1

Aims / Objectives

- Understand normal radiological imaging of the spine (X-rays, CT and MRI) and be able to demonstrate anatomical structures
- Understand the key concepts, indications, contraindications and basic physics principles behind X-Ray, CT, MRI, Bone scan, Myelogram and DEXA scan

- CT Computed Tomography
- MRI Magnetic Resonance Imaging
- DEXA Dual Energy X ray Absorptiometry aka Bone density scans

2

X - ray

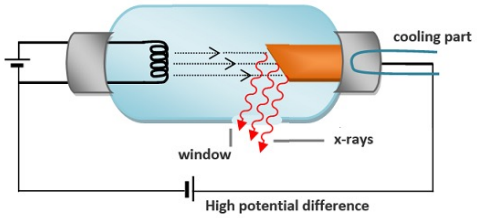
Quick and cheap
Using ionising x-rays
Good bone resolution
Two-dimensional
Can take multiple view

3

X-Ray

4

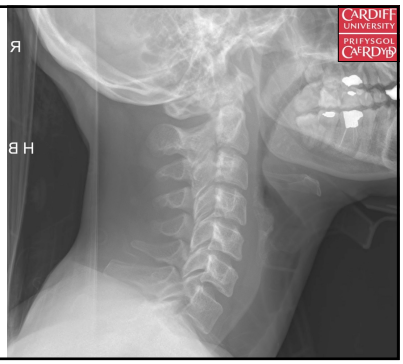
X-Ray Generation



5

Lateral C Spine XR

- Name / Age
- Date
- Type of Radiograph
- A : ADEQUECY / ALIGNMENT
- B : BONE
- C : CARTILAGE
- D : DENS
- E : EXTRA-AXIAL SOFT TISSUE



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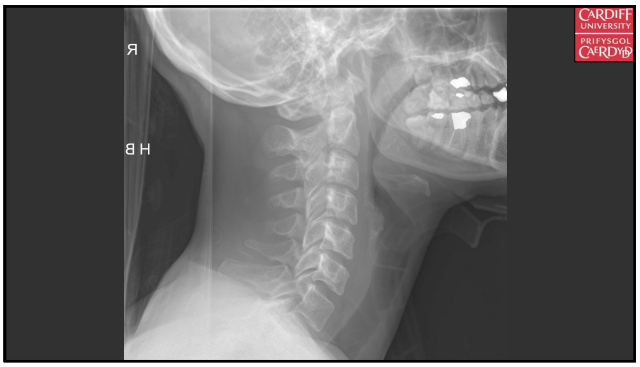

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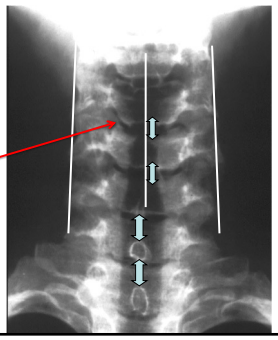
AP View

- Alignment
- Vertebral Bodies
- Lateral Masses
- Uncovertebral joint
- Spinous Processes
- Discs



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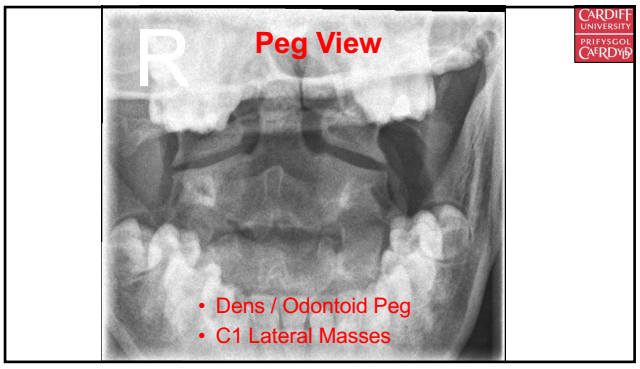

