Neuroradiology Spine

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Spine

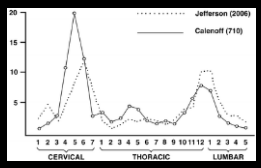
- X Ray: AP/L/Oblique
  - Vertebra & disc spaces
- CT & CTA
  - Vertebra, discs, vessels
- MRI & MRA
  - Vertebra, disc, vessels, meninges
  - Spinal cord & nerves
- Myelography
  - Spinal nerves, discs

Spine Pathology

- Trauma
- Degenerative disease
- Tumors and other masses
- Inflammation and infection
- Vascular disorders
- Congenital anomalies

Distribution of fractures

- Upper cervical (atlas and axis)
- Lower cervical (C5-C7)
- Upper thoracic (T4-T6)
- Thoracolumbar and lumbar



Role of radiology

- Diagnose the lesion
- Classify the lesion
- Detect stability / instability
- Decide on further investigations when the radiological diagnosis is incompatible with neurological signs

Radiological algorithm

- Imaging is not necessary in asymptomatic patients
- Imaging in symptomatic patients
  - According to clinical and neurological findings
  - According to the technical possibilities
- A high rate of symptomatic cases are diagnosed in proper direct radiography
  - 2-way, oblique, functional (flexion and extension) radiographs

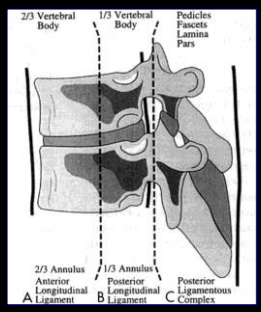
Radiological algorithm

- CT is performed when
  - Fracture on X-ray
  - Suspected fracture on X-ray
  - Normal X-ray in a symptomatic pt
- MRI is performed when
  - Positive neurological sign
  - Suspected ligament, cord or disk damage
  - Suspected epidural / paravertebral soft tissue lesion

What we are looking for?

- Bone fractures
- Ligamentous tear
- Cord / nerve root compression due to bone fragments
- Disc herniation
- Epidural hematoma
- Cord avulsion without fracture (0.7%)
  - Contusion (hematomyelia)
  - Edema

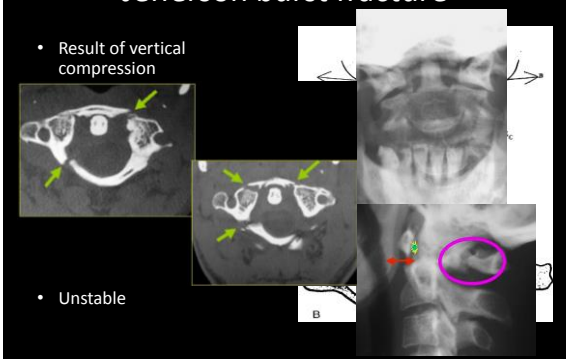
Denis' three column theory



- Stable:
  - One column involvement
  - Two non-adjacent column involvement
- Unstable:
  - 3 column involvement
  - Involvement of two adjacent columns
  - The middle column involvement

