جامعة المستقبل
كلية التقنيات الصحية والطبية
قسم تقنيات الاشعة

الفحوصات الشعاعية الخاصة
المرحلة الثالثة

Lecture 5 & 6

Method of imaging the Spine

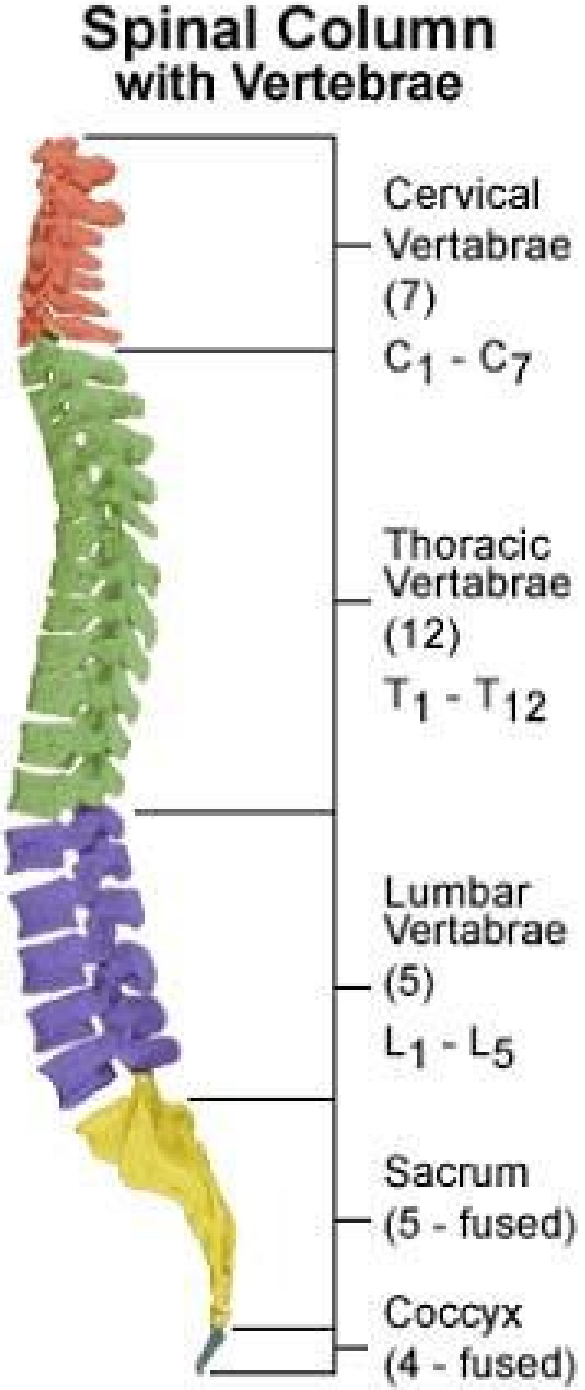
اعداد

م.م. مرتضى عبد الامير محمد

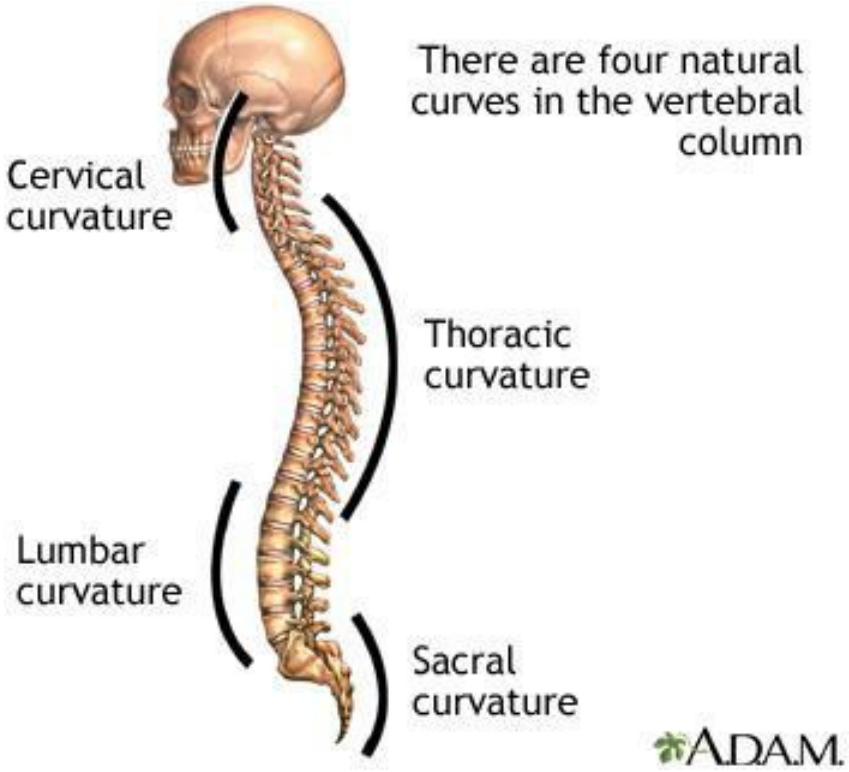
د. مهند احمد صاحب

Anatomy of the spine

- The spinal column is made up of 33 vertebrae that are separated by spongy disks and classified into areas:
- The cervical area consists of 7 vertebrae in the neck.
- The thoracic area consists of 12 vertebrae in the chest.
- The lumbar area consists of 5 vertebrae in the lower back.
- The sacrum has 5 small, fused vertebrae.
- The 4 coccygeal vertebrae fuse to form 1 bone.



- The vertebraes are separated by pads of flexible fibrocartilage called the **intervertebral disc** .
- The intervertebral disc cushion the vertebrae and absorbs shocks .
- The spinal curvature (Lordosis , kyphosis) and discs make the body flexible and prevent shock to head while walking or running.



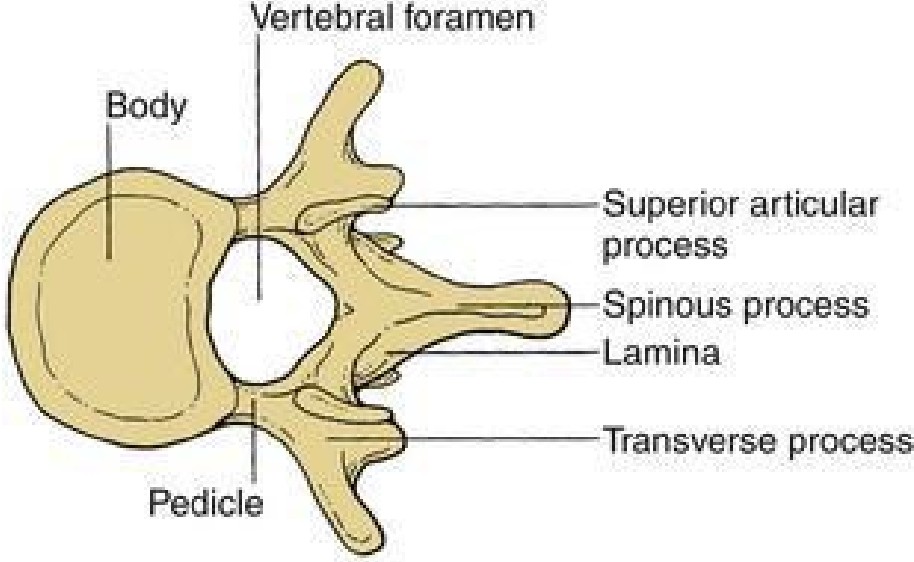
- ***The vertebrae in each region have unique features that help them perform their main function :***