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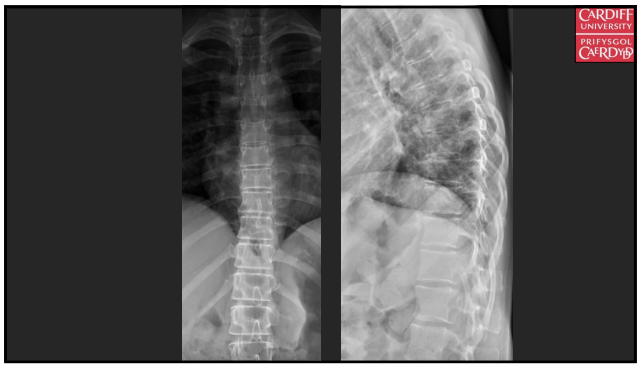

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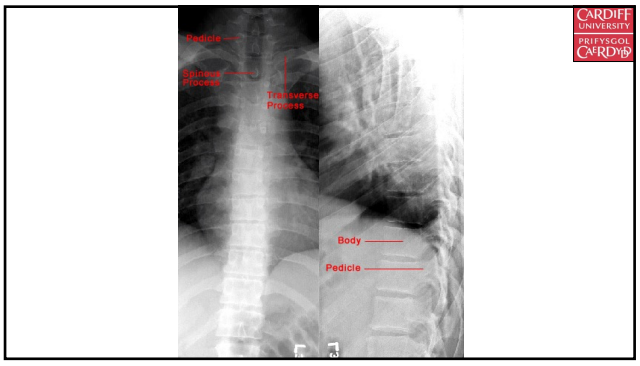

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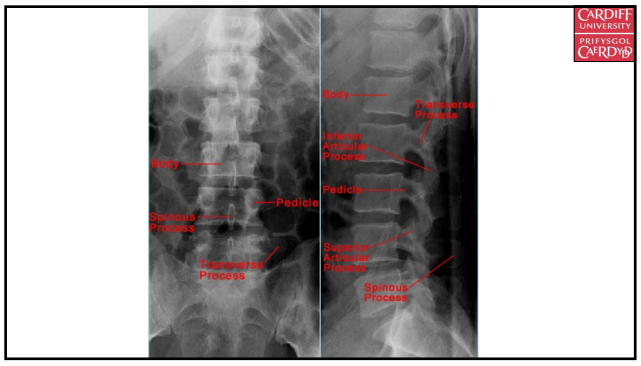

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CT

- 360 degrees rotating x-ray tube
- Acquires volume of data
- Can view image in any plane – Axial, Sagittal, Coronal, Oblique
- Very good spatial and contrast resolution
- Three-dimensional data
- Much more radiation than plain radiograph
- Fast

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CT

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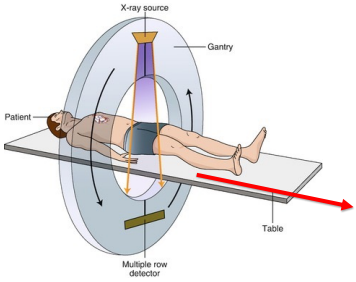
CT gantry



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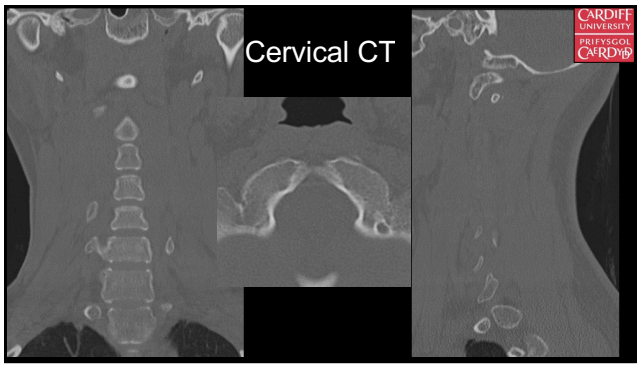