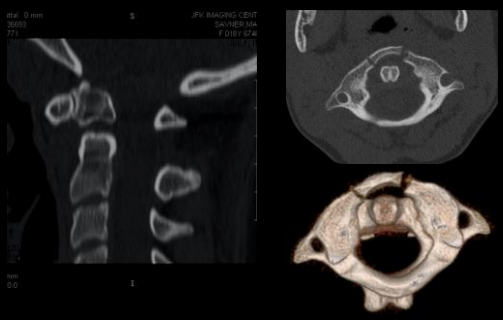
Jefferson burst fracture

- Result of vertical compression



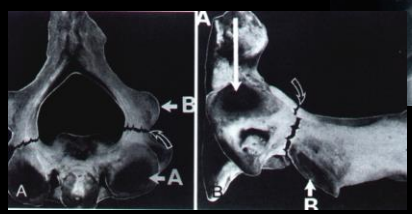
- Unstable

Fracture



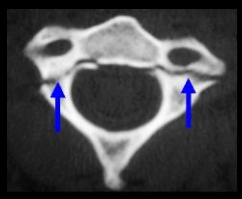
Hangman fracture

- Bilateral fracture of the pars interarticularis due to hyperextension strain



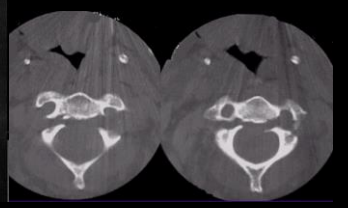
Hangman fracture

Type I
Stable



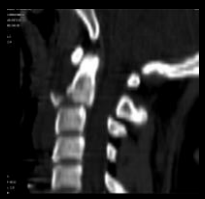
Hangman fracture

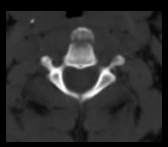
Type II
İnstabile



Hangman fracture

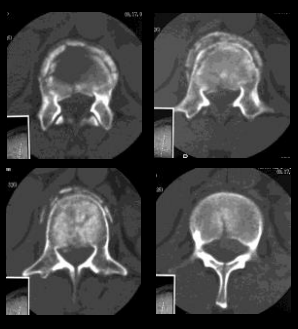
Type III
İnstabile



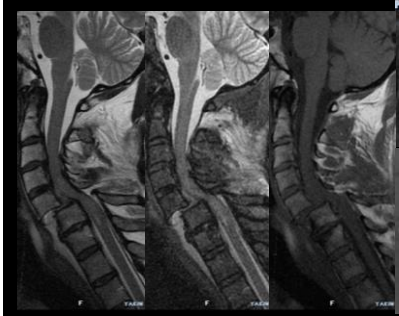


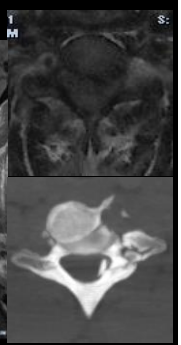
Teardrop fracture

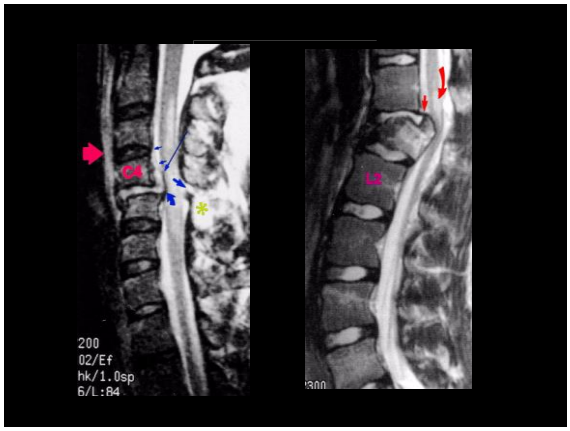
Unstable burst fx



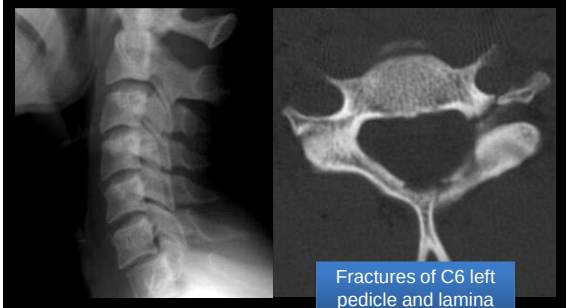
Translocation





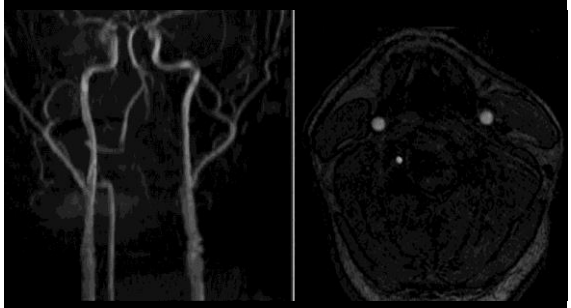


Anterolisthesis



Fractures of C6 left pedicle and lamina

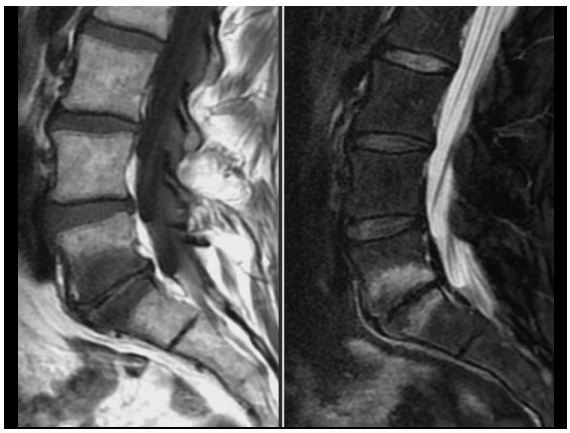
Vertebral Artery Dissection Occlusion due to C6 Fracture

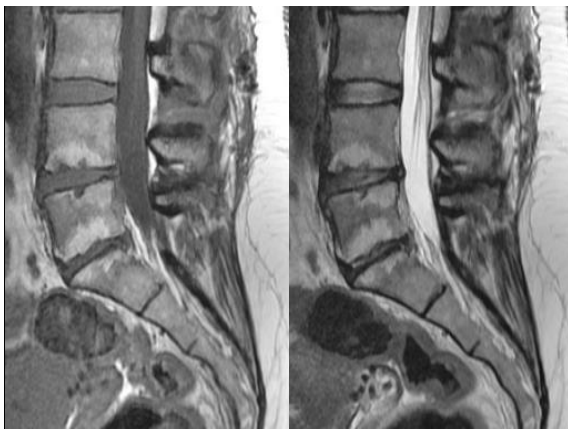


Vertebral degeneration

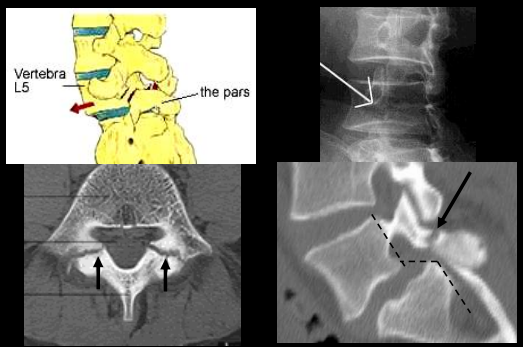
- Modic 1: T1 hypo / T2 hyper / C +