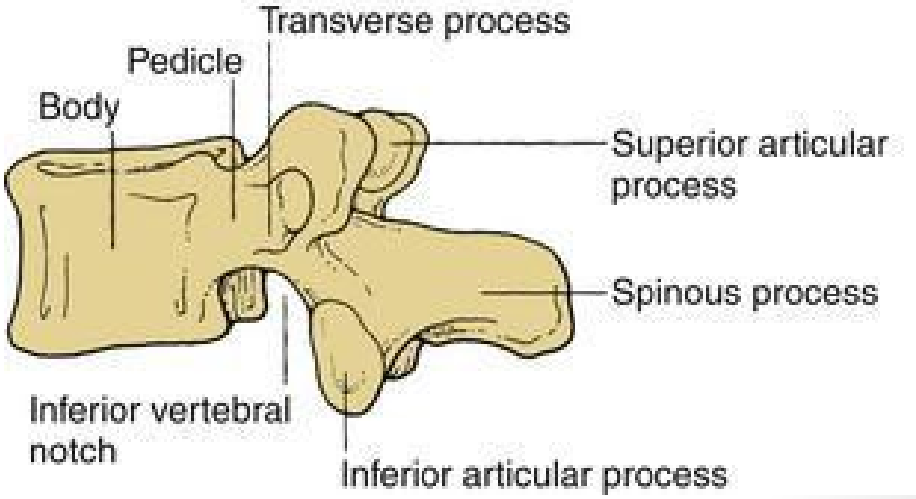
1. **Cervical vertebrae C1-C7:** The main function of cervical spines is to support the weight of the head
2. **Thoracic vertebra T1-T12:** The main function of thoracic spines is to hold the rib cage and protect the heart and lungs
3. **Lumber vertebrae L1-L5 :** to bear the weight of body
4. **Sacral bone:** The function of bone is to connect the spines with hip bones five fused vertebrae.
5. **Coccygeal region** four fused bones of coccygeal or tailbone provide attachment for ligaments and muscle of pelvic floor

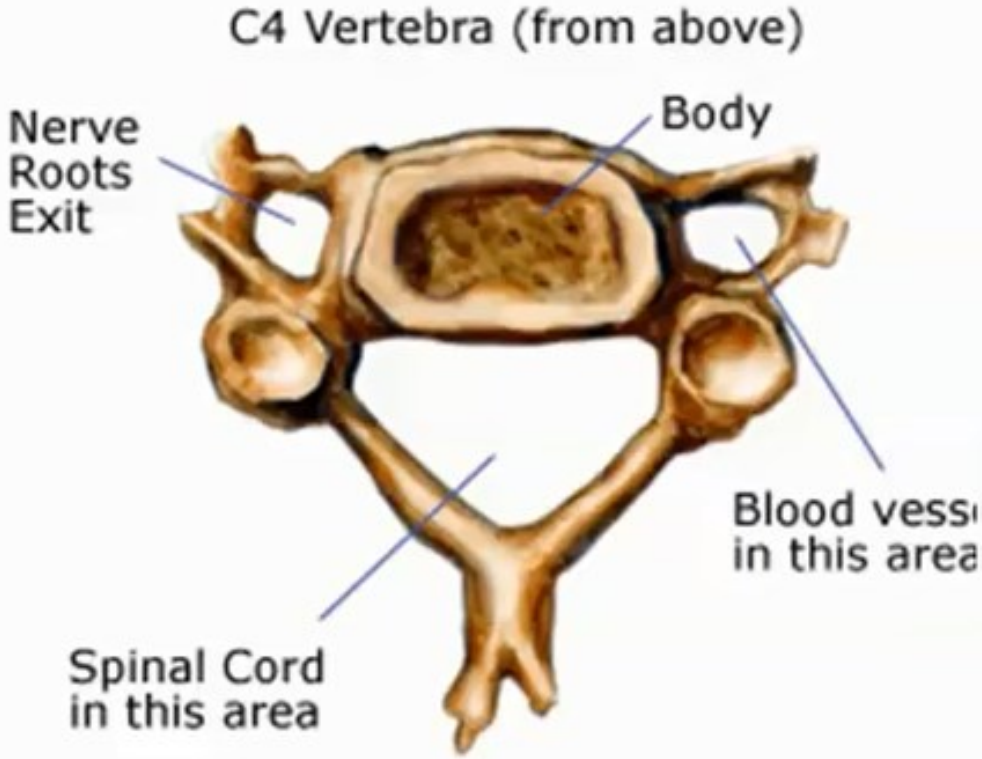
- **Typical vertebra**

- Any vertebra is made up of:
- 1.Body or Centrum :
- 2.Vertebral Arch :

- •Vertebral foramen lies between the body and the arch
- •The spinal cord passes through the vertebral foramen.






C4 Vertebra (from above)
Nerve Roots Exit
Body
Blood vess in this area
Spinal Cord in this area

Methods of imaging the spine

- There are a variety of ways to image the spine, many of which are expensive. The role imaging are selected for **diagnostic accuracy, clinical relation and cost-effectiveness**. Each diagnostic imaging procedure has a different degree of sensitivity when applied to a particular diagnostic problem. A combination of imaging techniques can be used in a complementary way to enhance diagnostic accuracy.

1- *Conventional Radiography*
2- Fluoroscopy
3- *Computed Tomography*
4- *Magnetic Resonance Imaging*
5- *Myelography*

X-Ray of the Spine

- A spinal x-ray is an imaging technique that uses radiation to provide a general overview of the spine. Spinal x-rays are used for the evaluation of **the bony structures, such as the vertebrate and joints**, in diagnosing and guiding medical treatment for conditions that cause neck or back pain.
- Also called a plain or conventional radiograph, the x-ray is one of the first tests ordered when a back or neck problem is suspected.

