

Introduction into Medical Imaging

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Disclosures

None

Defintion

Wikipedia:

- “Medical imaging is the technique and process of creating visual representations of the **interior of a body** for clinical analysis and medical intervention, as well as **visual representation of the function** of some organs or tissues (physiology).”

FDA:

- “Medical imaging refers to several different technologies that are used to view the human body in order to diagnose, monitor, or treat medical conditions. Each type of technology gives different information about the area of the body being studied or treated, related to possible disease, injury, or the effectiveness of medical treatment.”

History of medical imaging

- X-Rays discovered in 1895 by Wilhelm Röntgen
- X-Ray tomography in 1940s (today replaced by CT)
- Angiography with iodine contrast agent in 1950s
- Clinical use of ultrasounds in 1970s
- Magnetic resonance imaging in 1971
- Computed tomography (CT) in 1973
- PET/CT in 1998

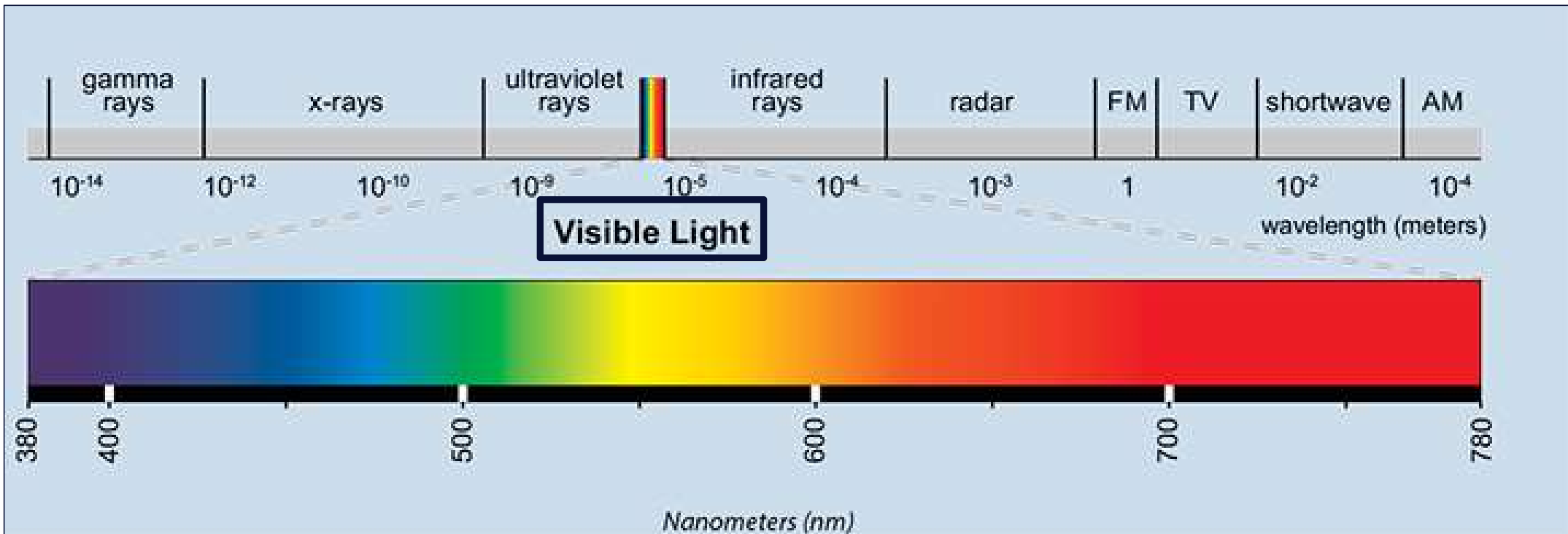


Major modalities in medical imaging

- Projection X-ray (Radiography)
- X-ray Computed Tomography (CT)
- Nuclear Medicine (SPECT, PET)
- Ultrasound
- Magnetic Resonance Imaging

