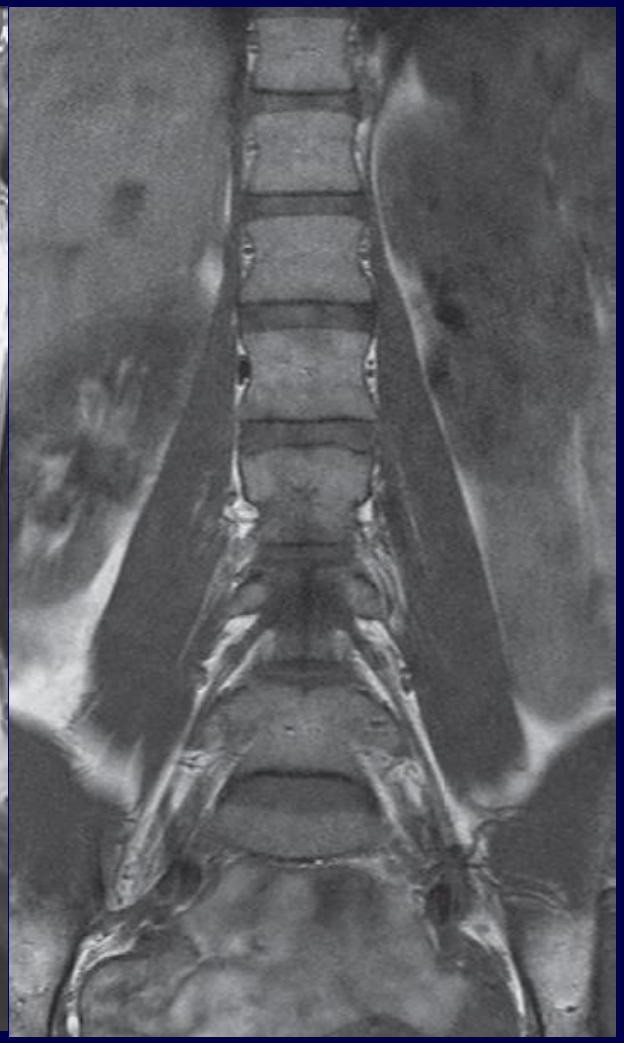
MRI SCANNER (closed type)

MRI SCANNER (open type)

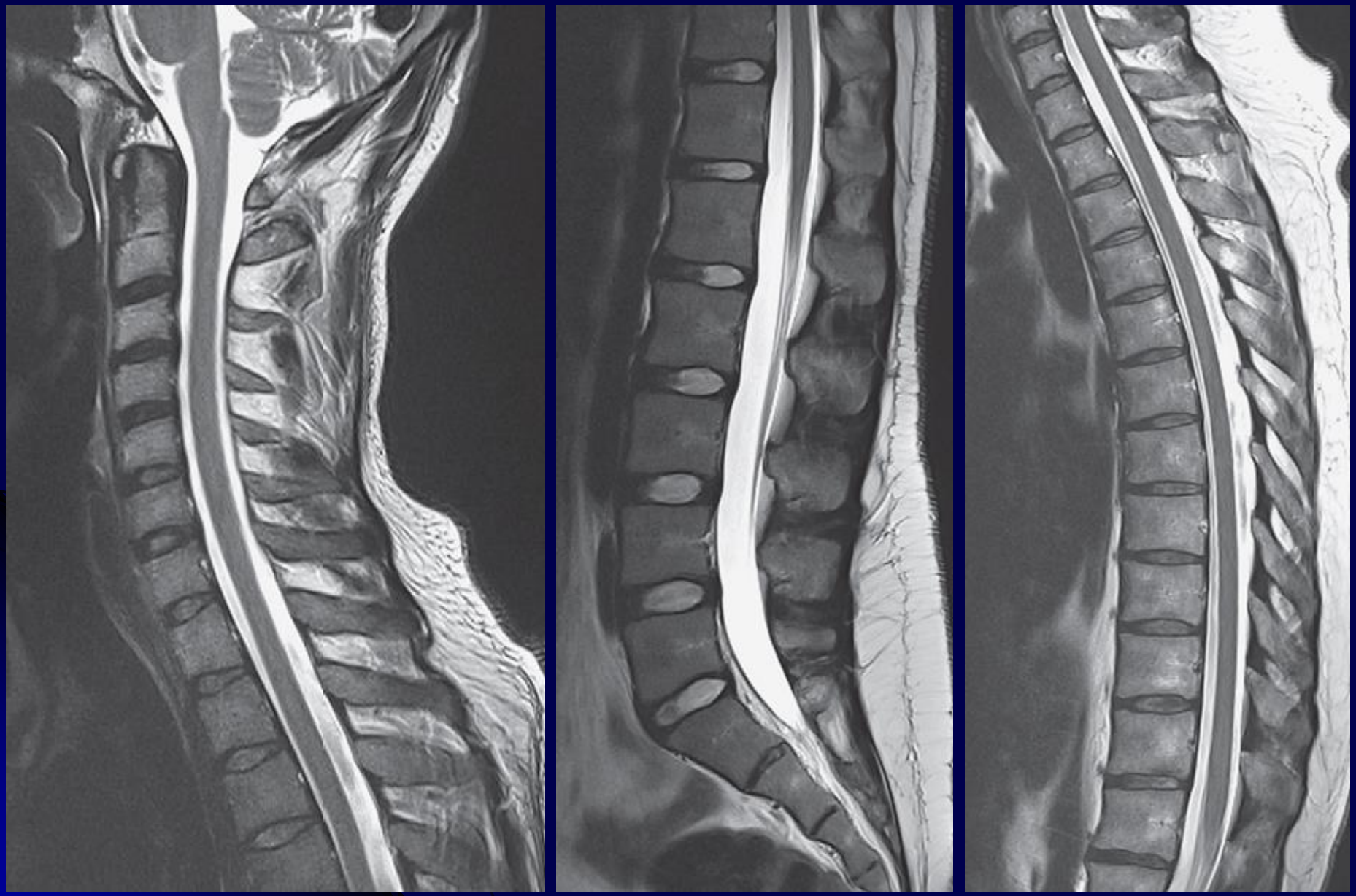
MR images are multi-planar







MR images are very high resolution



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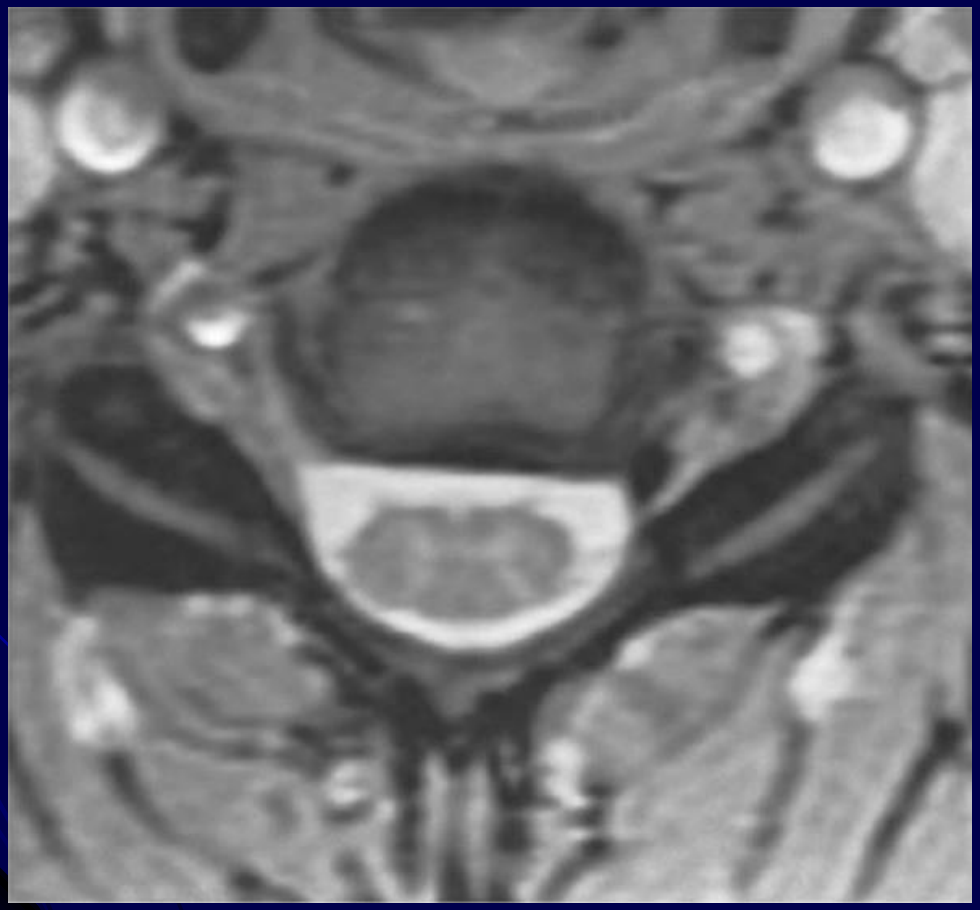
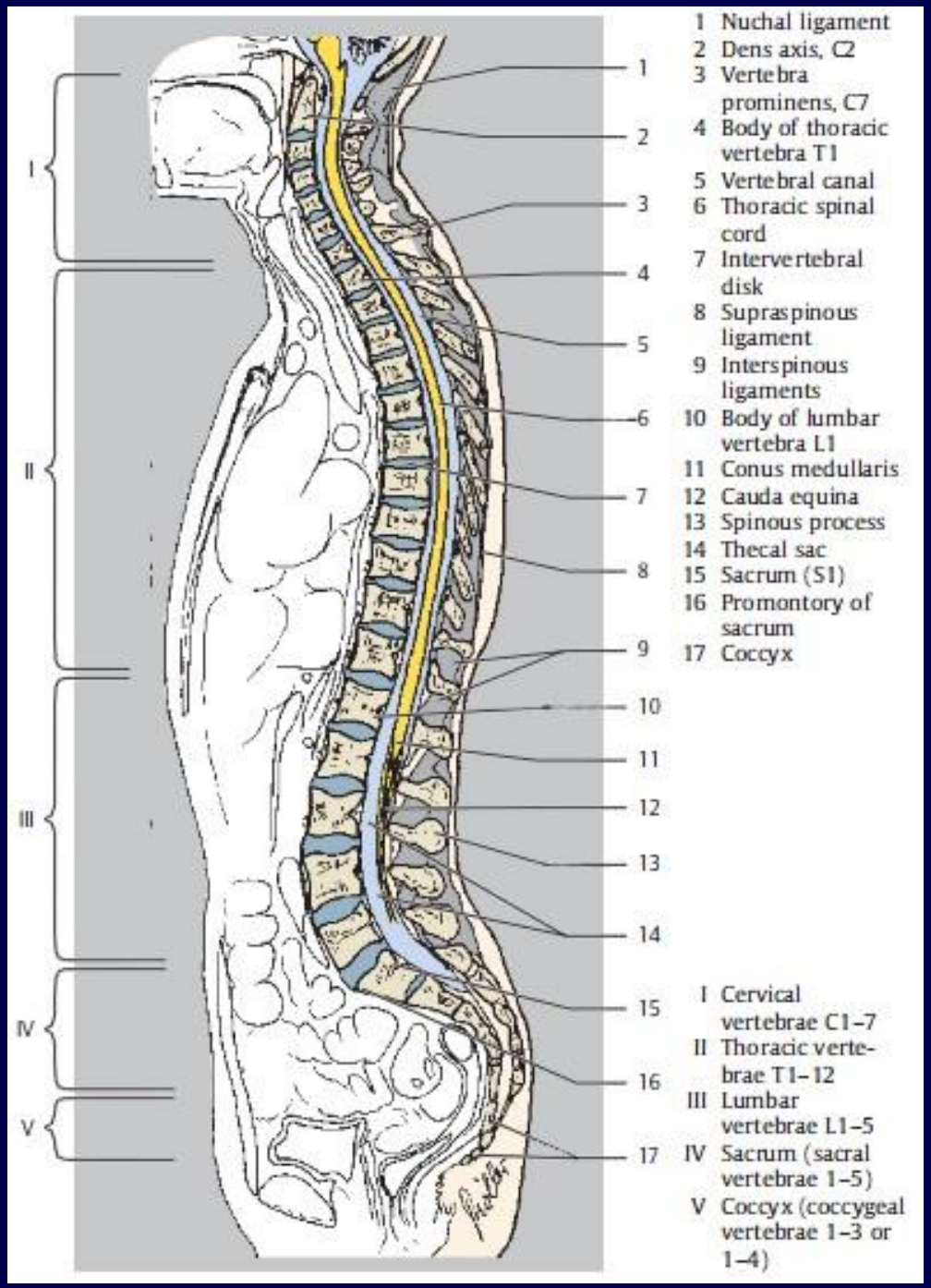