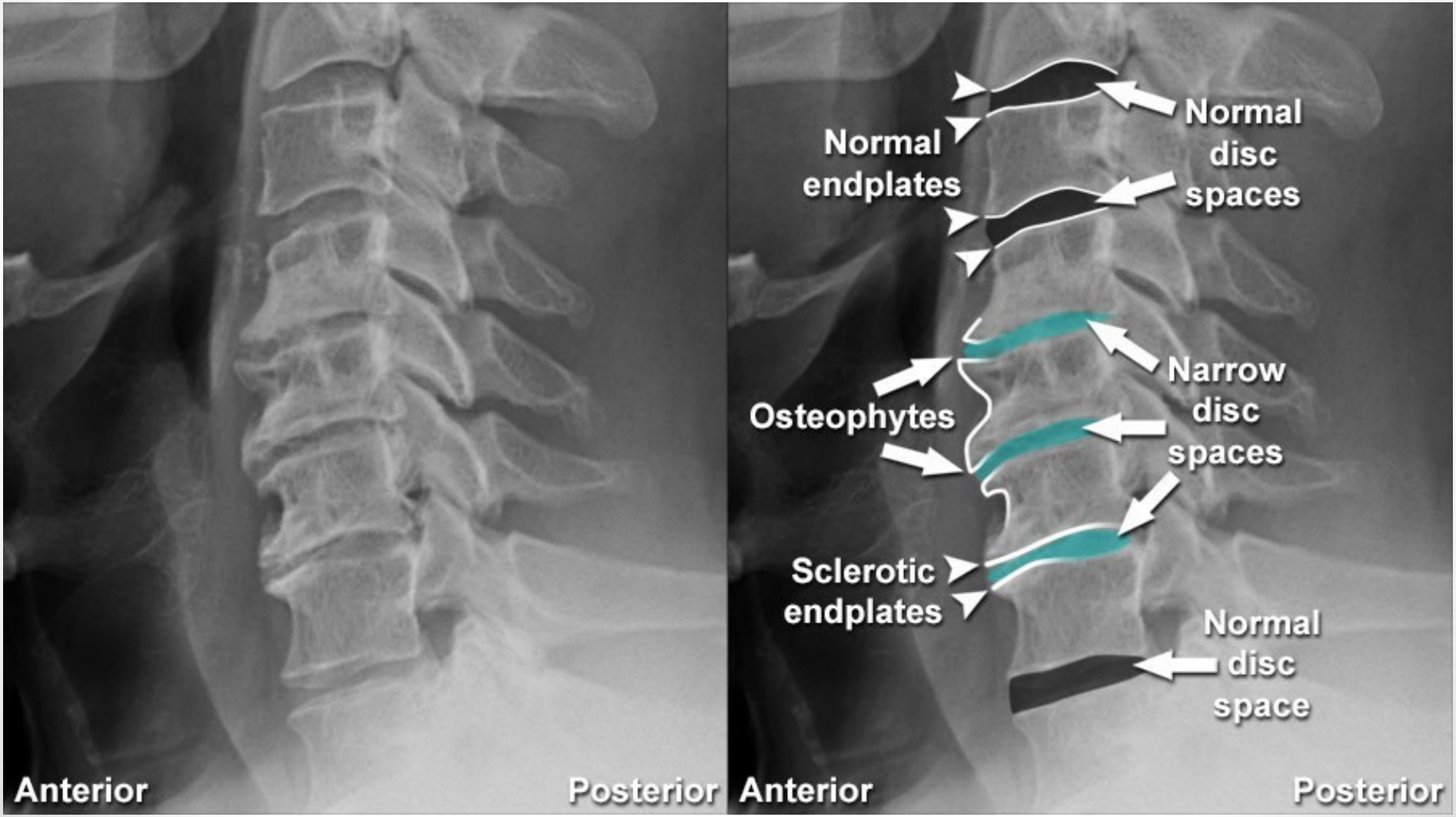
Cervical spine

Spinal Conditions that may be identified on an X-ray

The conventional x-ray typically has five views of the spine: one anteroposterior (or front-to-back) view, two lateral (or side) views, two (left and right) oblique views, and one odontoid view (taken from the front, to view the neck, with the mouth open). One or more of these views may be used in aiding the diagnosis of:

- Compression fractures (osteoporosis or bone cancer)
- Stress fracture or spondylolysis
- spinal muscle Spasm
- Spinal arthritis and bone spurs
- Spinal tumors
- Spinal alignment disorders (abnormal curves of the spine), such as scoliosis , kyphosis and lordosis
- Neuroforaminal stenosis (narrowing of the bony openings in the spine through which the spinal nerves pass)
- Spinal osteopenia (thin of the spinal bones)
- Birth defect (such as a lumbar sacralization or fusion of the L5 vertebra with the pelvic bone, spina bifida occulta, normal variant and other abnormal fusions in the spine)

Cervical spine X-Ray



Stress fracture

Compression fractures

spinal muscle Spasm

Spinal arthritis

scoliosis

kyphosis

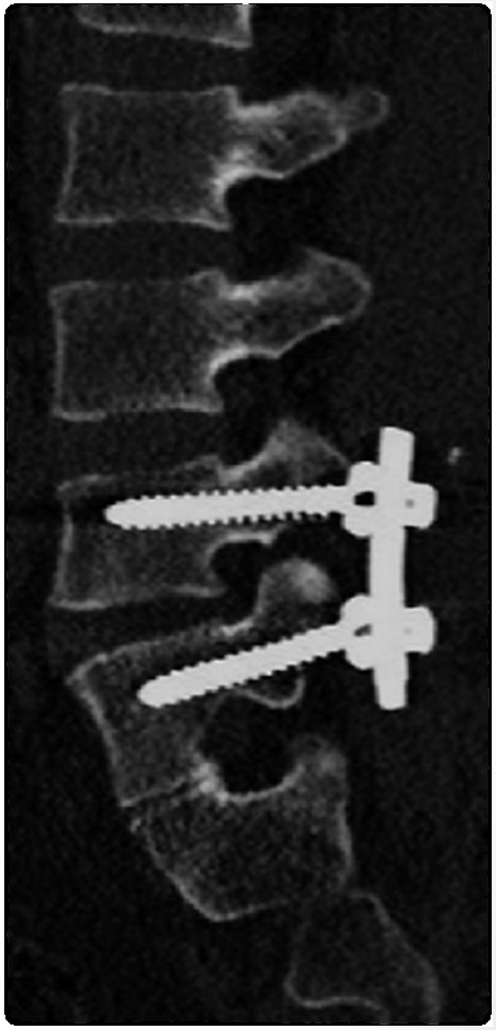
Osteopenia

fusions in the spine

Computerized Tomography (CT) Scan

Computerized Tomography (CT) Scan

- A computed tomography scan, commonly referred to as a CT scan, is a radiological imaging technique that creates two-dimensional images of the body in horizontal , cross-sectional (sliced) planes and three-dimensional images .
- CT scan is a rapid, 5-20 minute painless exam that combines the power of X-rays with computers to produce 360 degrees, cross-sectional views of your body. CT images of **internal organs, bones, soft tissue and blood vessels provide greater detail than traditional x-rays, particularly of soft tissues and blood vessels.**



Abnormal Lumber spine imaging

Normal Lumber spine imaging (radiopedia)