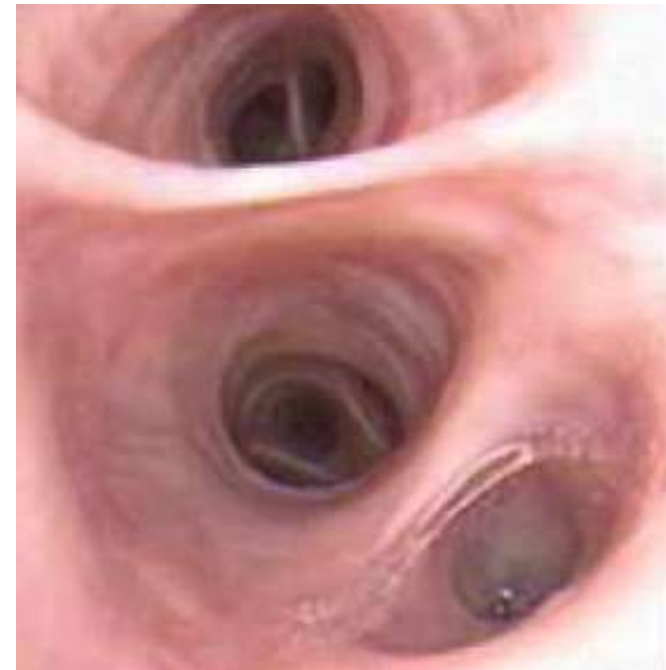
Indications for medical imaging

- **Diagnosis**
 - Tumors
 - Infection
 - Fractures
- **Therapy planning**
 - Primary and re-staging in oncology
 - Presurgical assessment
- **Therapy response evaluation**
 - RECIST
 - PERCIST



Fibre glass endoscopy

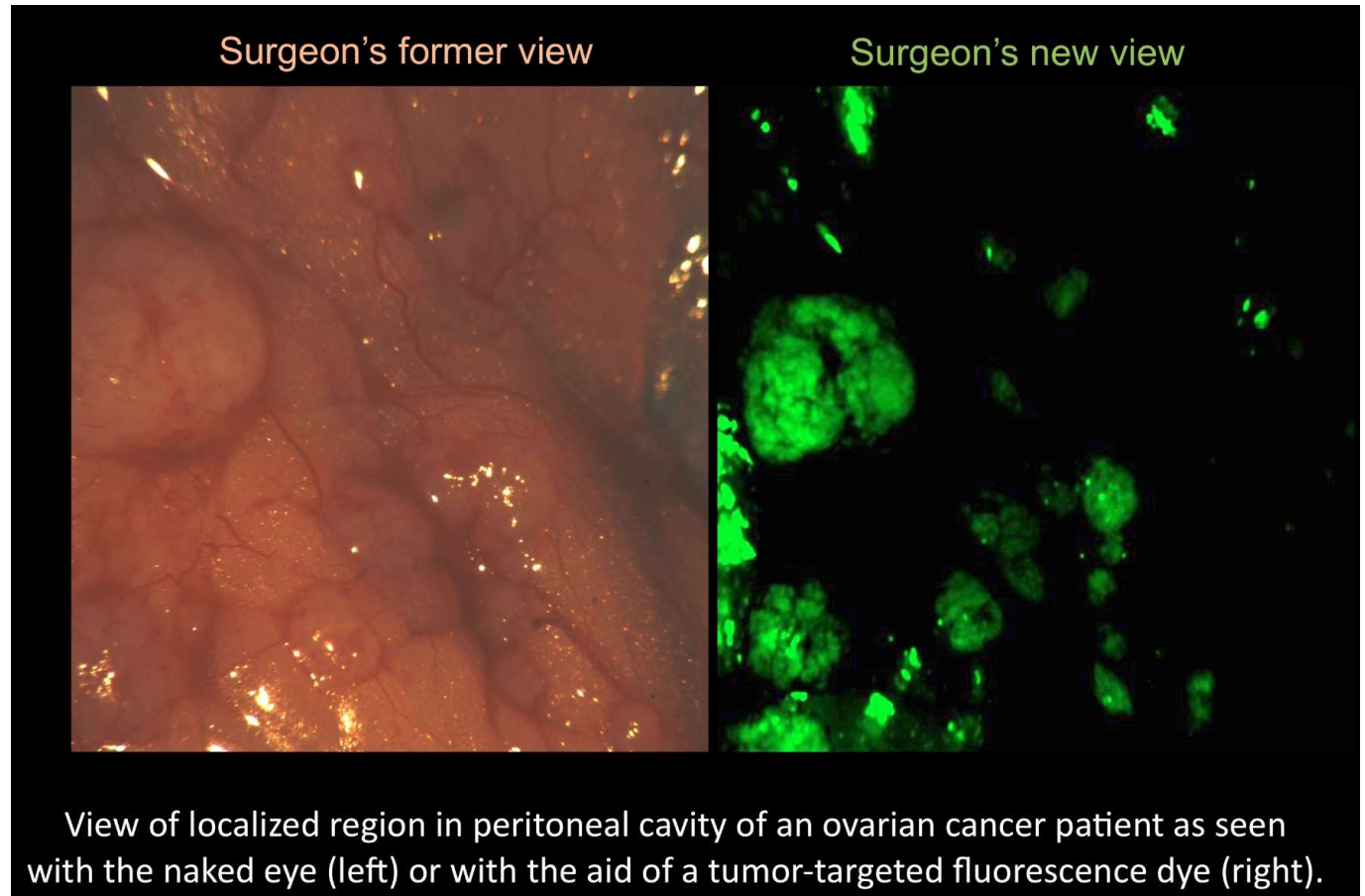
- Fibre glass endoscopy
 - Ability to emit light as well as receive the image
 - Flexibility
- Indications for endoscopy
 - Colonoscopy
 - Colorectal polyps
 - Bronchoscopy
 - Biopsy
 - Foreign objects
 - Cystoscopy
 - Stenosis
 - Biopsy