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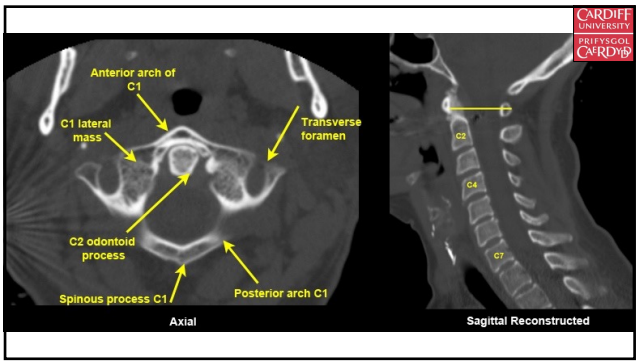

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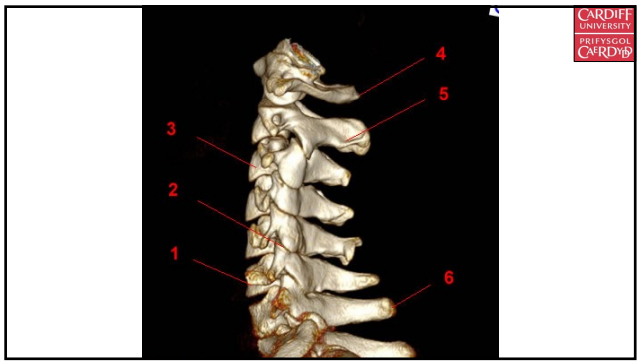

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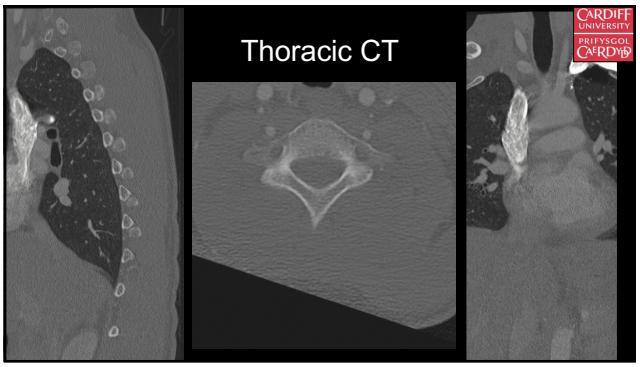

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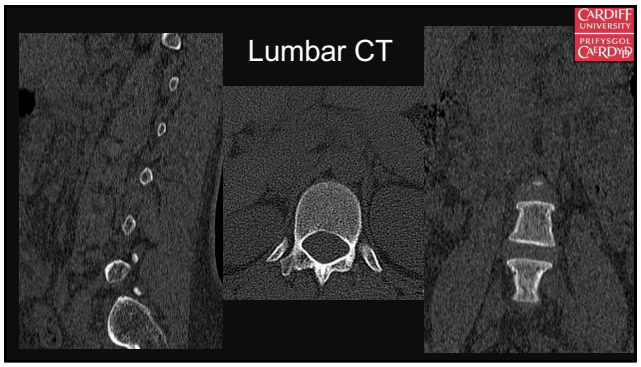

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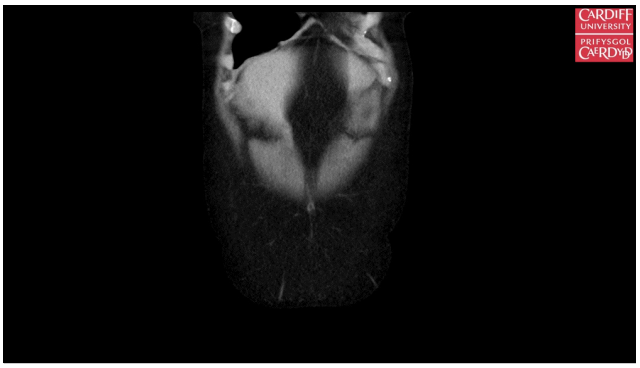