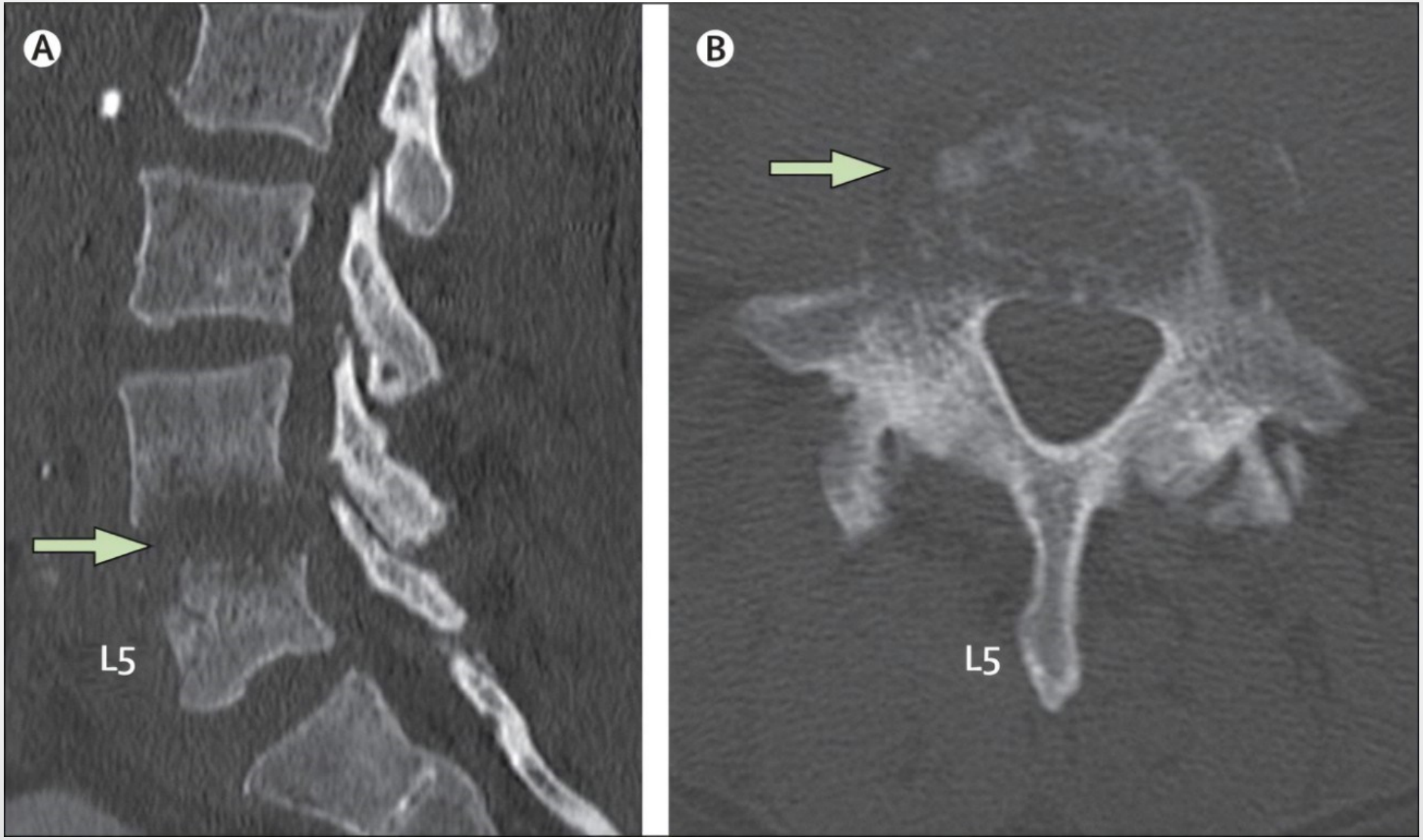
Items for evaluation

- Spinal canal diameter[lumbar]
- Disc lesions
- Others
  - Joints [facet, neuro central, sacroiliac]
  - Para vertebral soft tissues

Spinal Conditions that may be identified on a CT Scan

- A spinal CT scan can show details of bones, muscles, and organs, and aid in the diagnosis of neck or back pain from:
- Vertebral fractures
- Spinal degenerative changes
- Spinal osteomyelitis (bacterial infection)
- Spinal tumors and masses
- A CT procedure can allow the entire cervical (neck) spine or the whole spine to be adequately visualized, and this type of view is typically preferred in **the emergency department to examine traumatic injuries in detail**. CT is the imaging technique of choice for gunshot wounds, providing clear details of the injury, which cannot be seen in other specialized scans, such as a magnetic resonance imaging (MRI) scan, due to the metallic nature of the bullet.

- Spinal osteomyelitis (bacterial infection)



MRI Scan of the Spine

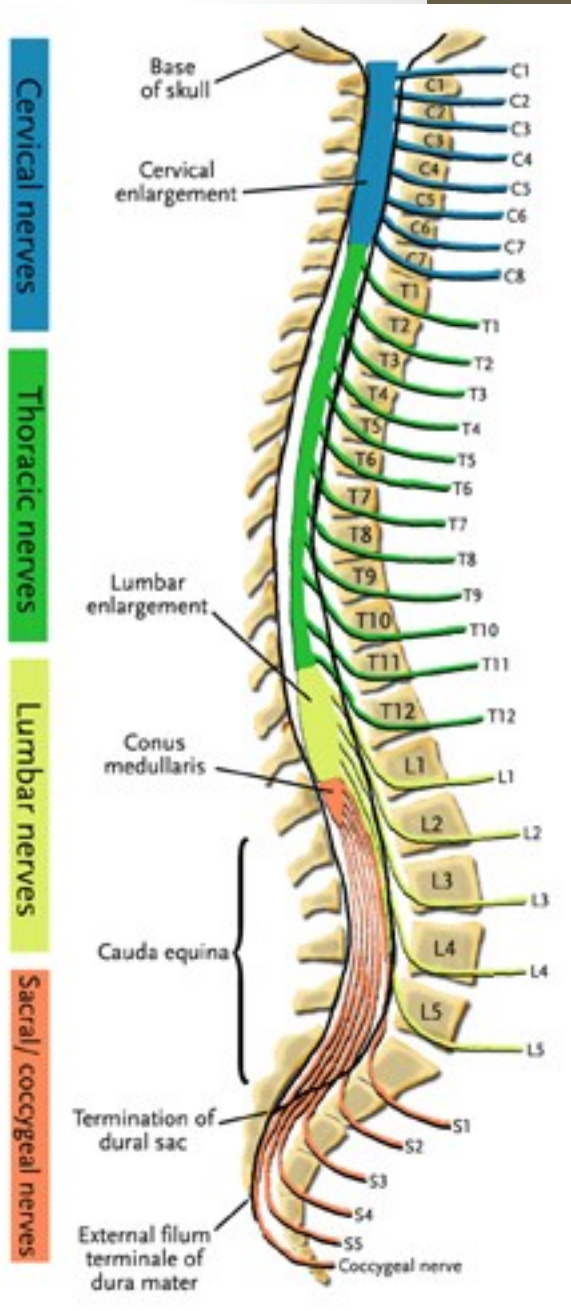
MRI Scan of the Spine

- Magnetic resonance imaging (MRI) is a highly sensitive and specific imaging technique that yields comprehensive images of **the structure, function, and composition of tissues in the body.** The technique uses a strong magnet, radio waves, and a computer to generate detailed images of the body. In the spine, an MRI scan can reveal thorough details **of the joints, muscles, tendons, ligaments, spinal discs, spinal nerve roots, and the spinal cord.**

- MRI produces detailed images without the use of ionizing radiation, making it a safer option compared to standard imaging techniques, like x-rays or computed tomography (CT) scans.

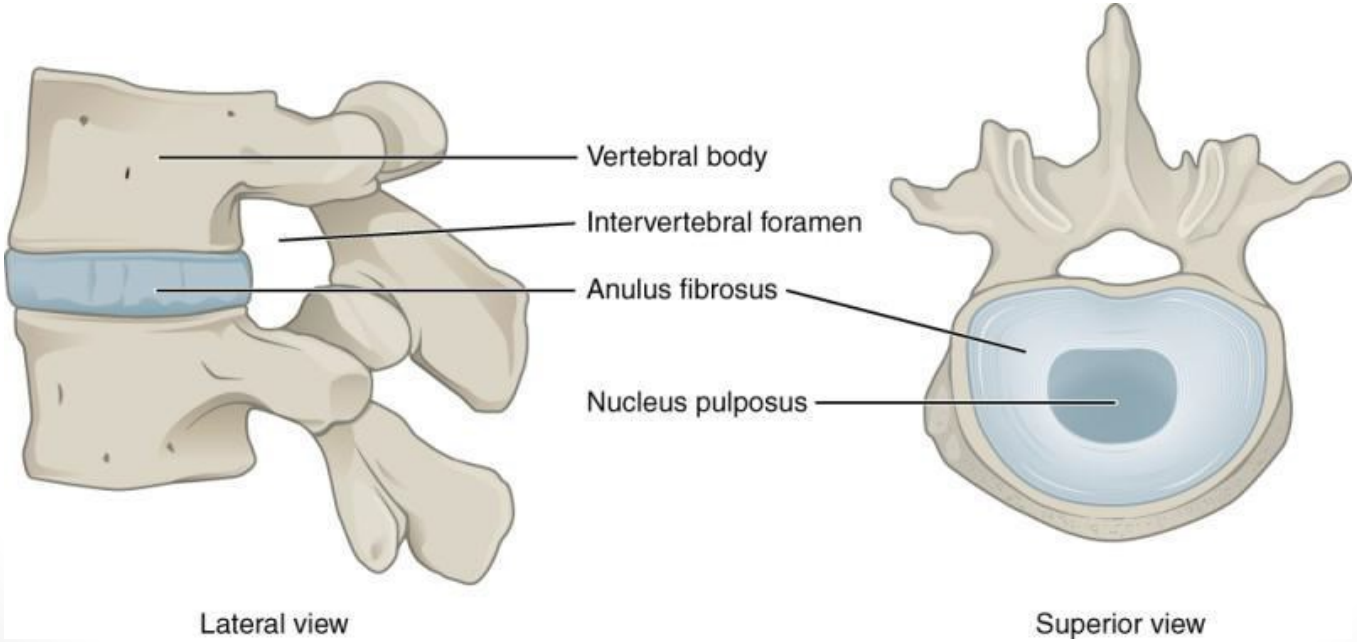
Spinal coil of the MRI

- **MRI may be recommended when the following conditions are suspected:**
- Spinal cord compression in the neck due to conditions such as cervical stenosis with myelopathy
- Spinal cord compression in the lower back, leading to conditions such as cauda equina syndrome
- Primary or secondary spinal tumors
- Herniated disc
- In these conditions, MRI is considered the gold standard for imaging and investigating the underlying cause of the specific condition and formulating the treatment plan.