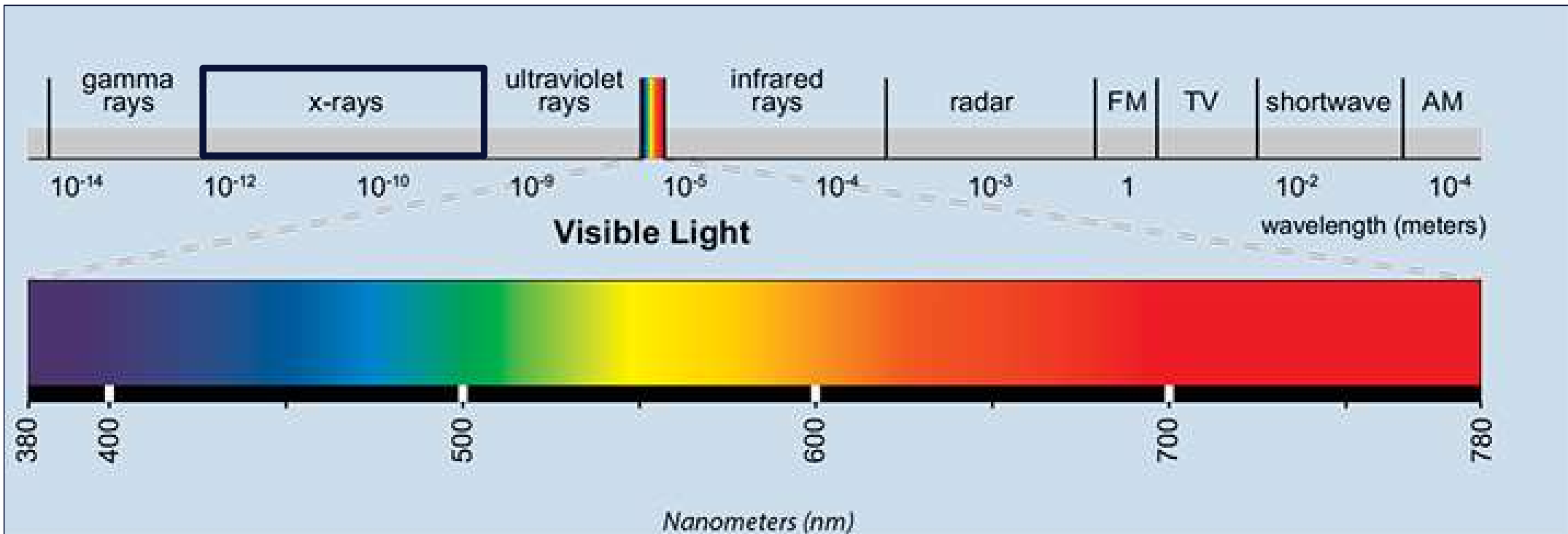
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Fluorescence