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MRI

- Water is abundant in the body
- Water has hydrogen – H2O
- MR imaging uses the absorption and emission of radio frequency energy from **hydrogen.**

- This is done by using:
  - Very strong magnetic fields – 1.5 to 3 Tesla (up-to 7 Teslain research)
  - Magnetic field gradients
  - Radio waves

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MRI

- Excellent for soft tissue
- Able to see spinal cord, nerves, ligaments very well
- No radiation
- Very high magnetic field – always on
- Tight scanning chamber
- Very noisy - clattering and banging noises
- Takes approximately 30 mins for a simple scan
- Tricky in anesthetised patients due to the magnet/equipment
- Young children do not lie still – may need sedation/GA

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MRI

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Contraindication to MRI

Magnetic field strength 120 times gravity

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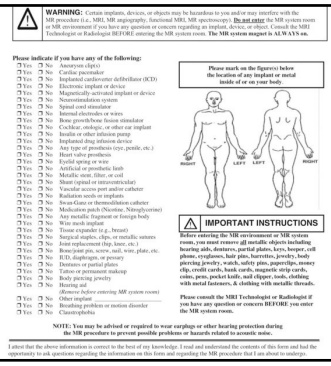
MRI safety questionnaire



WARNING: Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). Do not enter the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist BEFORE entering the MR system room. The MR system magnet is ALWAYS on.

Please indicate if you have any of the following:

- ☐ Yes ☐ No Aneurysm clip(s)
- ☐ Yes ☐ No Cardiac pacemaker
- ☐ Yes ☐ No Implanted cardioverter defibrillator (ICD)
- ☐ Yes ☐ No Electronic implant or device
- ☐ Yes ☐ No Magnetically activated implant or device
- ☐ Yes ☐ No Neurostimulation system
- ☐ Yes ☐ No Spinal cord stimulator
- ☐ Yes ☐ No Internal electrodes or wires
- ☐ Yes ☐ No Bone growth/bone fusion stimulator
- ☐ Yes ☐ No Cochlear, otologic, or other ear implant
- ☐ Yes ☐ No Insulin or other infusion pump
- ☐ Yes ☐ No Implanted drug infusion device
- ☐ Yes ☐ No Any type of prosthesis (eye, penile, etc.)
- ☐ Yes ☐ No Heart valve prosthesis
- ☐ Yes ☐ No Eyelid spring or wire
- ☐ Yes ☐ No Artificial or prosthetic limb
- ☐ Yes ☐ No Metallic stent, filter, or coil
- ☐ Yes ☐ No Shunt (spinal or intraventricular)
- ☐ Yes ☐ No Vascular access port and/or catheter
- ☐ Yes ☐ No Radiation seeds or implants
- ☐ Yes ☐ No Swan-Ganz or thermodilution catheter
- ☐ Yes ☐ No Medication patch (Nicotine, Nitroglycerine)
- ☐ Yes ☐ No Any metallic fragment or foreign body
- ☐ Yes ☐ No Wire mesh implant
- ☐ Yes ☐ No Tissue expander (e.g., breast)
- ☐ Yes ☐ No Surgical staples, clips, or metallic sutures
- ☐ Yes ☐ No Joint replacement (hip, knee, etc.)
- ☐ Yes ☐ No Bone/joint pin, screw, nail, wire, plate, etc.
- ☐ Yes ☐ No IUD, diaphragm, or pessary
- ☐ Yes ☐ No Dentures or partial plates
- ☐ Yes ☐ No Tattoo or permanent makeup
- ☐ Yes ☐ No Body piercing jewelry
- ☐ Yes ☐ No Hearing aid
  (Remove before entering MR system room)
- ☐ Yes ☐ No Other implant _____
- ☐ Yes ☐ No Breathing problem or motion disorder
- ☐ Yes ☐ No Claustrophobia

NOTE: You may be advised or required to wear earplugs or other hearing protection during the MR procedure to prevent possible problems or hazards related to acoustic noise.