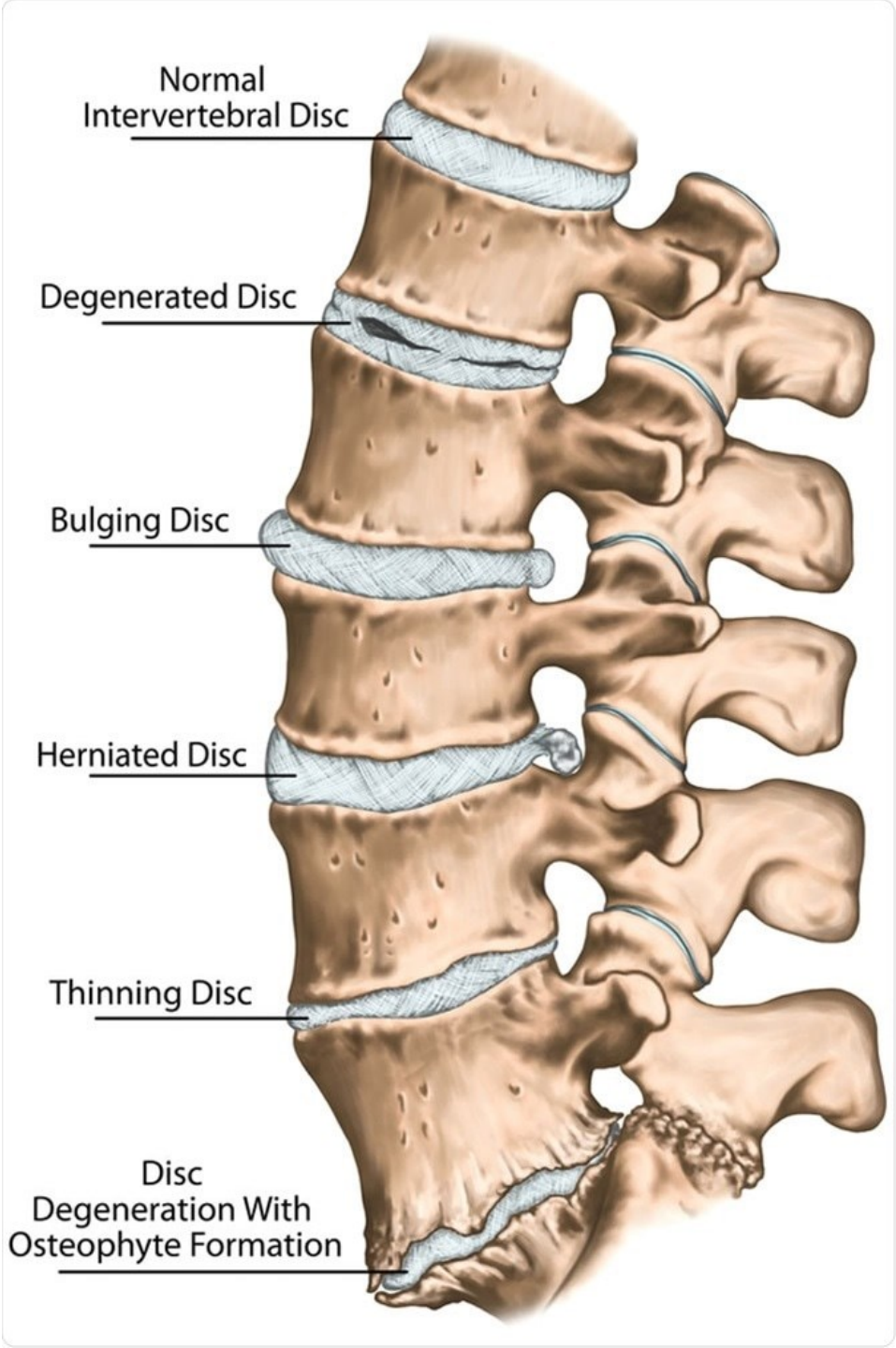


Intervertebral disc

- **Each vertebrae is separated and cushion by intervertebral disc, keeping the bones from rubbing together .**
- **Disc are designed like a radical car tire .**
- **The outer ring called the annulus, has criss-crossing fibrous bands, these bands attached between the body of each vertebrae. Inside the disc is a gel filled center called nucleus.**