- Use of fluorescent dyes that are excited by certain wavelengths
- Indications
 - Fluorescence image-guided surgery
 - Fluorescence tomography in mouse models

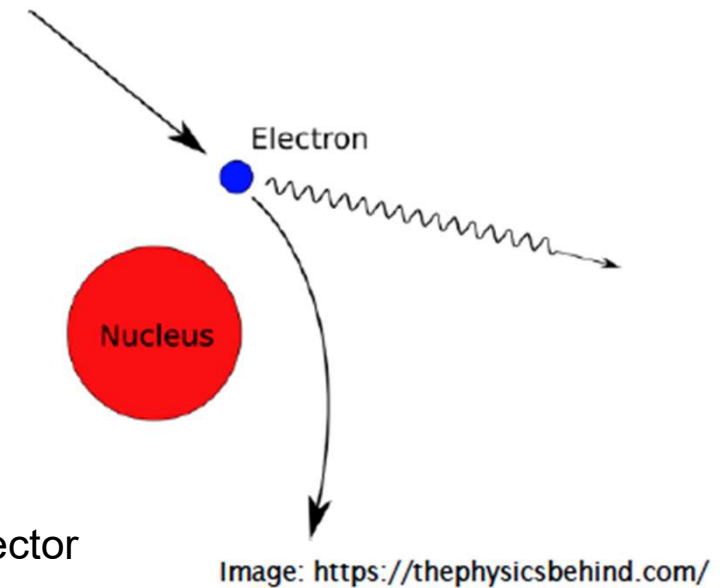
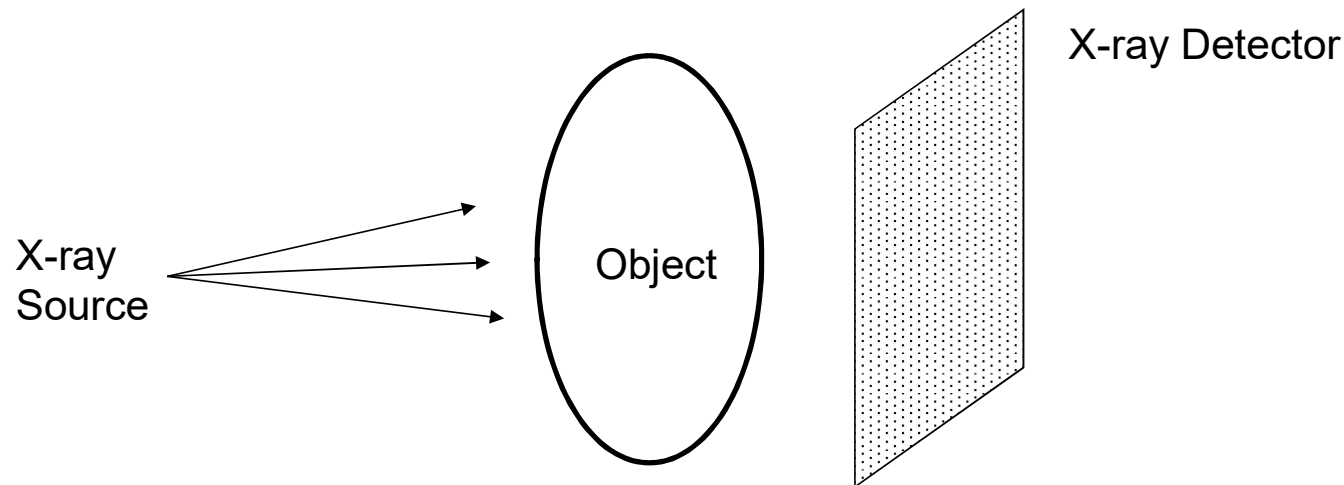