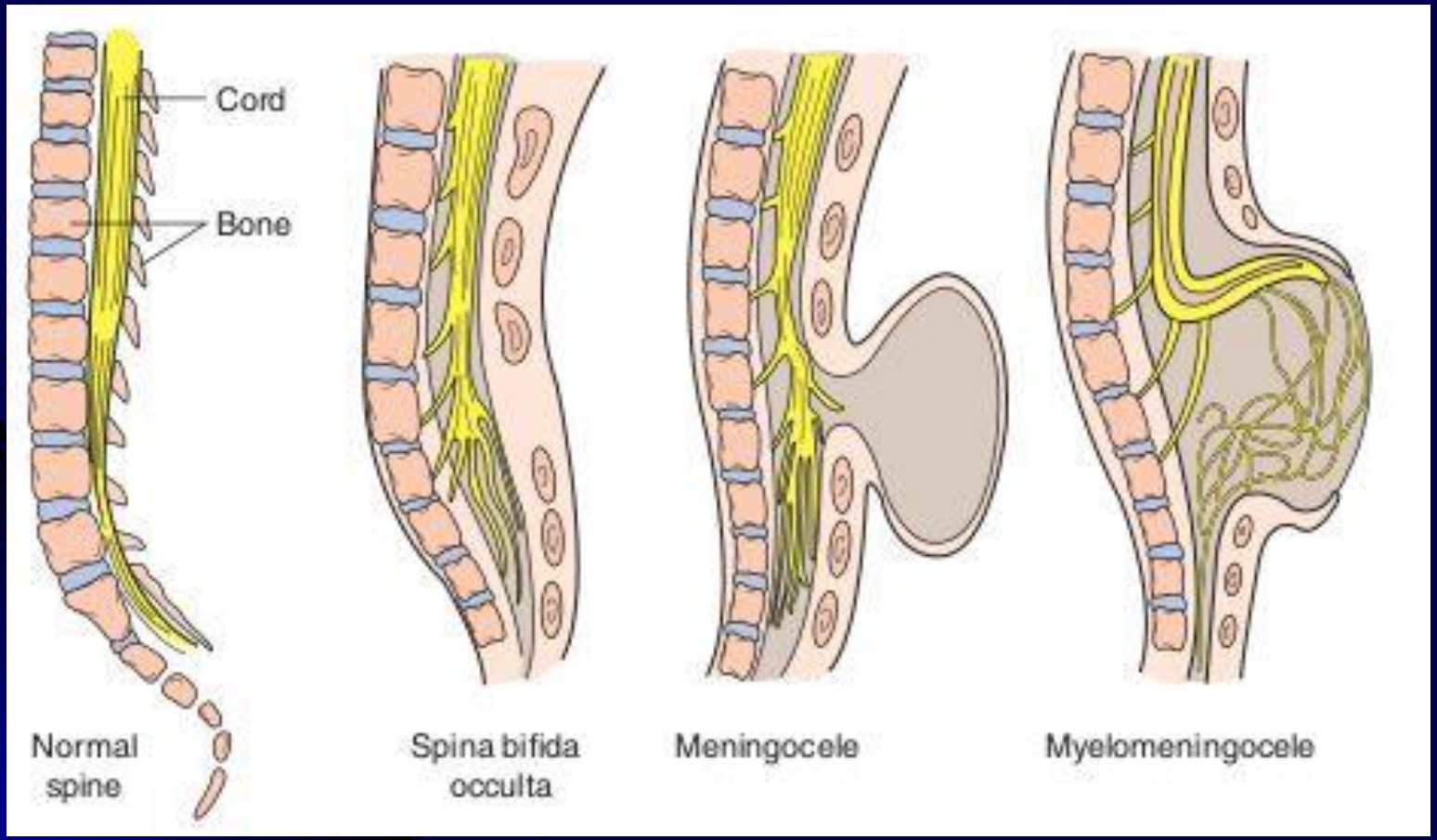

1 Nuchal ligament
2 Dens axis, C2
3 Vertebra prominens, C7
4 Body of thoracic vertebra T1
5 Vertebral canal
6 Thoracic spinal cord
7 Intervertebral disk
8 Supraspinous ligament
9 Interspinous ligaments
10 Body of lumbar vertebra L1
11 Conus medullaris
12 Cauda equina
13 Spinous process
14 Thecal sac
15 Sacrum (S1)
16 Promontory of sacrum
17 Coccyx
I Cervical vertebrae C1–7
II Thoracic vertebrae T1–12
III Lumbar vertebrae L1–5
IV Sacrum (sacral vertebrae 1–5)
V Coccyx (coccygeal vertebrae 1–3 or 1–4)

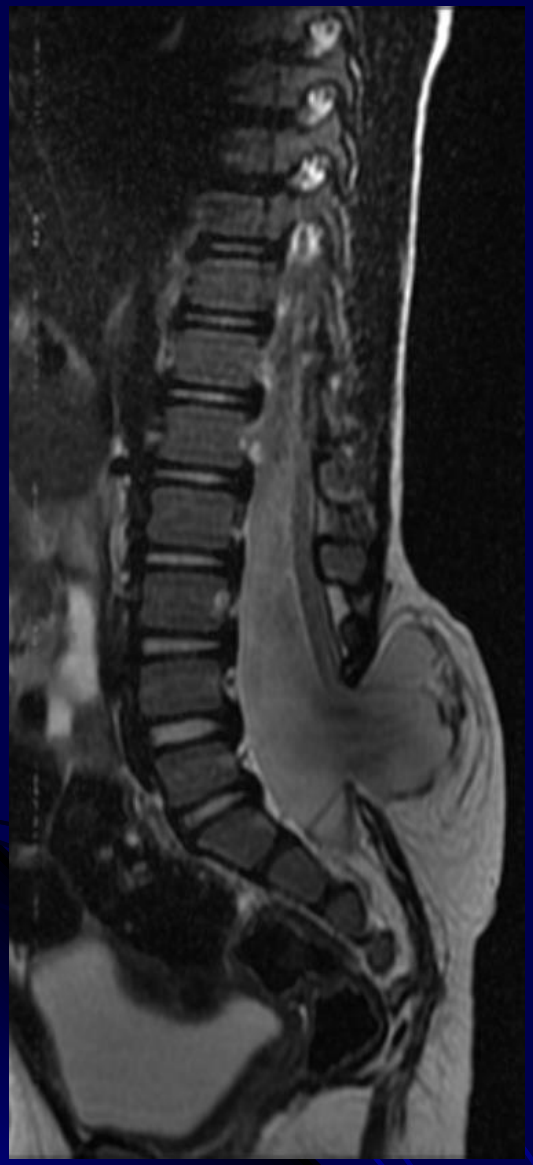
Congenital Anomalies

CONGENITAL ANOMALIES

MRI is the best to assess the contents of the cavity, extent of abnormalities, and spinal cord.