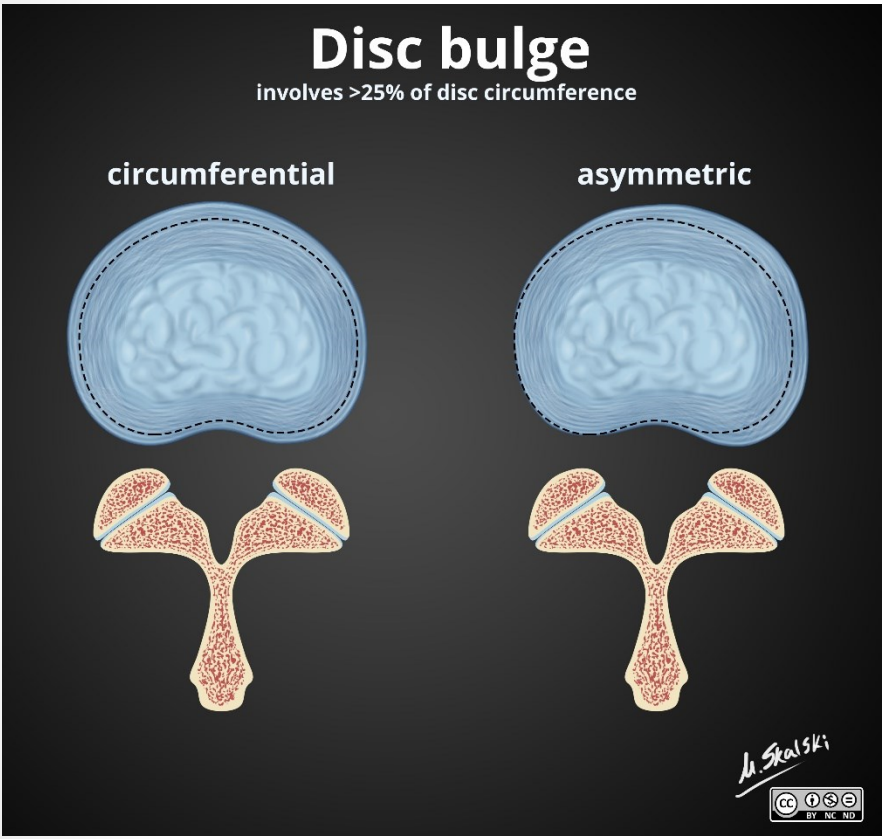
Spine problems can be more complex

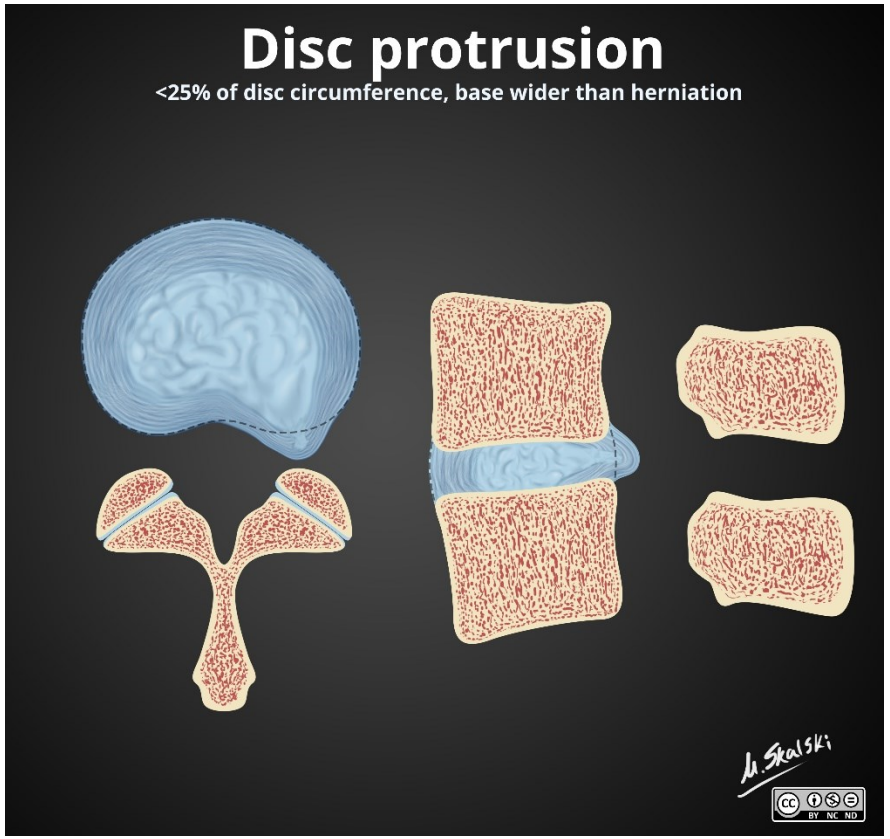


Disc prolapse levels

A

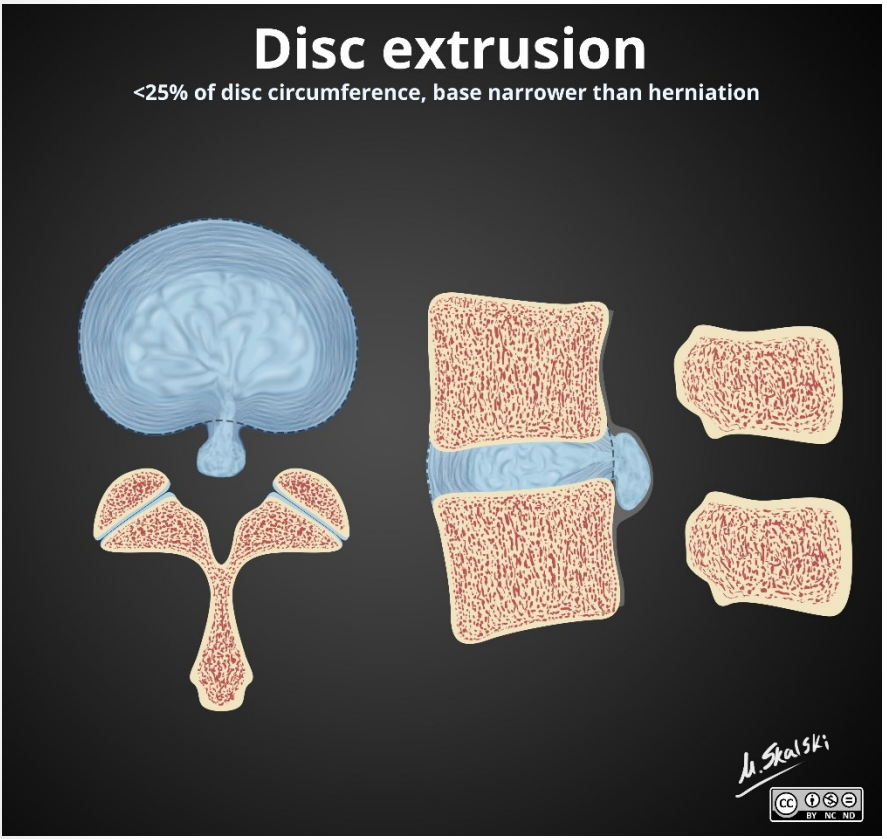