Please mark on the figure(s) below the location of any implant or metal inside of or on your body

RIGHT LEFT LEFT RIGHT

IMPORTANT INSTRUCTIONS

Before entering the MR environment or MR system room, you must remove all metallic objects including hearing aids, dentures, partial plates, keys, beeper, cell phone, eyeglasses, hair pins, barrettes, jewelry, body piercing jewelry, watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, tools, clothing with metal fasteners, & clothing with metallic threads.

Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room.

I attest that the above information is correct to the best of my knowledge. I read and understand the contents of this form and had the opportunity to ask questions regarding the information on this form and regarding the MR procedure that I am about to undergo.

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MRI

- Lots and lots of Sequences
  Fundamental sequences are T1 and T2
  - T1 weighted: fat bright (high signal), fluid dark (low signal)
  - T2 weighted: fat bright (high signal), fluid bright (high signal)
  - Can Saturate (darken/hide) fat to show fluid (pus/inflammation/fluid/blood) more easily
- Image is representation of Signal (high to low)

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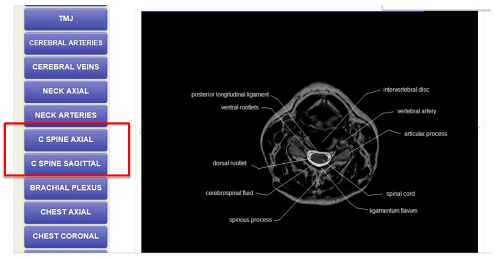
MRI anatomy resource



https://mrimaster.com/anatomy%20spine%20c%20spine%20axial.html

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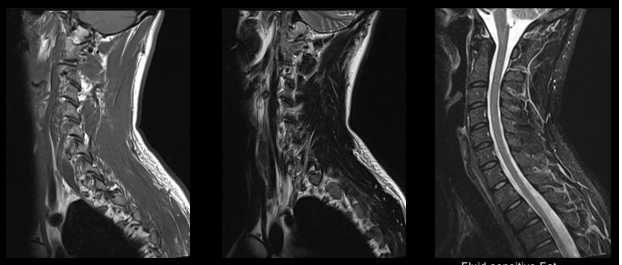
Cervical MRI



T1 T2 Fluid sensitive Fat supressed/saturated (STIR)

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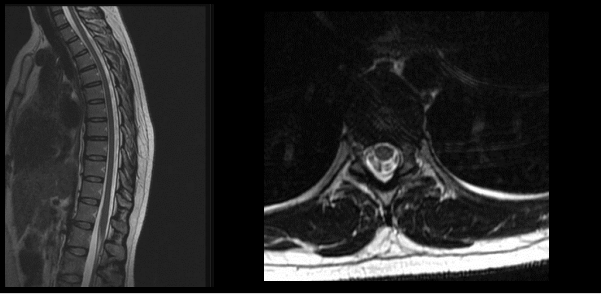
Thoracic MRI (T2)



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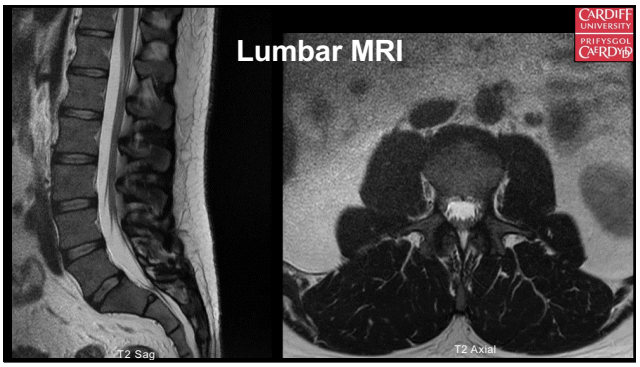