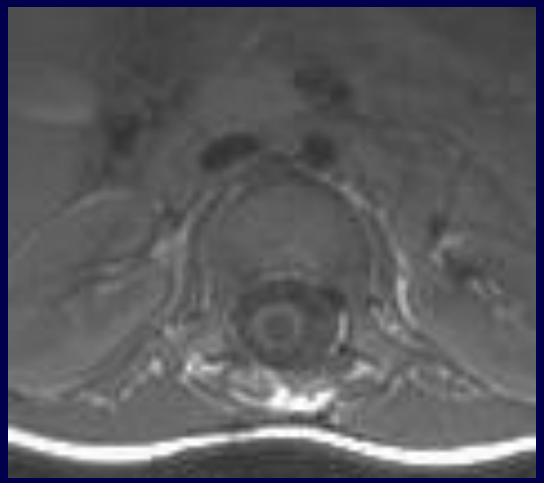
CT shows bony structures the best and is often used before surgery

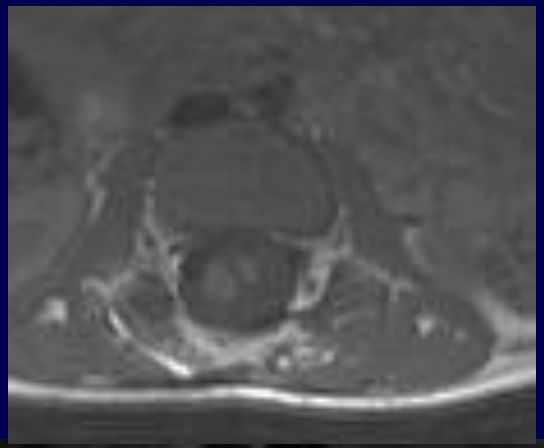


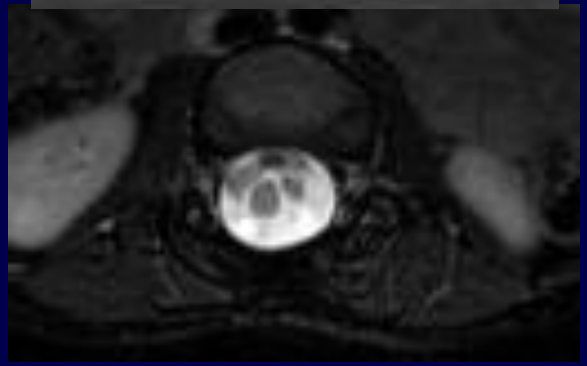


Meningocele

Low lying cord tethered to large lipoma





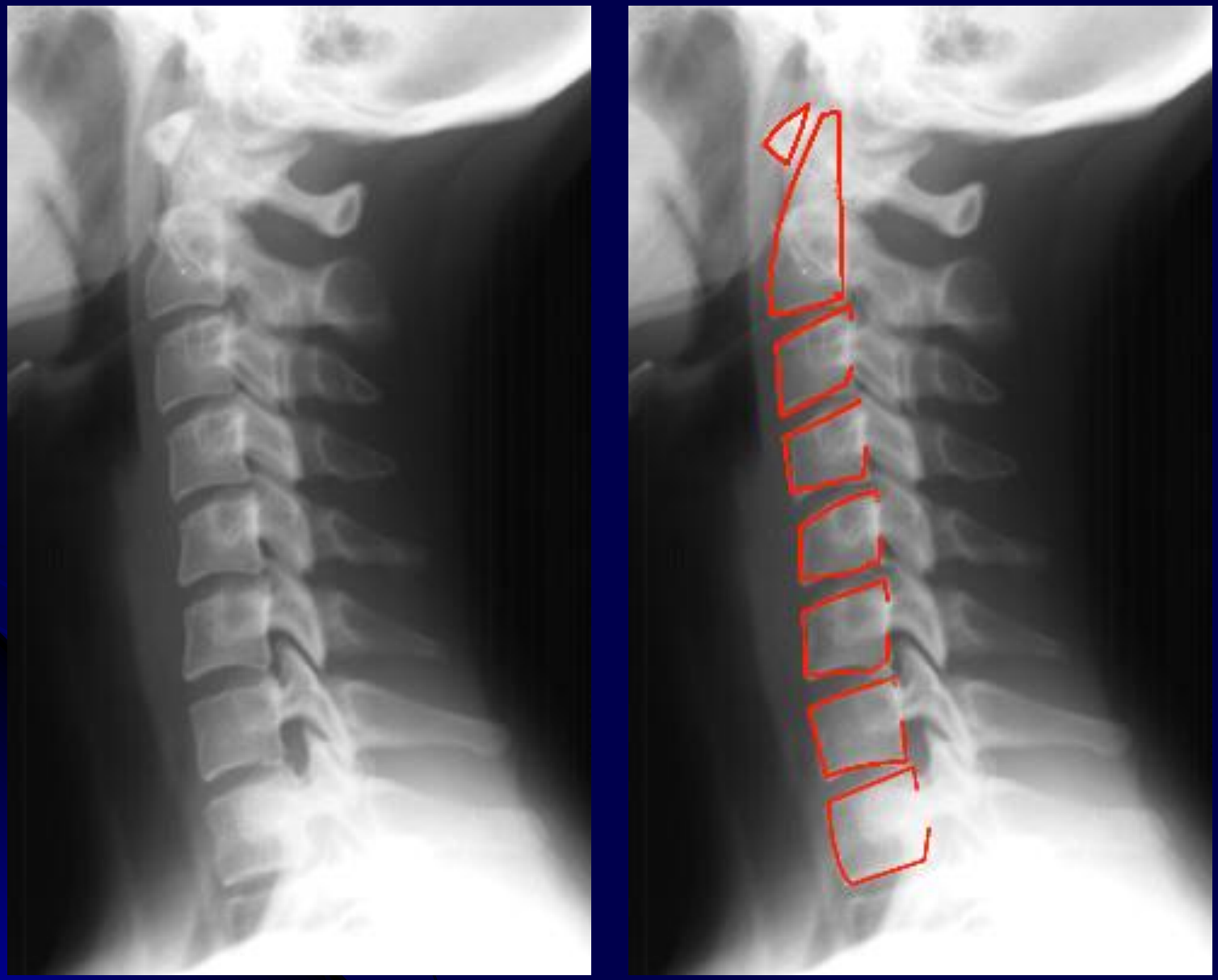


Split low lying cord (diastematomyelia)

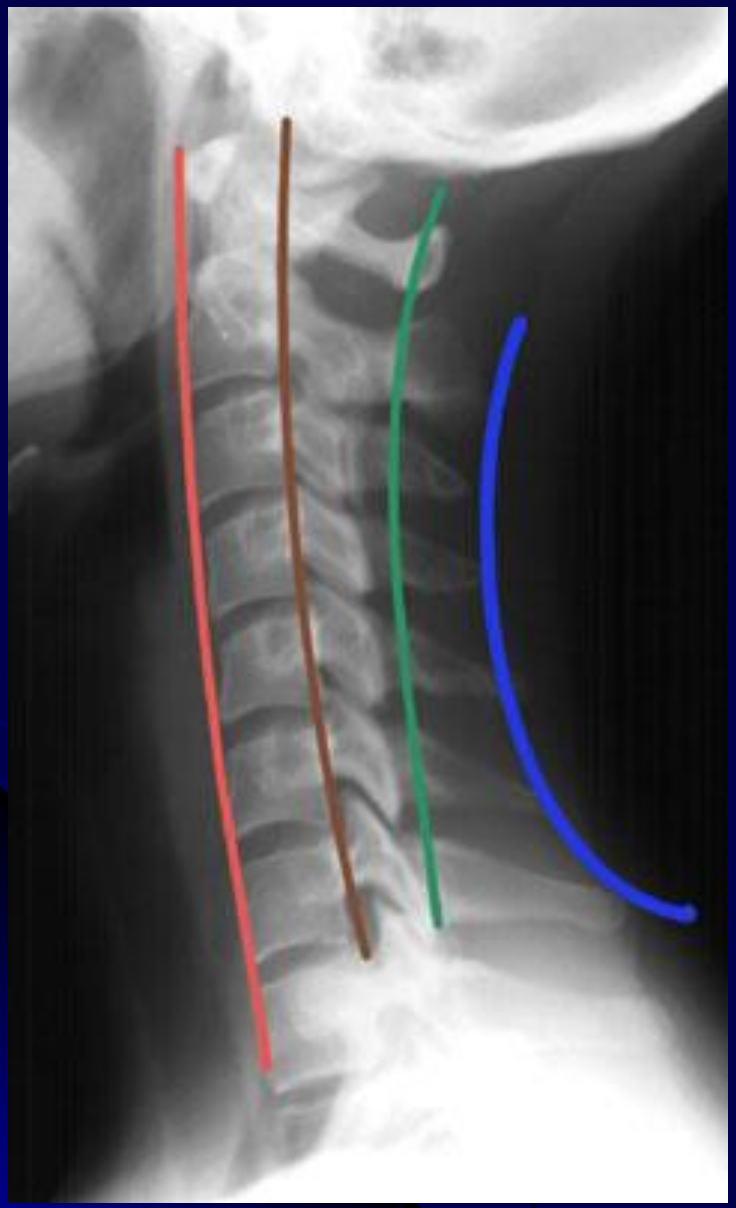
Multiple fusion abnormalities of vertebrae on plain film