  - Subchondral edema due to increased vascularity
- Modic 2: T1/T2 hyper
  - Fatty degeneration due to chronic bone marrow ischemia
- Modic 3: T1/T2 hypo
  - End plate sclerosis
- Type 1 changes correlated with low back pain but 10-25% of patients may be asymptomatic *
  - Symptom (-): Focal, anterosuperior end plate, in the middle lumbar spine, normal adjacent discs
  - Symptom (+): Widespread and settles in end plates adjacent to the degenerated disc

*Chung CB, et al. Skeletal Radiol 2004;33(7):399–404.





Spondylolysis / Spondylolisthesis



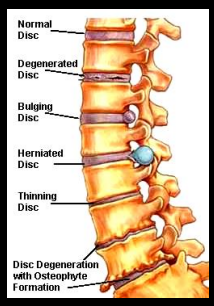
Confusing "Spondy-" Terminology

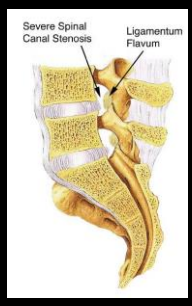
- Spondylosis = "spondylosis deformans" = degenerative spine
- Spondylitis = inflamed spine (e.g. ankylosing, pyogenic, etc.)
- Spondylolysis = chronic fracture of pars interarticularis with nonunion ("pars defect")
- Spondylolisthesis = anterior slippage of vertebra typically resulting from bilateral pars defects
- Pseudospondylolisthesis = "degenerative spondylolisthesis" (spondylolisthesis resulting from degenerative disease rather than pars defects)