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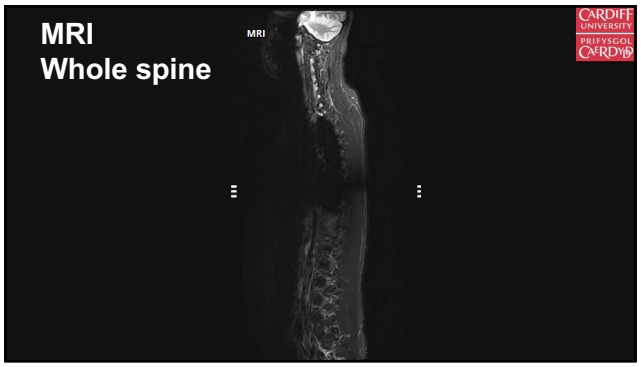

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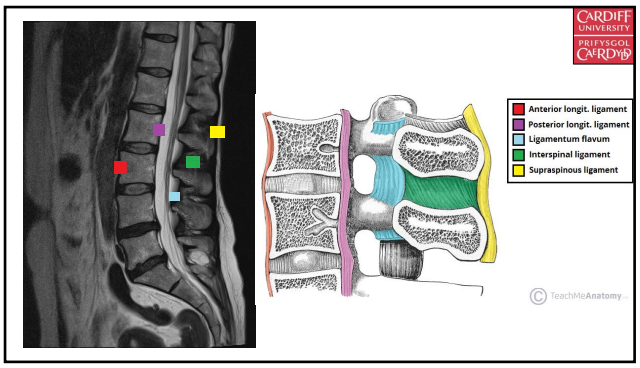

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Bone Scan (scintigraphy)

- Functional nuclear medicine scan
- Patient is injected with radioactive tracer – radioactive Tc99m-MDP (a type of bisphosphonate).
- The Tc99m-MDP (tracer) circulates in the body and sticks to bone.
- More tracer accumulates in areas of bone which are metabolically more active: Fracture, infection, inflammation, cancer etc.
- The tracer gives off radiation from inside the patient and this is detected by a gamma camera

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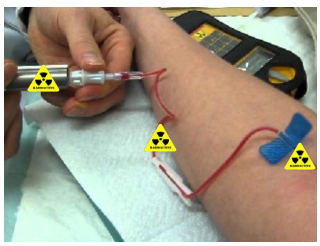
Tracer injection (Tn99m-MDP)

- Radioactivity injected into patient
- The patient then becomes radioactive
- The tracer builds up in areas such as fractures, tumours, inflammation
- Gives off radiation from inside the patient and this is detected by a gamma camera



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Gamma camera

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Bone Scan (scintigraphy)

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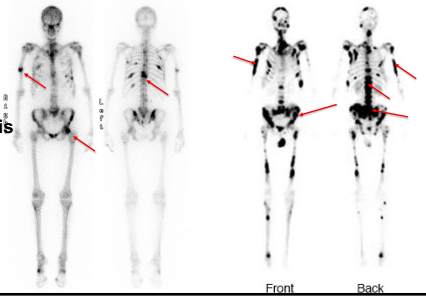
Bone Scan

Cancer metastasis to bone



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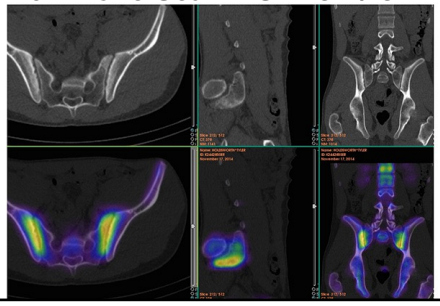
3D Bone Scan – SPECT / CT



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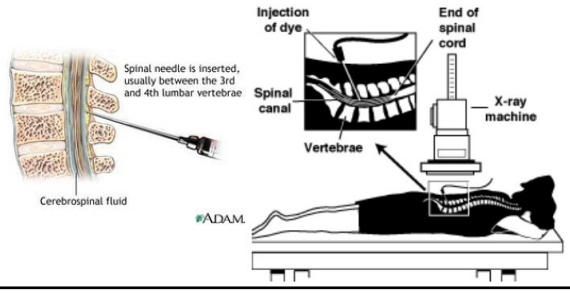
Myelogram

- An uncommon exam due to advent of MRI and CT.
- Now mainly used in conjunction with a CT in patients who cannot have an MRI.
- Contrast is injected into the subarachnoid space under x-ray guidance (fluoroscopy) and the patient then goes on to have a CT scan.
- Not suitable if allergic to contrast.