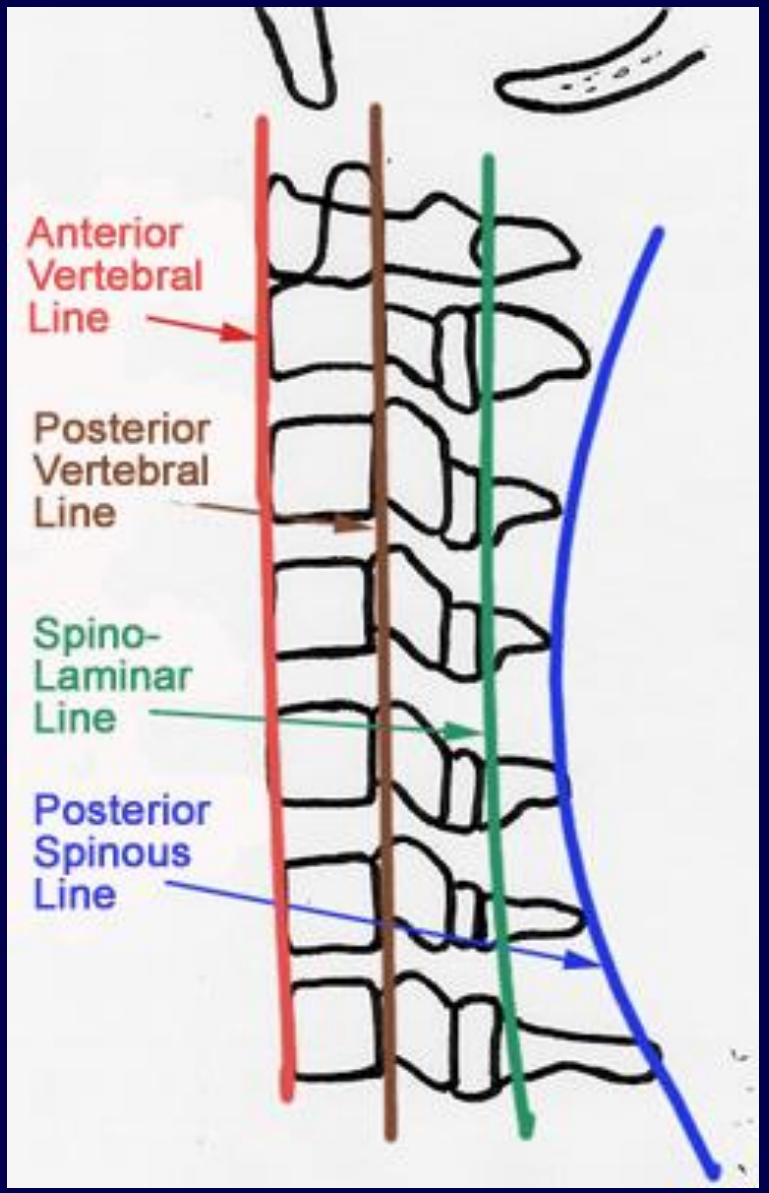
TRAUMA

Plain film assessment of trauma – the first imaging method



Alignment should be normal – check by drawing lines

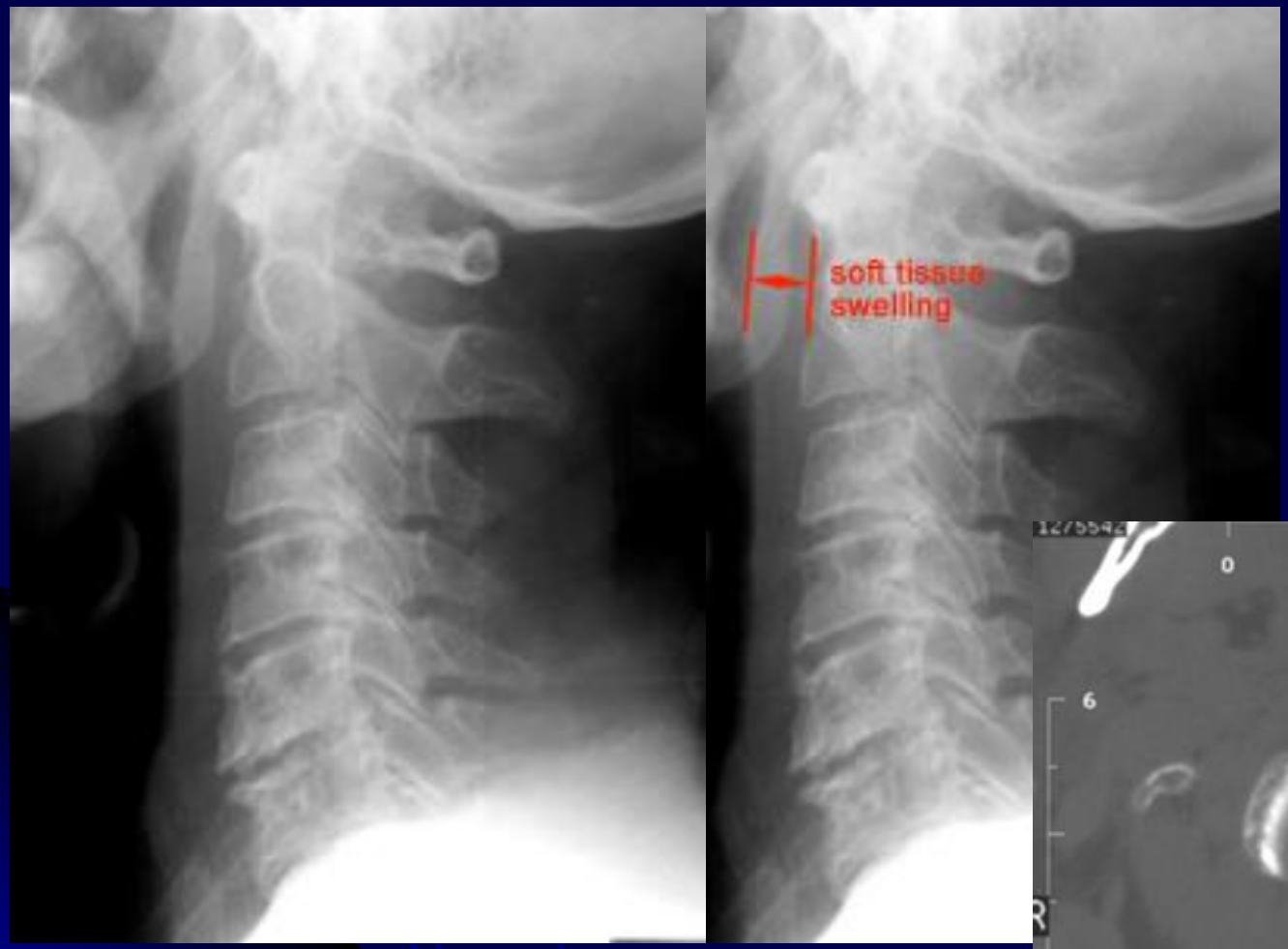


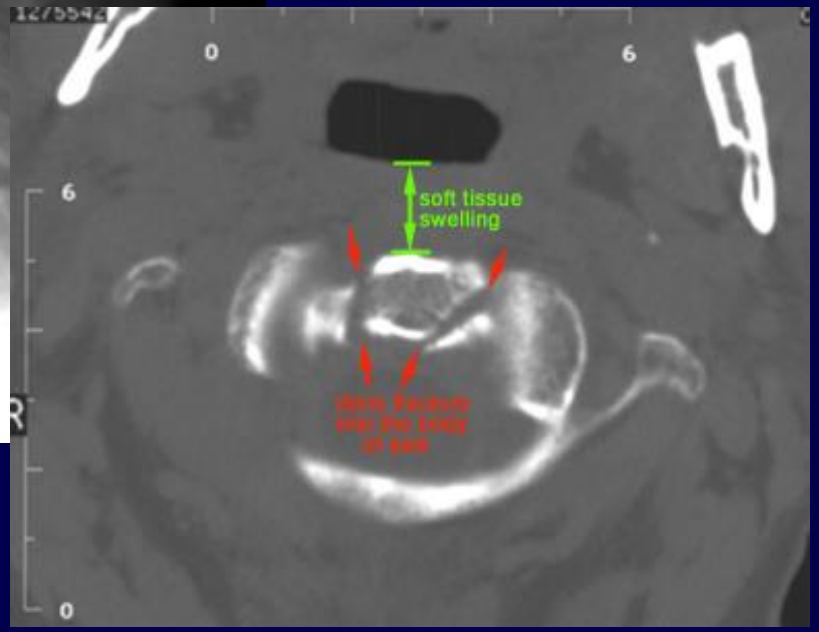



double corticle line
lateral mass
facet joint
lamina
spinous process
pedicle


naso-
pharyngeal
space
retro-
pharyngeal
space
retro-
tracheal
space

Soft tissue anterior to spine is very important