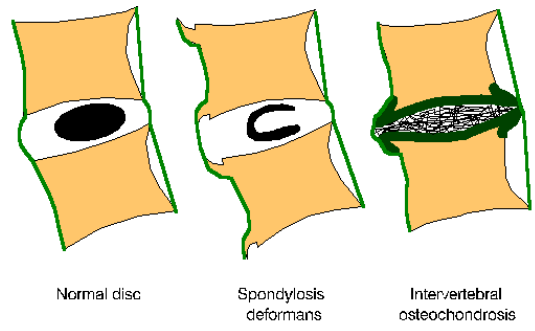
General Classification of Disc Lesions

- Normal (excluding aging changes)
- Congenital/Developmental variant
- Degenerative/traumatic lesion
  - Anular tear
  - Herniation — Protrusion/Extrusion, Intravertebral
  - Degeneration — Spondylosis deformans, Intervertebral osteochondrosis
- Inflammation/Infection
- Neoplasia
- *Morphologic variant of unknown significance*

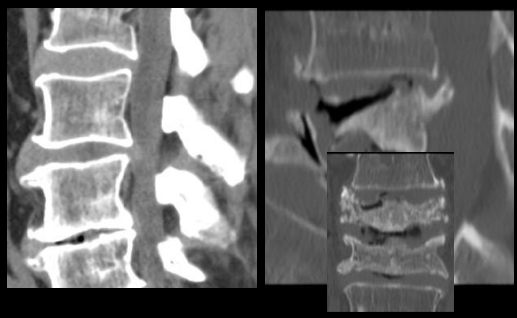
Degenerative Disc Disease





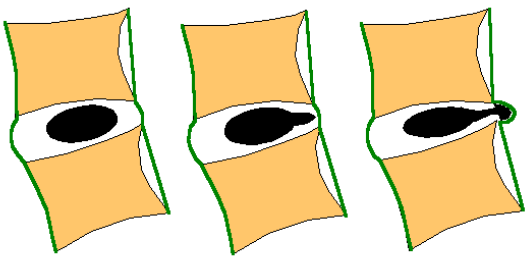


Degenerative disc disease

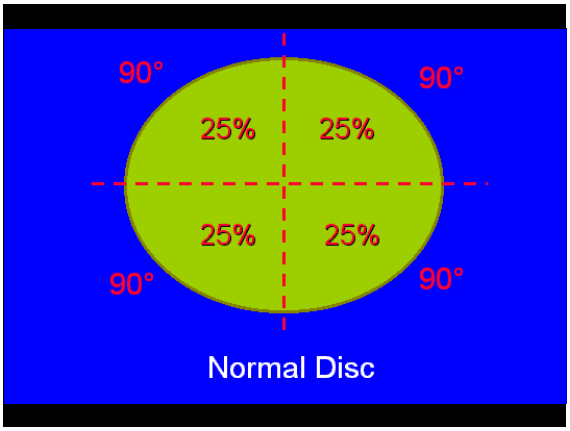


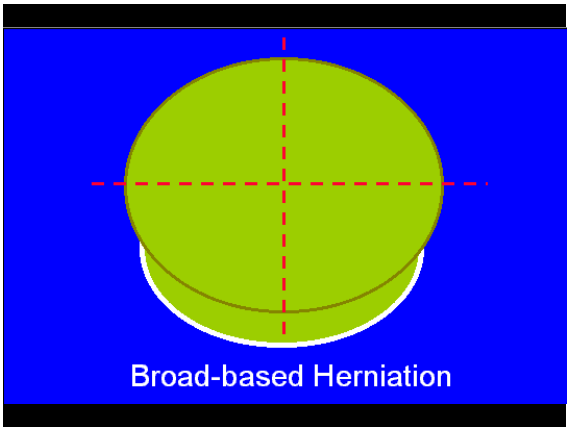
Degenerative Disc Disease

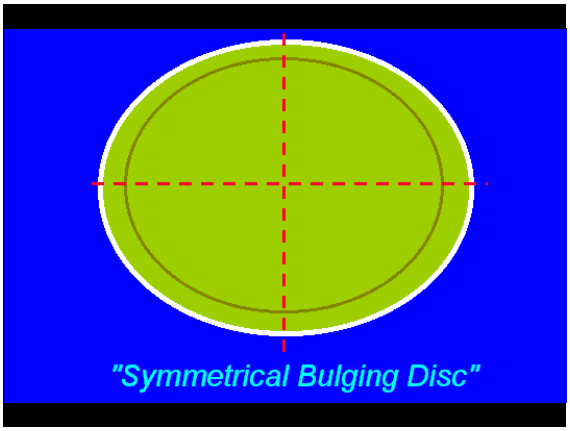
Schmorl's Nodes

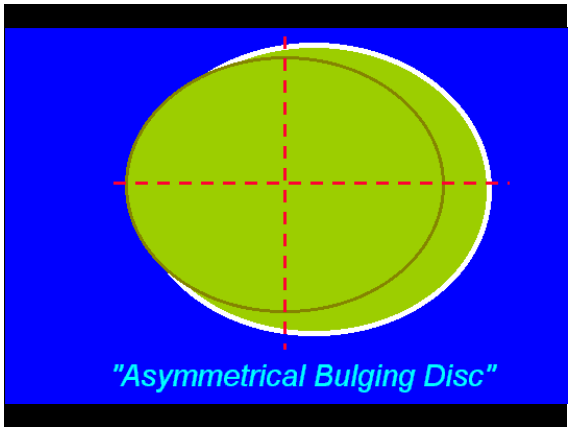


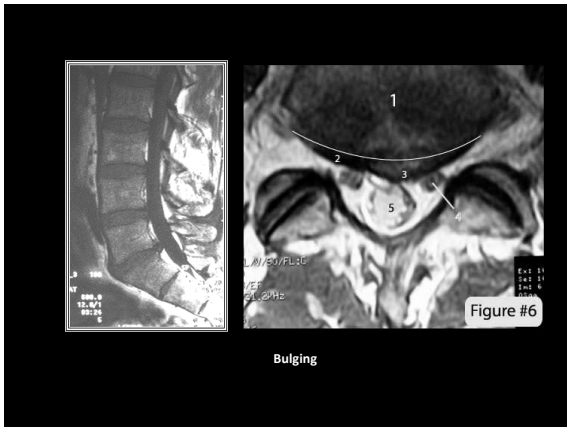
Normal Disc | Anular Tear | Herniated Disc