40

Fluoroscopy guided myelogram



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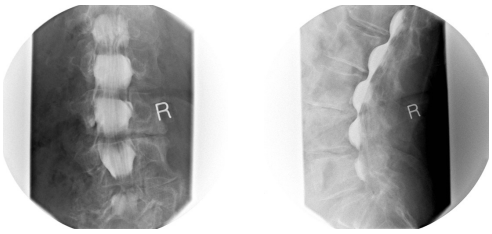
Myelogram



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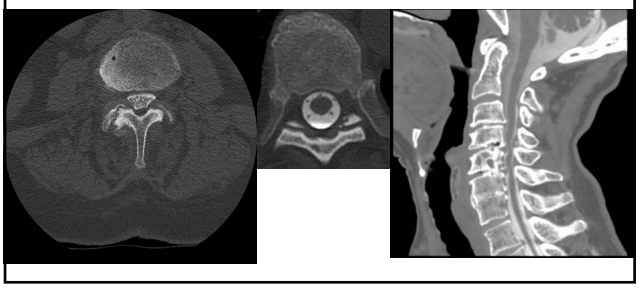
CT Myelogram



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DEXA Scan

- Dual-energy X-ray absorptiometry
- Measures bone mineral density
- Quick and non-invasive
- Produces data for diagnosis and to guide treatment for **osteoporosis**

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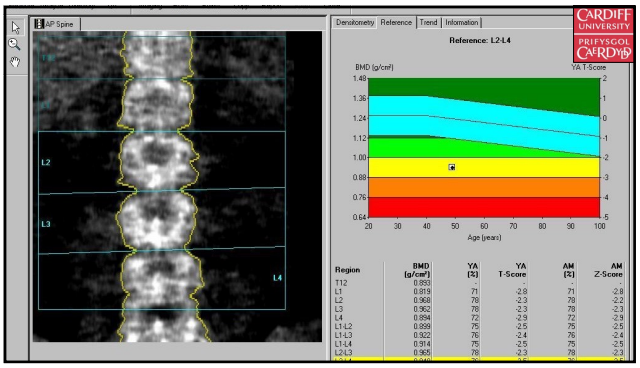

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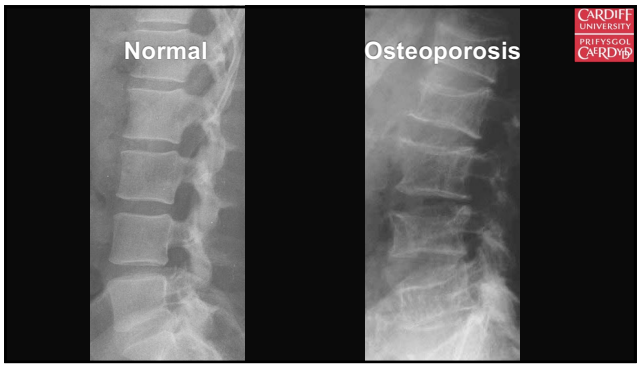

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Summary

	X-ray	CT	MRI	Bone scan	DEXA
Advantages					
Disadvantages					

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Excellent resources

- www.radiopedia.org
- https://pubs.rsna.org/page/radiographics/abr-core-exam-study-guide
- CT spine anatomy - http://w-radiology.com/ct-cervical-spine.php
- MRI spine anatomy - https://mrimaster.com/anatomy%20spine%20c%20spine%20axial.html
- Todays cases - https://radiopaedia.org/playlists/19735

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