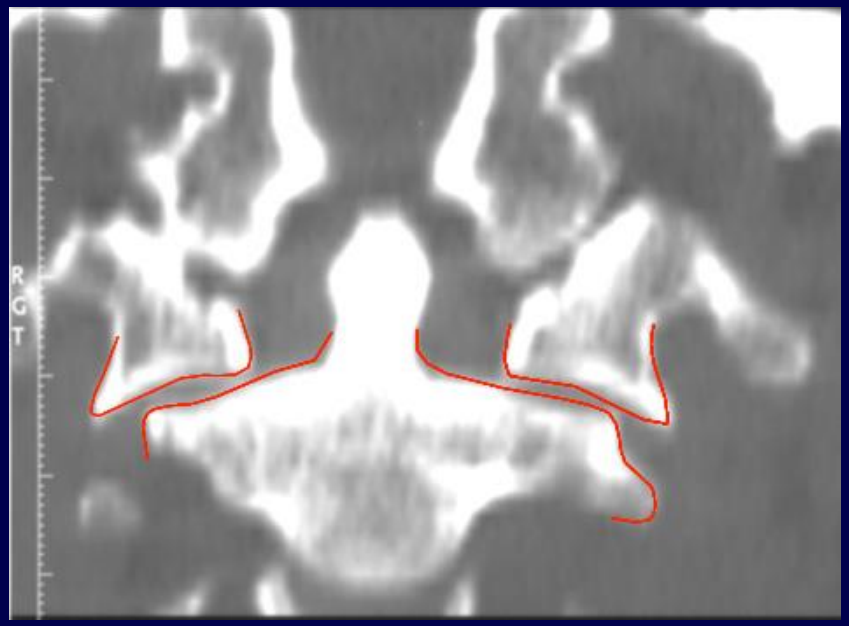


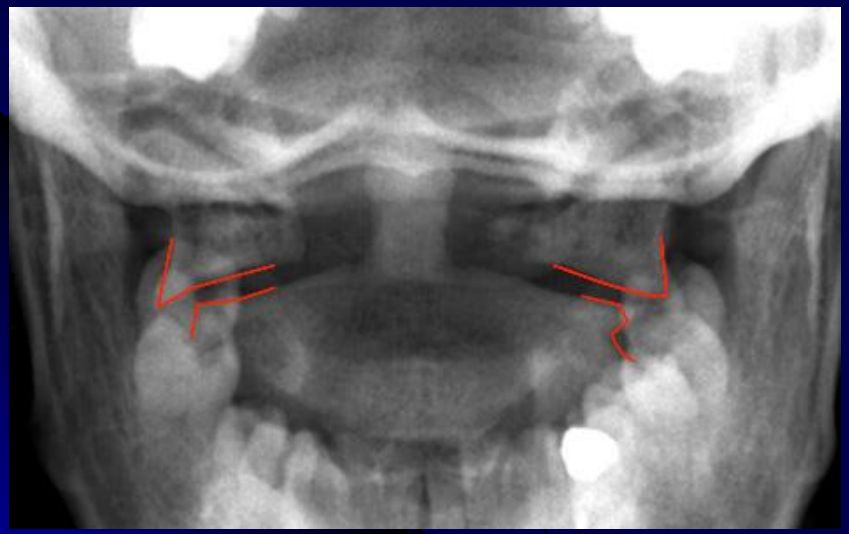
Jefferson Fracture

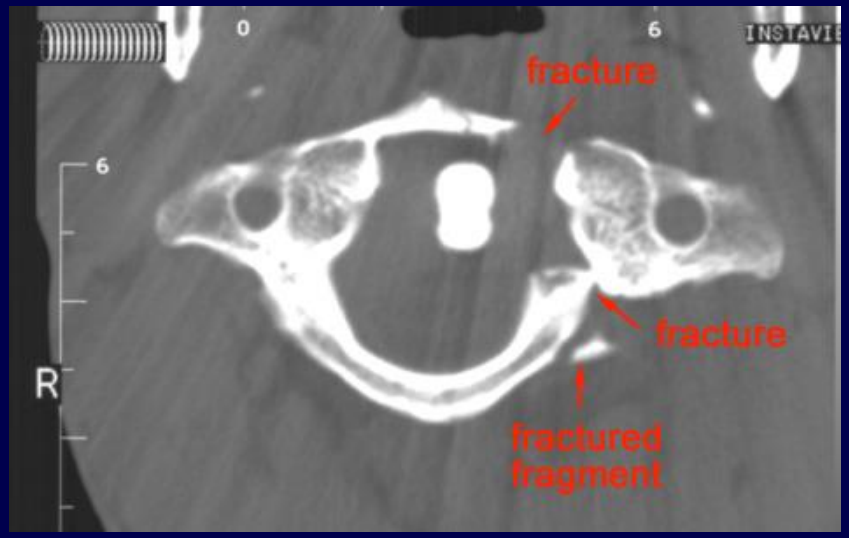
Lateral displacement of C1 in plain film (A)

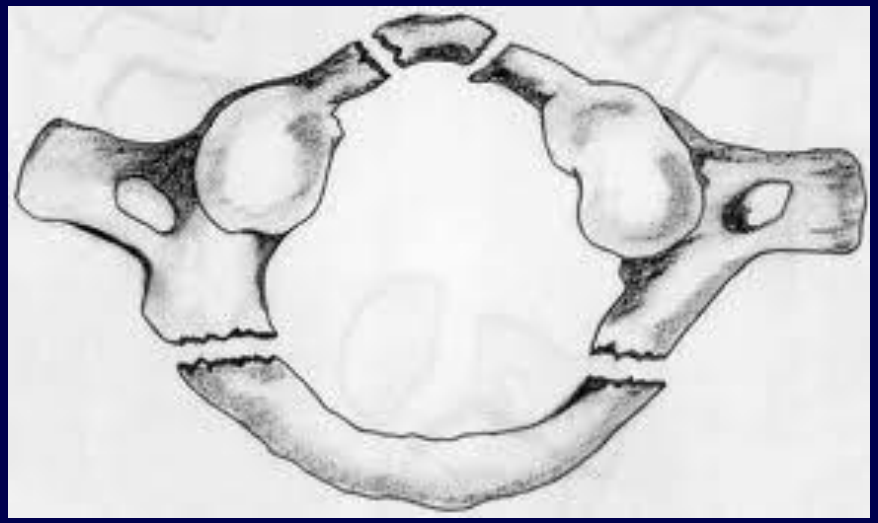
Coronal reconstruction from a CT confirms the findings from the odontoid view

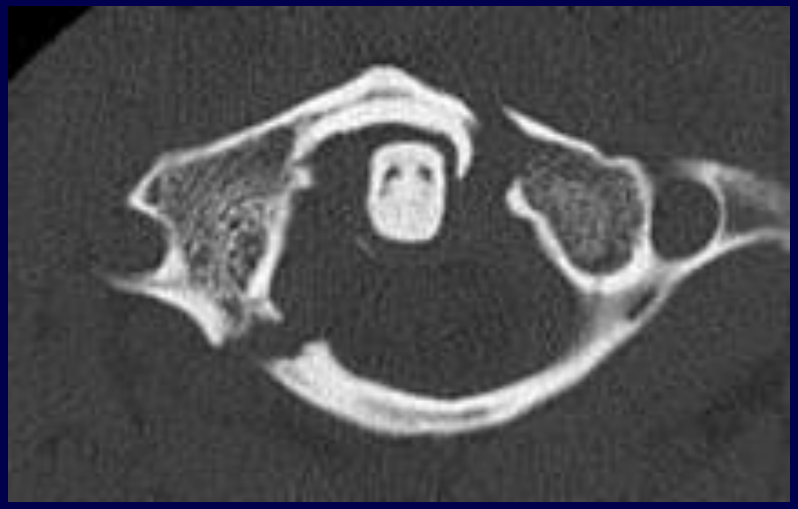
Axial CT clearly shows the location of the fractures of C1