B



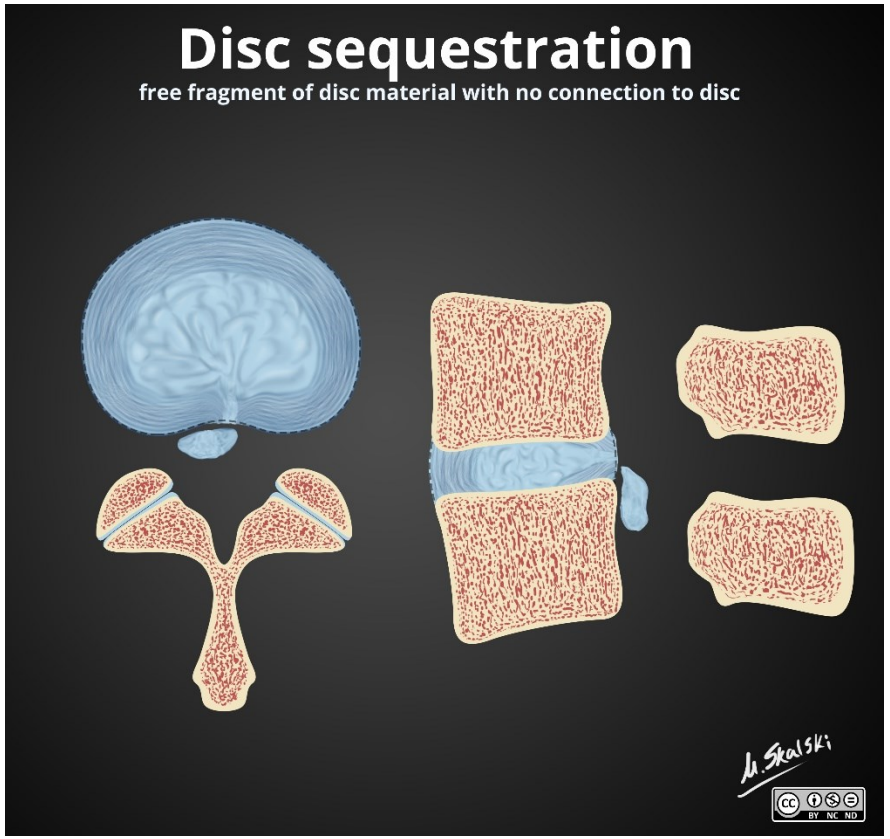


MRI DISC PROLAPSE LEVELS

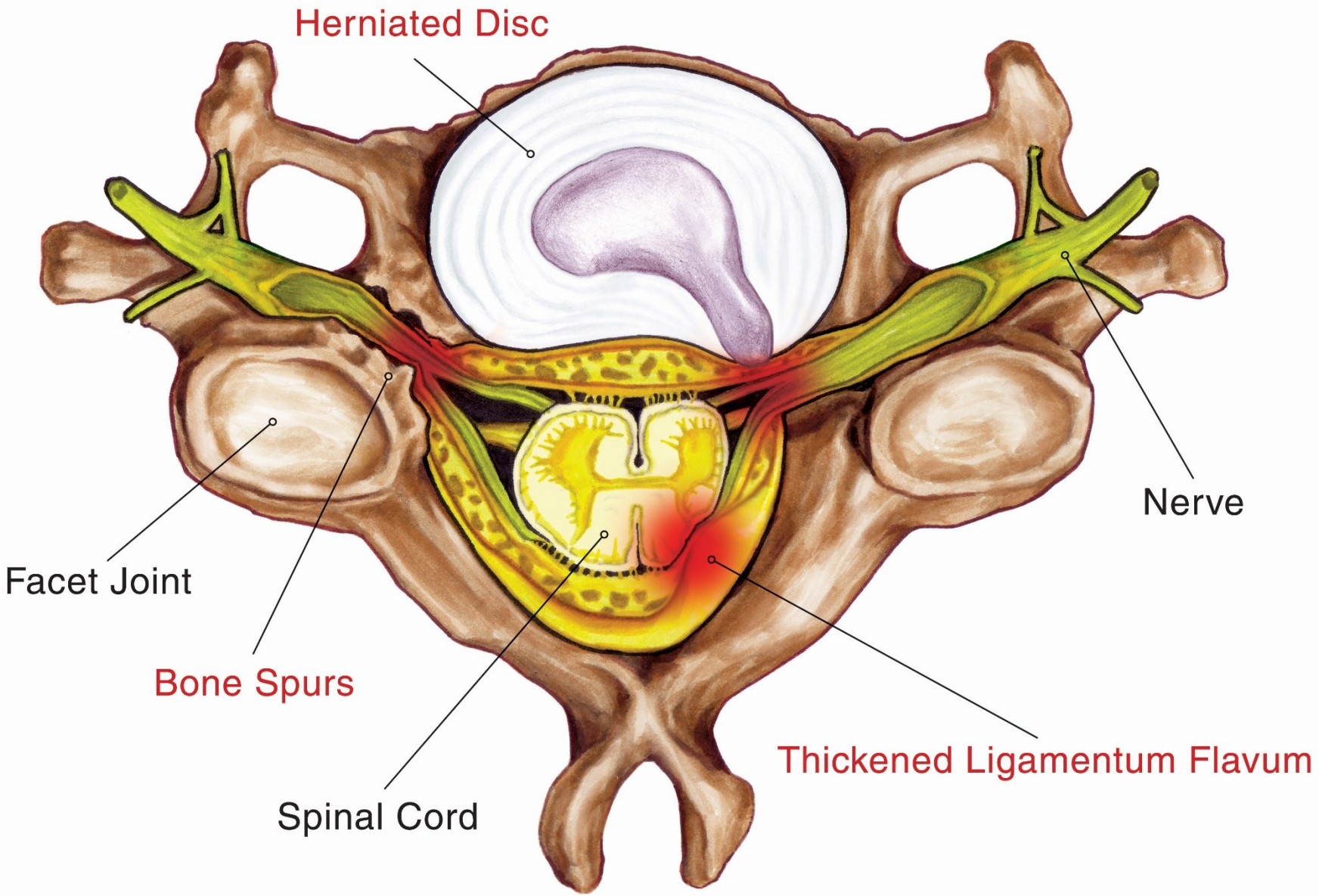
C



D



Example of Spinal Nerve Compression (viewed from above)