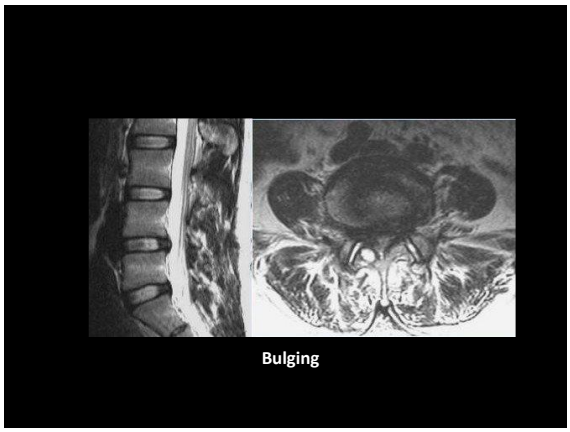


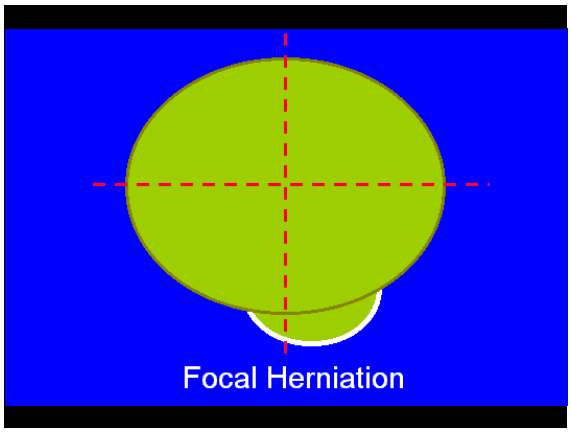


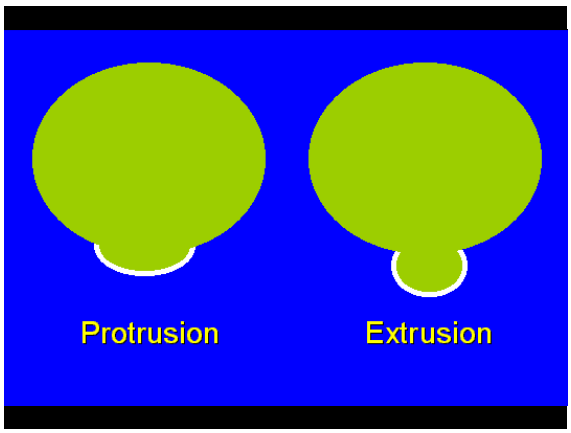


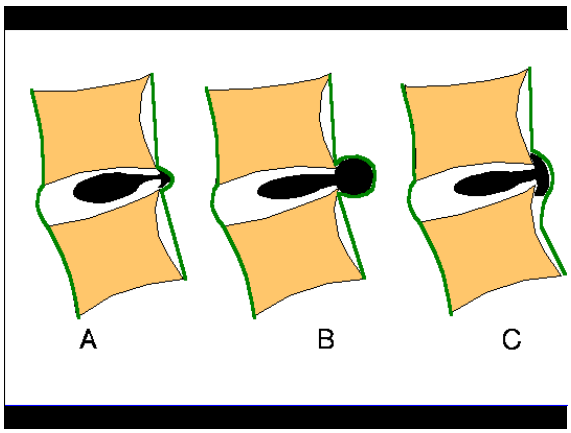

"Asymmetrical Bulging Disc"