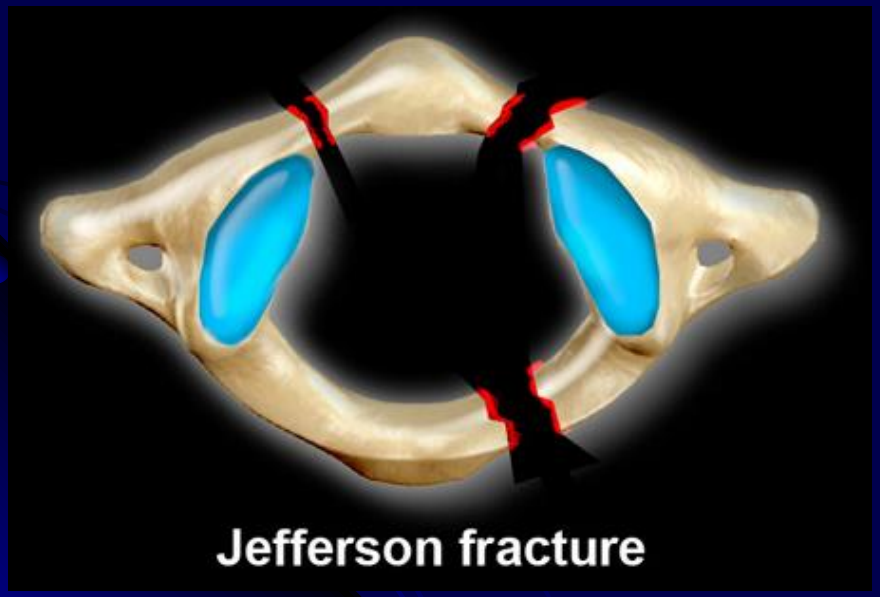


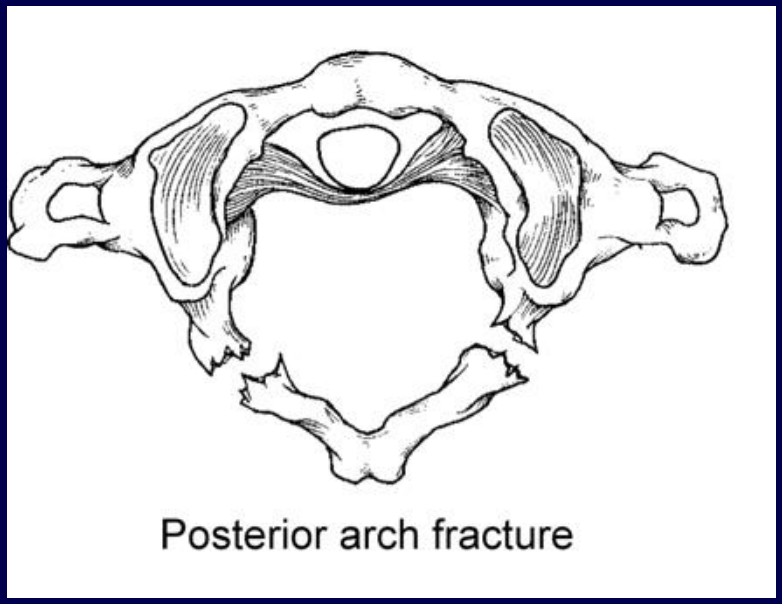




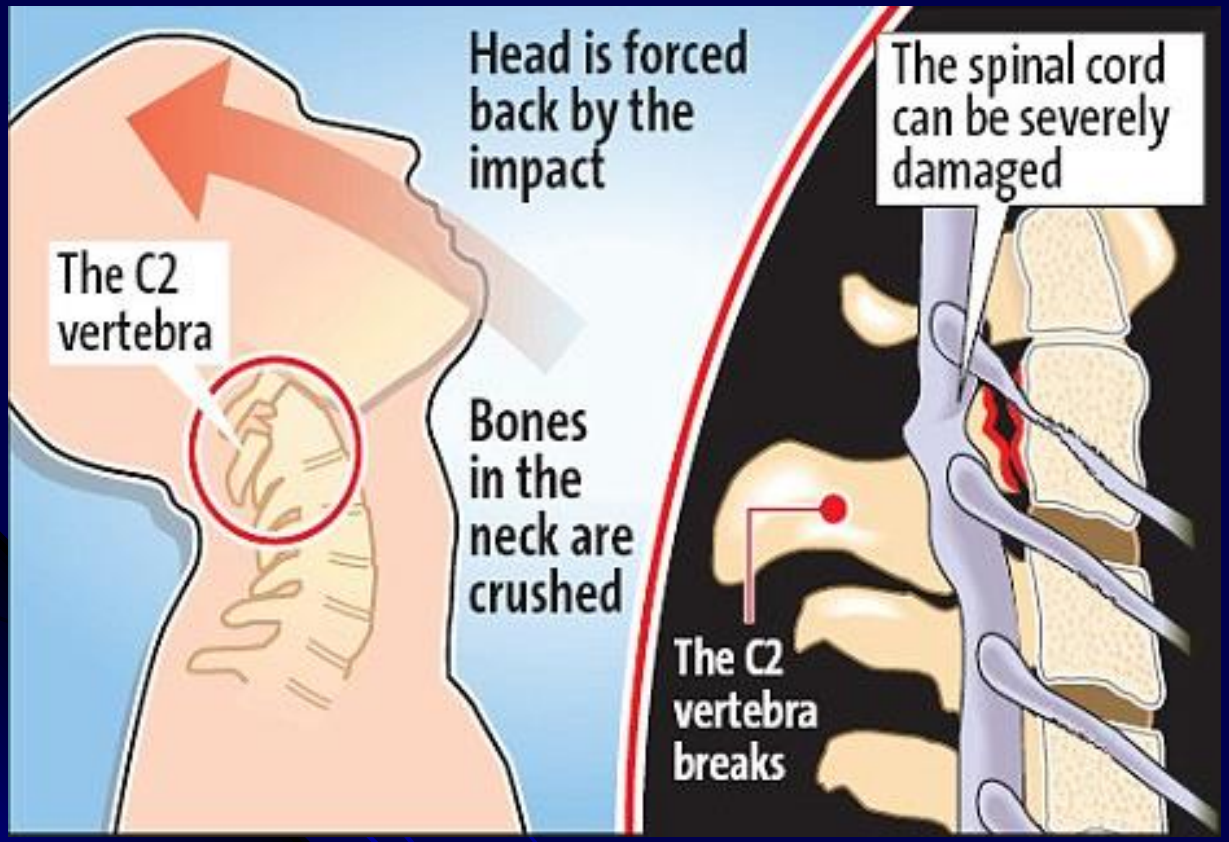


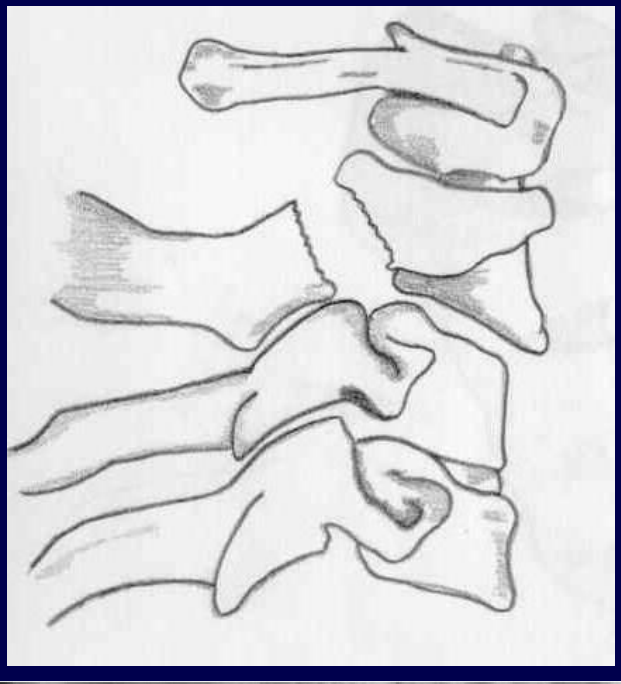



Jefferson fracture


Posterior arch fracture

Hangman's Fracture





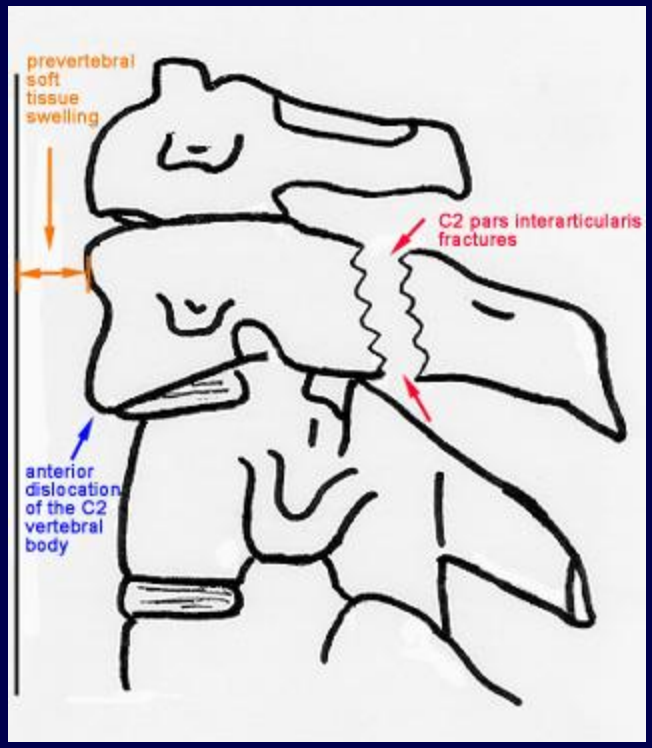
Hangman's Fracture

Fractures through the pars interaticularis 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

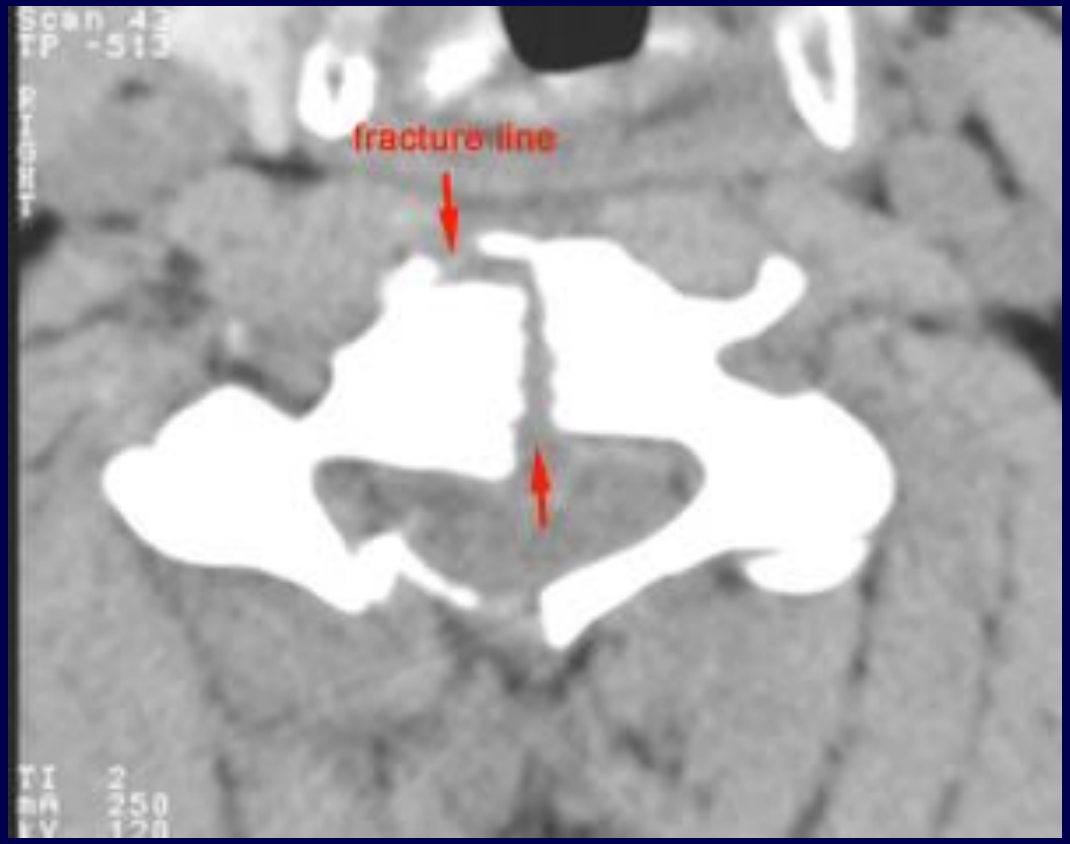


Burst Fracture

Results from axial compression

Injury to spinal cord is common due to displacement of posterior fragments

CT is required for all patient to evaluate extent of injury



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 inflammed tissues after contrast
- Fluid collections (abscesses) are common