Normal MRI cervical spine

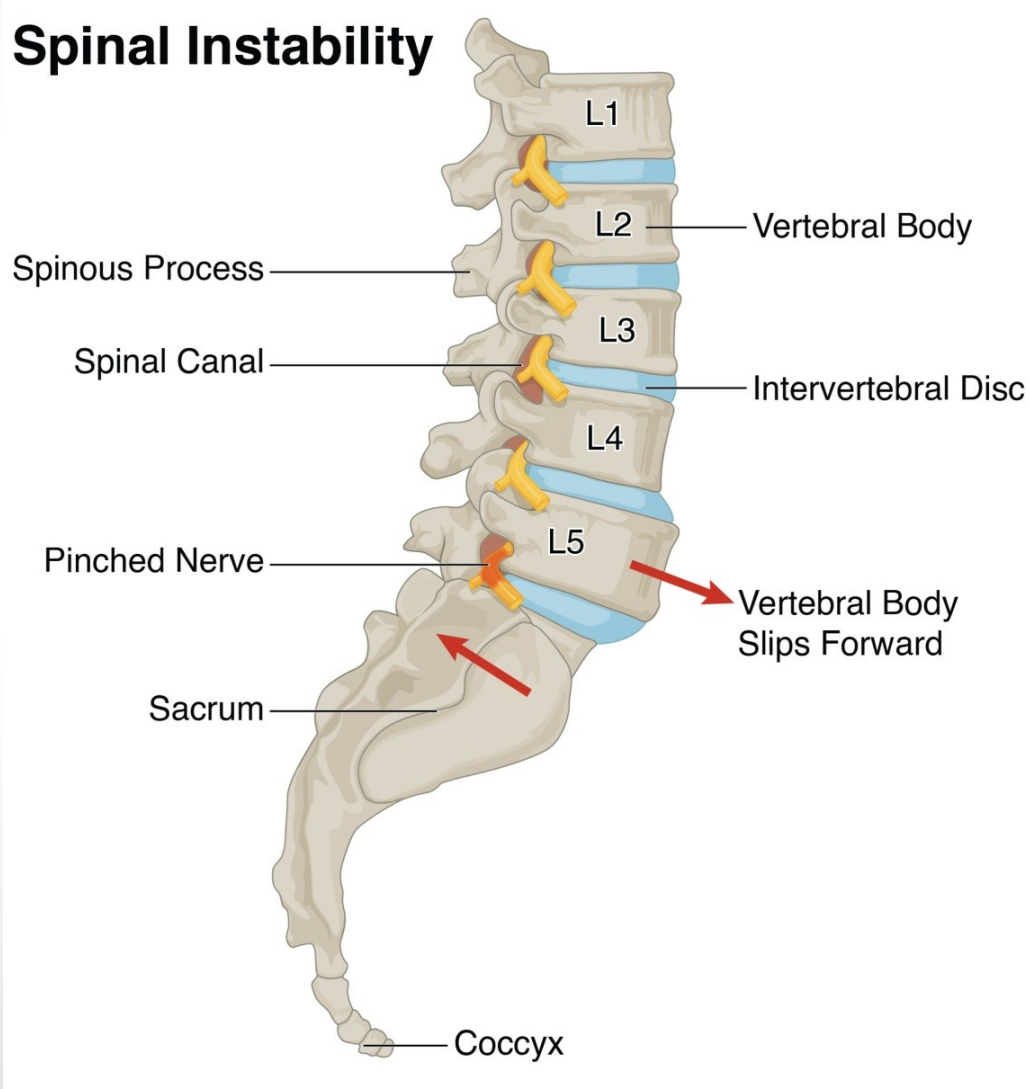
Normal MRI lumber spine

Spinal canal stenosis

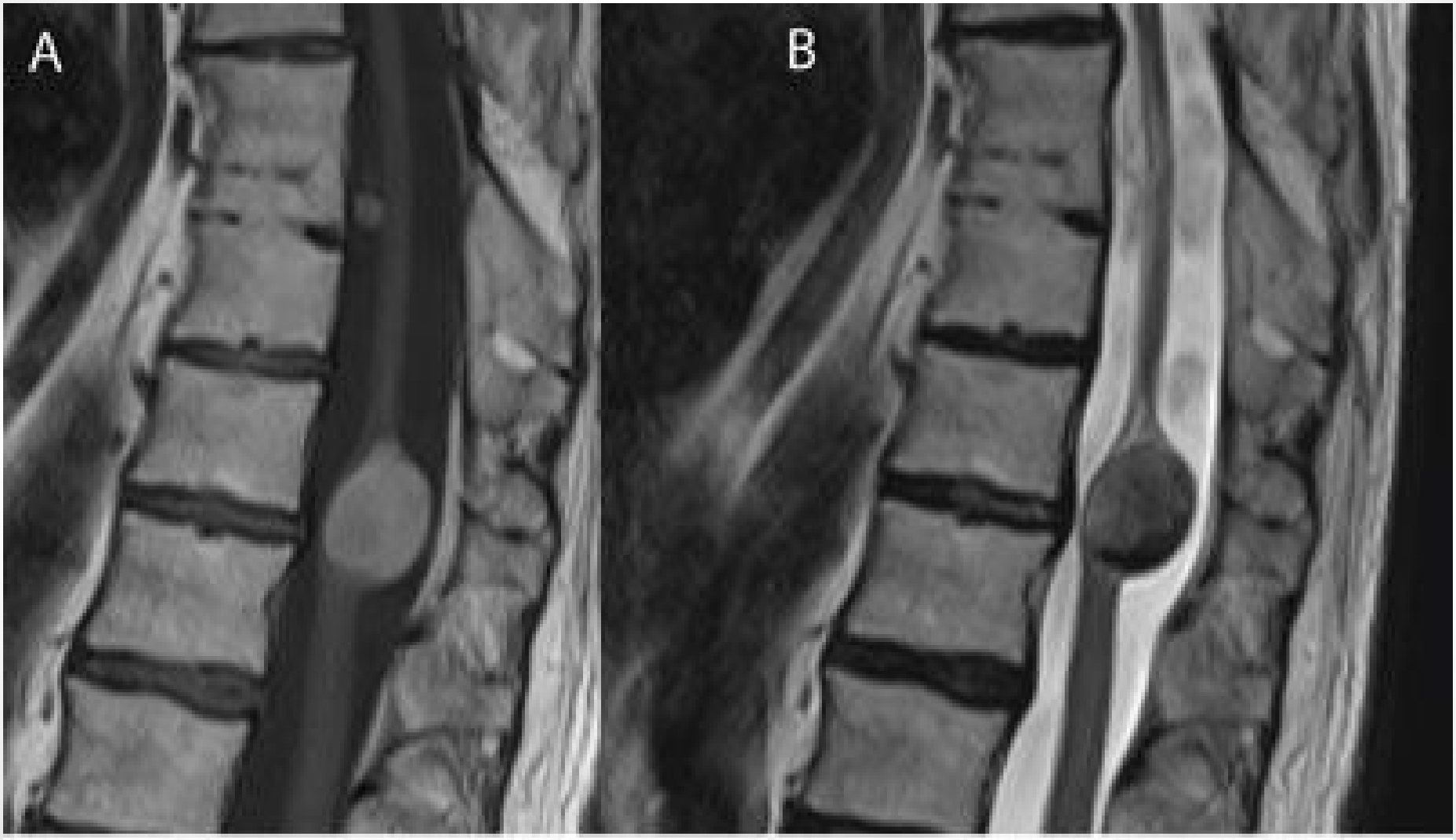
Disc herniation (sequestration)

Ligamenta Flava hypertrophy

vertebral problem : spondylolisthesis



Spinal cord problem



A- T1 with contrast

B- T2 without contrast

MRI with Contrast

- For certain conditions, an additional MRI sequence using contrast can help more accurately determine the **anatomy and pathology** of the area of the spine being studied. These contrast agents make the **abnormality in the tissues brighter and clearer on T1** helping doctors identify the pathology with greater precision.

Contrast administration

Yes	*Post-operative lumbar spine* *Inflammatory and neoplastic lesion*
No	*Any other pathology [disc lesions, spinal trauma, congenital anomalies*

TO recapitulate Spinal MRI imaging

Degenerative diseases

1- spinal canal stenosis

2- Disk lesions

3- Bone marrow change

4- Spinal instability → spondylolisthesis (antrolisthesis , Retrolisthesis)

5- cord pathology

- Loss of water→↓ T2 signal **[MRI]**
- Loss of height → narrowing of disc space **[**X ray, MR, CT?**]**
- Intradiscal air (vacuum phenomena) [CT]

Myelography

Myelography

Myelography is a type of radiographic examination that uses a contrast medium to detect pathology of the spinal cord, including the location of a spinal cord injury, cysts, and tumors. Historically the procedure involved the injection of a radiocontrast agent into the cervical or lumbar spine, followed by several X-ray projections. Today, myelography has largely been replaced by the use of MRI scans, although the technique is still sometimes used under certain circumstances – though now usually in conjunction with CT rather than X-ray projections.

CERVICAL MYELOGRAPHY

This may be performed by introduction of contrast medium into the thecal sac by lumbar puncture and then run up to the cervical spine, or by direct cervical puncture at C1/2.

Indications

Suspected spinal cord pathology or root compression in patients unable or unwilling to undergo MRI imaging.

Lateral Cervical C1/2 Puncture Versus Lumbar Injection

- cervical region to allow diagnostic quality radiographs, which were performed on the fluoroscopy table. Cervical myelography is therefore most easily, and safely, performed as a lumbar injection, at the level of the cauda equina, and then running the contrast up into the cervical region.

- Cervical puncture is indicated where there is severe lumbar disease, which may restrict the flow of contrast medium and may make lumbar puncture difficult, and when there is thoracic spinal canal stenosis..

Contrast Medium

- Non-ionic contrast medium is used with a total dose not exceeding 10 mL of contrast medium (a concentration of 300 mg mL−1).

Equipment

- Tilting x-ray table with a C-arm fluoroscopic facility for screening and radiography in multiple planes.

Radiographic Views

- After needle withdrawal, two antero-posterior (AP) radiographs are obtained, with the tube angulated cranially and caudally, in turn, along with both oblique views once again with cranial and caudal tube tilt. lateral views are needed to ensure full assessment of the cervico-thoracic junction.
- Lastly, a further lateral view of the craniocervical junction is taken with mild neck flexion, because the extended neck position may prevent full visualization of the upper cervical cord up to the foramen magnum.

LUMBAR MYELOGRAPHY

- This procedure is to look for the level of spinal cord disease such as lumbar nerve root compression , cauda equina syndrome, conus medullaris lesions, and spinal stenosis. This is done for those who are unwilling or unable to do MRI scan of the spine. Lumbar puncture is done before injected contrast into the thecal sac.
- The lumbar thecal sac is punctured at L2/3, L3/4 or L4/5. The higher levels tend to be away from the most common sites of disc herniation and stenosis, and therefore puncture may be easier.

Indications

- Suspected lumbar root or cauda equina compression, spinal stenosis and conus medullaris lesions in patients who are unable or unwilling to undergo MRI.

Contraindications

- However, it is dangerous to do lumbar puncture in those who has raised intracranial pressure. For those who had recently done lumbar punctre in one week time, there may be some cerebrospinal fluid (CSF) accumulates in the subdural space. Thus needle maybe mistakenly inserted into subdural space rather than the targeted subarachnoid space.

Contrast Medium

- The contrast medium is the same as that used for cervical myelography. The maximum dose is again the equivalent of 3 g of iodine, and may be given as 10 mL of contrast medium of 300 mg mL−1 concentration, or 12.5 mL of 240 mg mL−1.

Radiographic Views

1. AP and oblique views are obtained. (About 25 degrees of obliquity is typical
2. Lateral view with a horizontal beam is useful, but further laterals in the erect or semierect position on flexion and extension.

THORACIC MYELOGRAPHY

- If the thoracic spine is the primary region of interest, the lumbar puncture injection is made with the patient lying on one side, and the patient's head supported on a bolster or pad to prevent contrast medium from running up into the head.

- When the injection is complete, lateral radiographs may be taken, and the patient is then turned to lie supine. Further AP views are then taken.

THANK YOU

For you attention