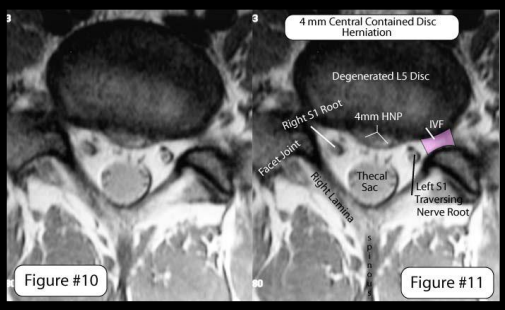

1
2
3
5
Figure #6
Bulging


Bulging


Focal Herniation

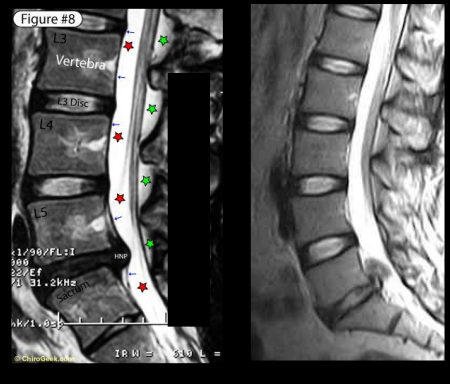

Protrusion
Extrusion

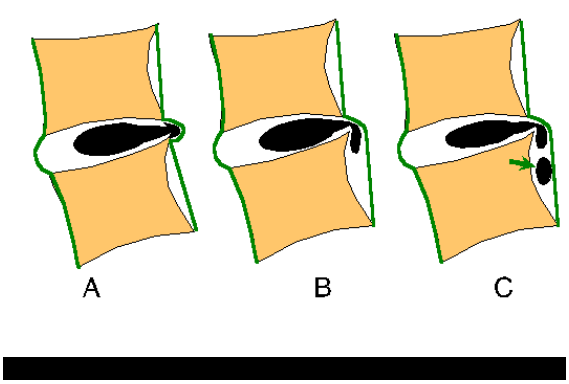

A
B
C

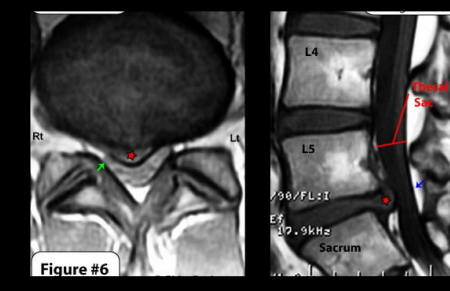


Protrusion

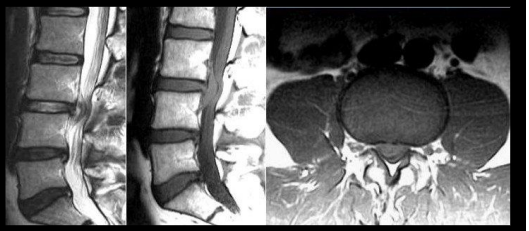
Protrusion



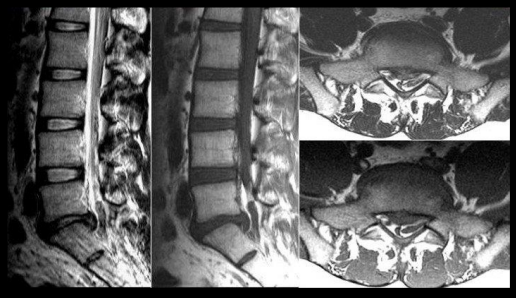




Extrusion



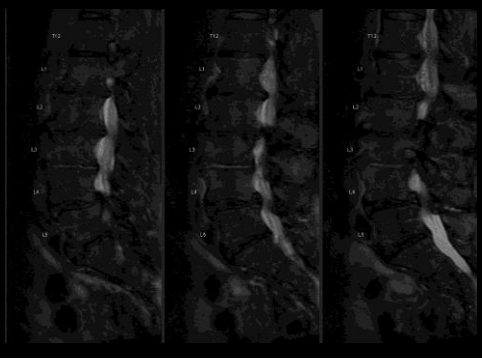
Extrusion



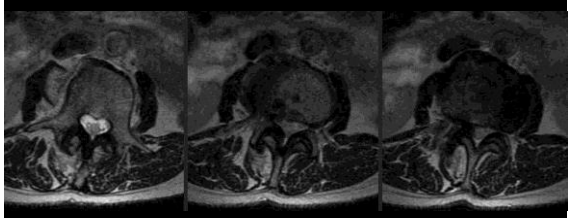
Sequestration

Lumbar Spinal Stenosis

Lumbar Spinal Stenosis



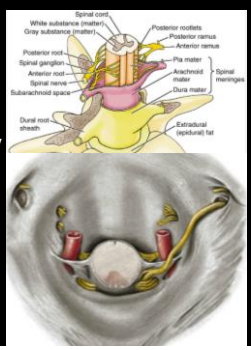
Lumbar Spinal Stenosis



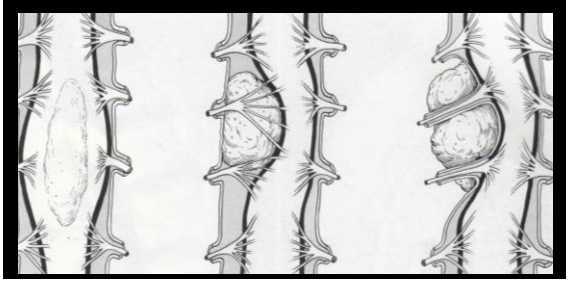
Disc bulge, facet hypertrophy and flaval ligament thickening frequently combine to cause central spinal stenosis

Classification of Spinal Lesions

- Extradural
  - outside the thecal sac (including vertebral bone lesions)
- Intradural extramedullary
  - within thecal sac but outside cord
- Intramedullary
  - within cord