Spondylo-discitis

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

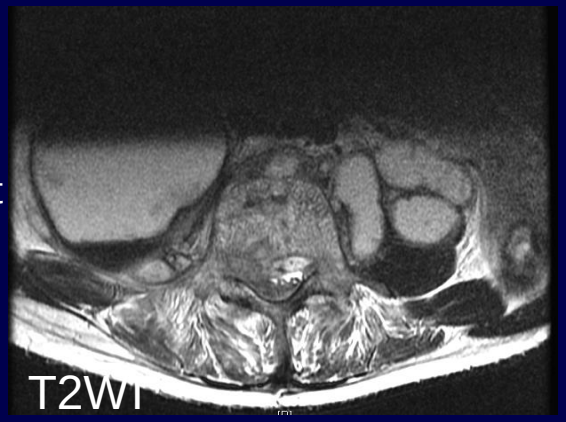
Spondylo-discitis

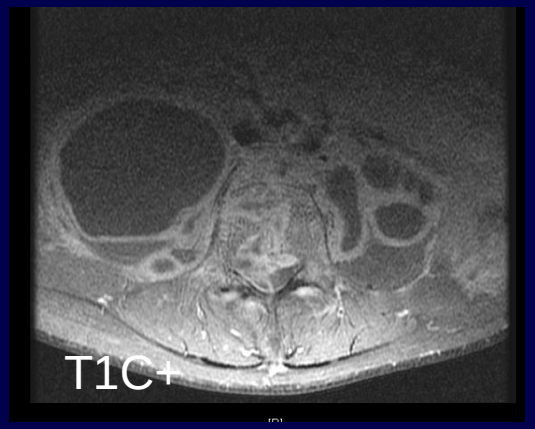
Sagittal T1WI shows decreased signal of vertebral bodies and disc with end plate destruction.

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

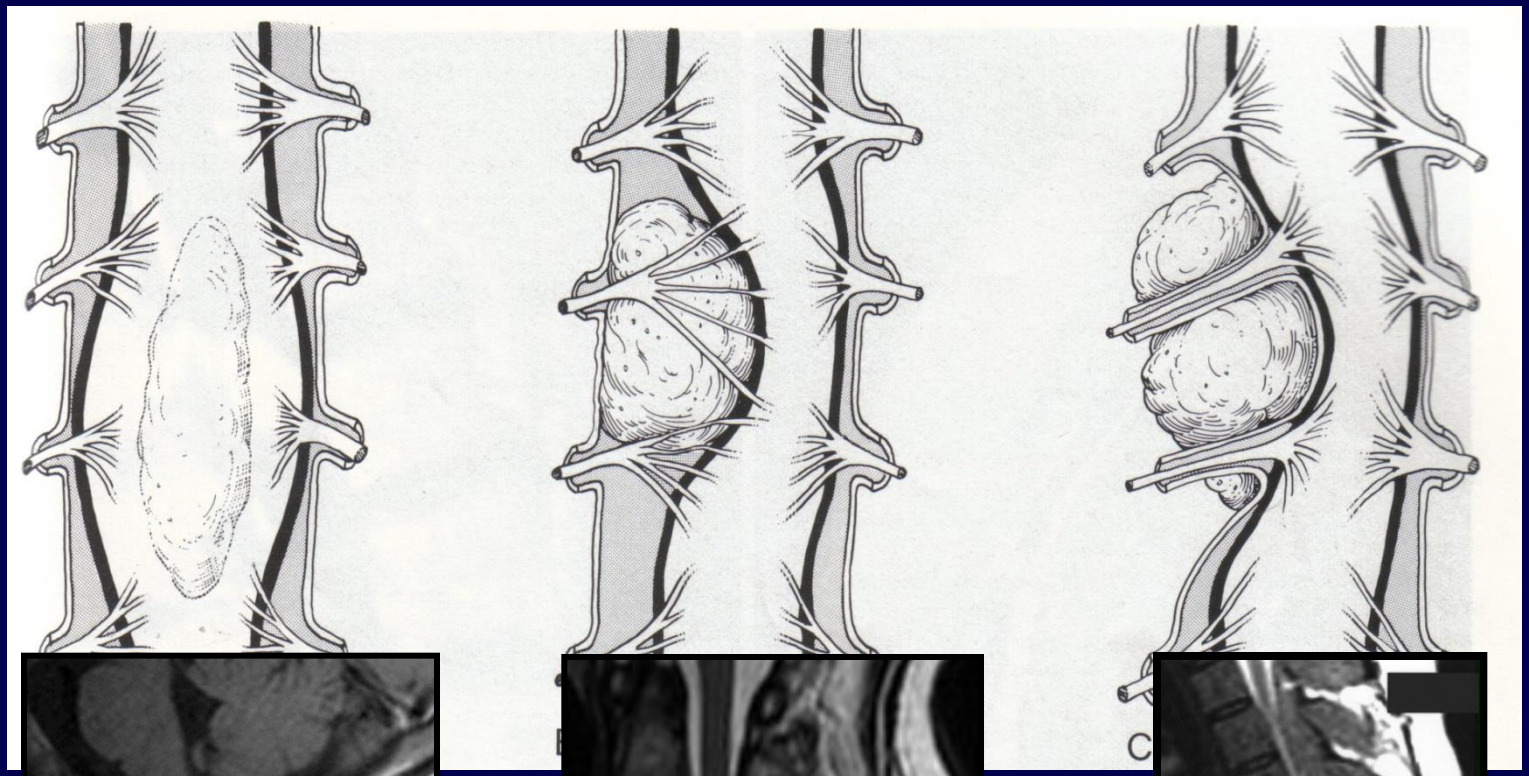
Sagittal contrast-enhanced T1-fat sat shows intense enhancement the involved area

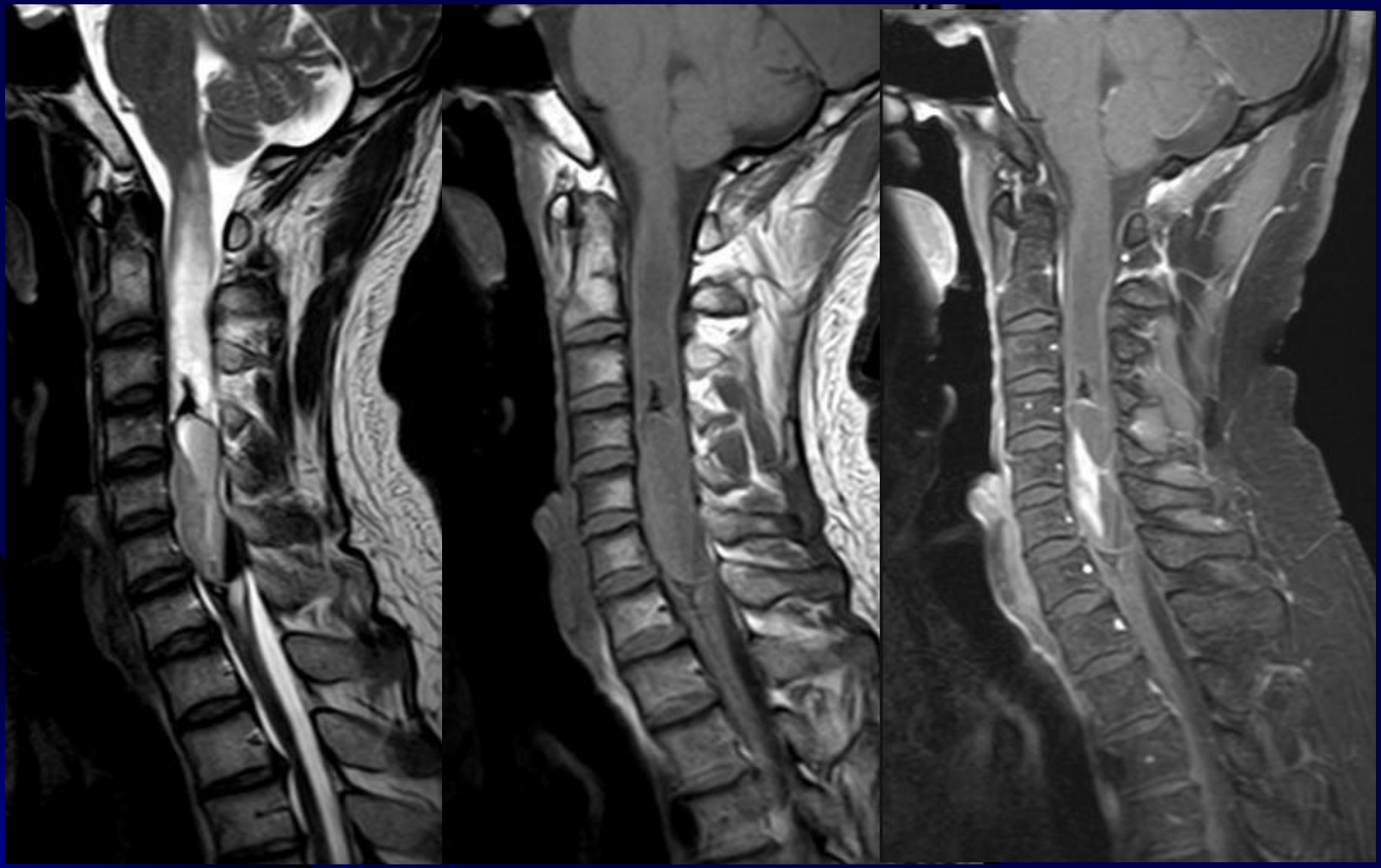
Axial T2WI and axial contrast-enhanced T1 fat sat show the para spinal large abscesses





TUMORS





Ependymoma

Astrocytoma

INFLAMMATORY

Multiple Sclerosis

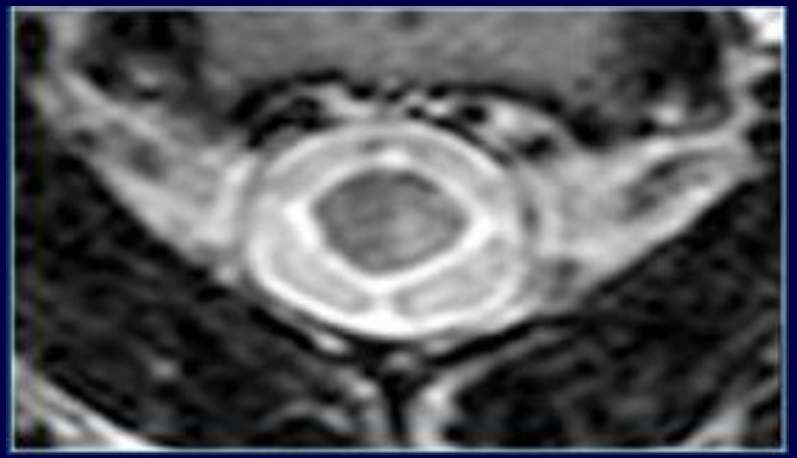
MS is an immune-mediated inflammatory demyelinating disease of the brain and the spinal cord.

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

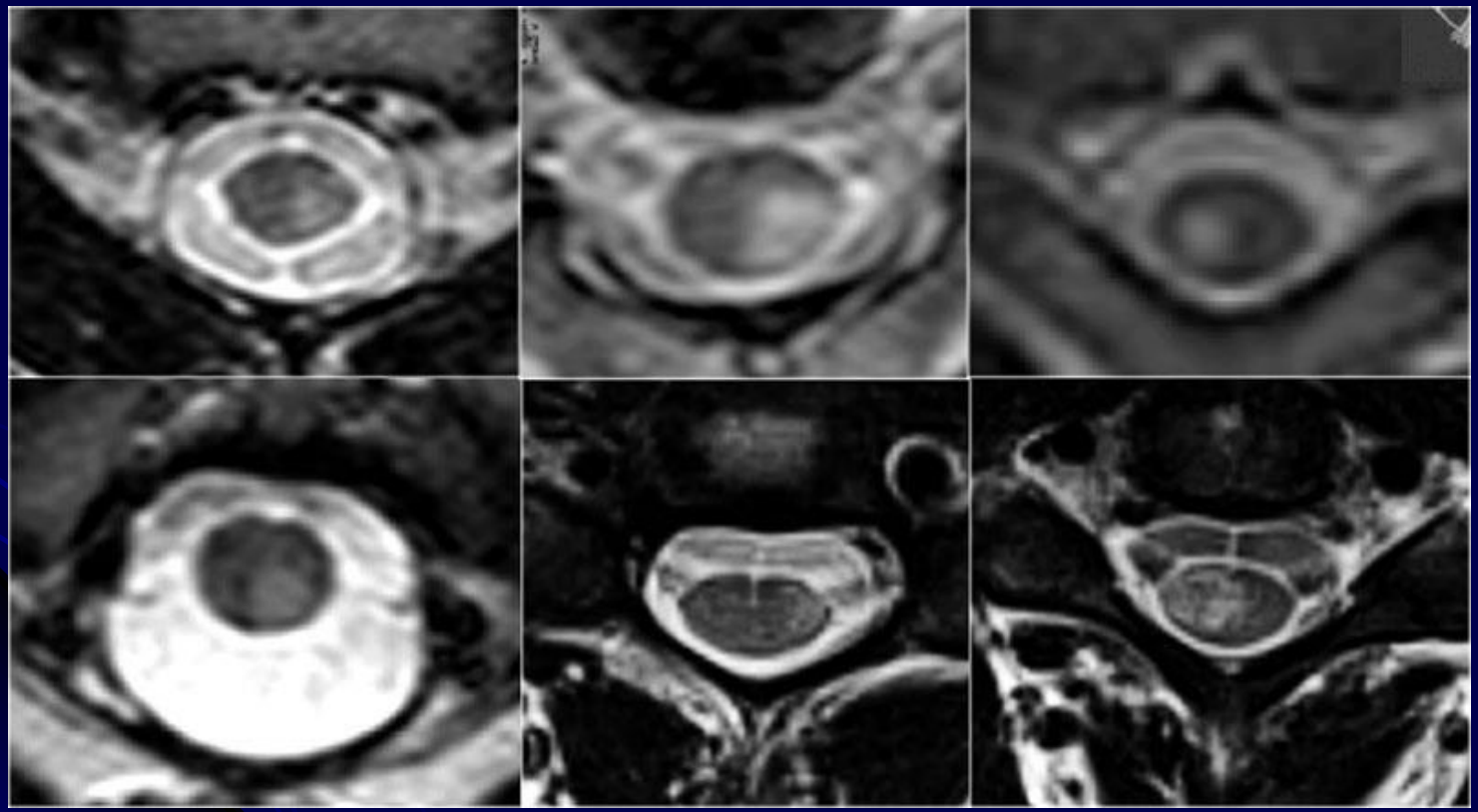
SPINAL CORD LESIONS

- 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

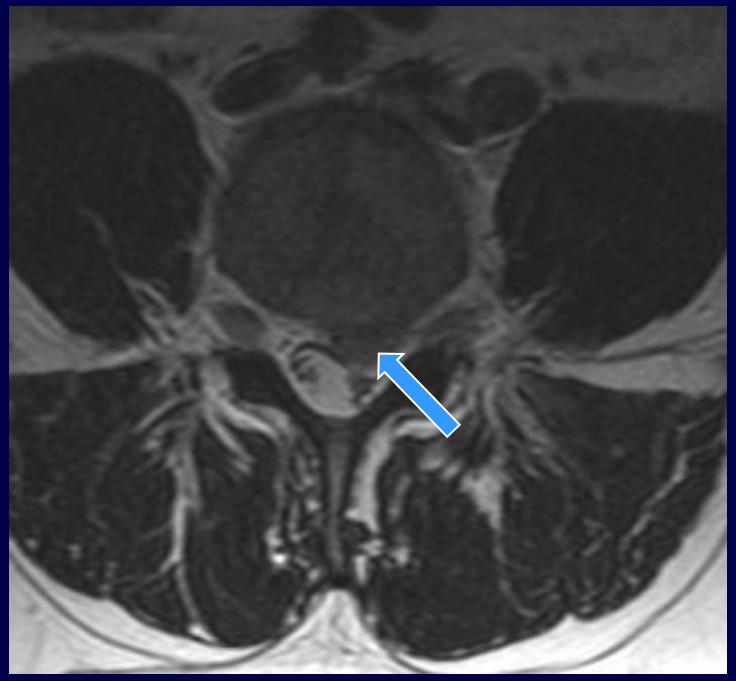


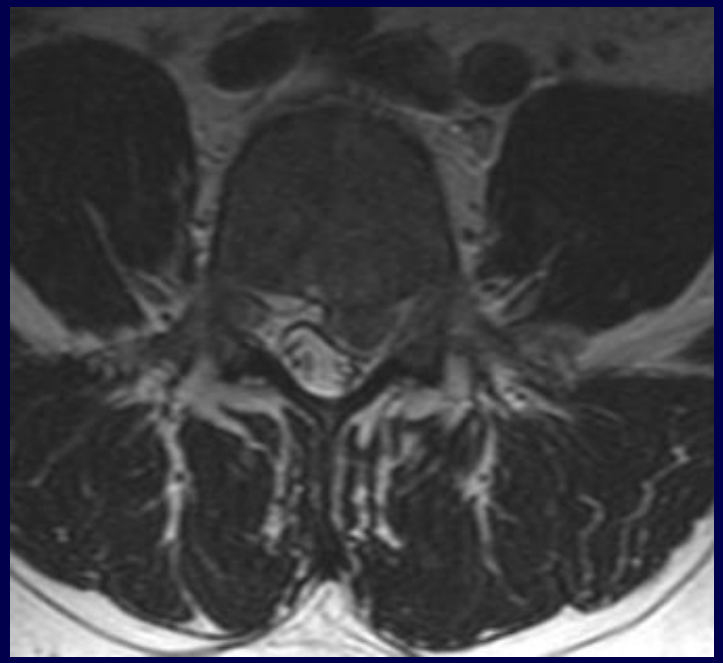
Multiple Sclerosis

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



DISC DISEASE





Disc herniation with sequestered disc fragment

THANKS