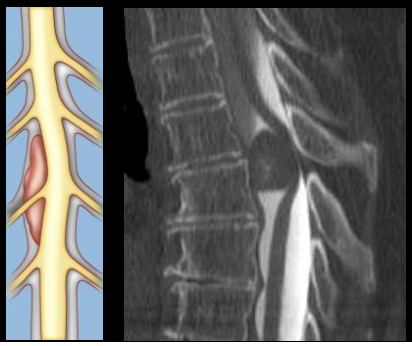
Location of Spinal Lesions



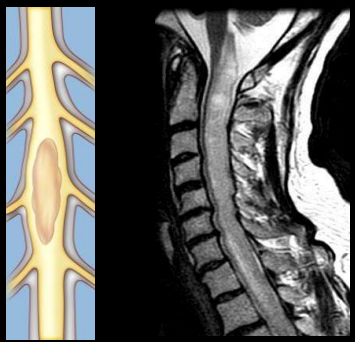
Intramedullary	Intradural extramedullary	Extradural
✓Astrocytoma ✓Ganglioglioma ✓Ependymoma ✓Hemangioblastoma ✓AVM ✓Metastasis ✓Abscess	✓Myxopapillary ependymoma ✓Nerve sheath tumors ✓Meningioma ✓Metastasis ✓ARTT ✓PNET ✓Dermoid ✓Epidermoid ✓Arachnoid cyst ✓Neuroenteric cyst	✓ Benign bone tumors ✓ Hemangiomas ✓ Osteoid osteoma ✓ Osteoblastoma ✓ Aneurysmal bone cyst ✓ Eosinophilic granuloma ✓ Teratoma ✓ Malignant bone tumors ✓ Ewing's sarcoma ✓ Osteosarcoma ✓ Lymphoma / leukemia ✓ Epidural space tumors ✓ Bone sarcomas off ✓ Lymphoma / leukemia ✓ Germ cell tumors ✓ Extradural tumors ✓ Neuroblastoma ✓ Nerve sheath tumors ✓ EM hematopoiesis

Extradural: Epidural Abscess

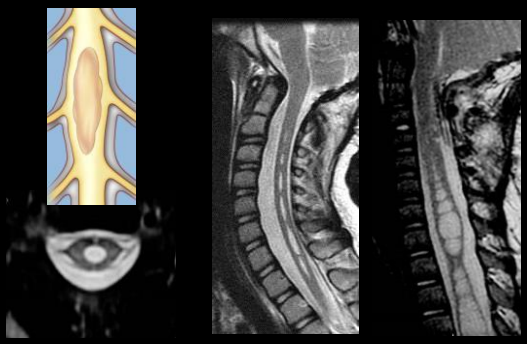
Intradural Extramedullary Meningioma



Intramedullary: Astrocytoma



Intramedullary: Syringohydromyelia



Confusing "Syrinx" Terminology

- Hydromyelia: Fluid accumulation/dilatation within central canal, therefore lined by ependyma
- Syringomyelia: Cavitary lesion within cord parenchyma, of any cause (there are many). Located adjacent to central canal, therefore not lined by ependyma
- Syringohydromyelia: Term used for either of the above, since the two may overlap and cannot be discriminated on imaging
- Hydrosyringomyelia: Same as syringohydromyelia
- Syrinx: Common term for the cavity in all of the above

Infectious Spondylitis / Diskitis

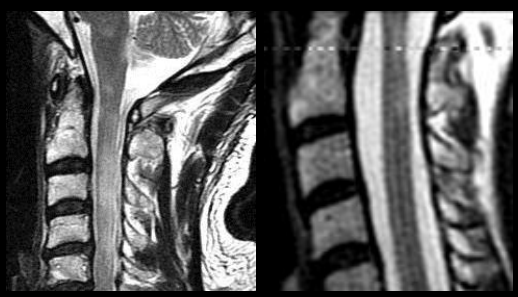
T2 T1 T1+C T1+C

Spinal TB (Pott's Disease)

Transverse Myelitis

- Inflamed cord of uncertain cause
  - Viral infections
  - Immune reactions
  - Idiopathic
- Myelopathy progressing over hours to weeks
- DDX: MS, glioma, infarction

Multiple Sclerosis



Cord Edema

- As in the brain, may be secondary to
  - ischemia (e.g. embolus to spinal artery)
  - venous hypertension (e.g. AV fistula)