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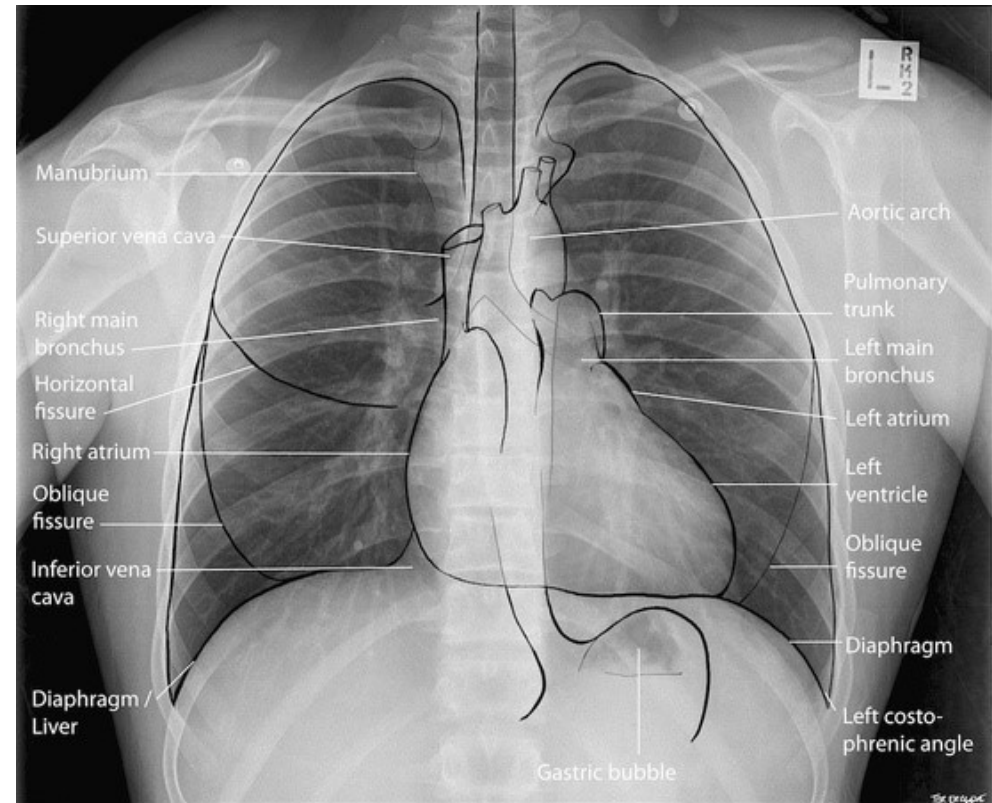
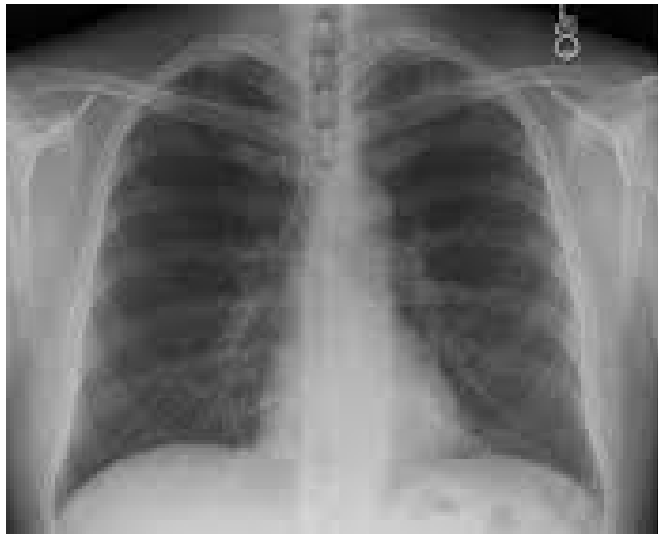


X-Ray

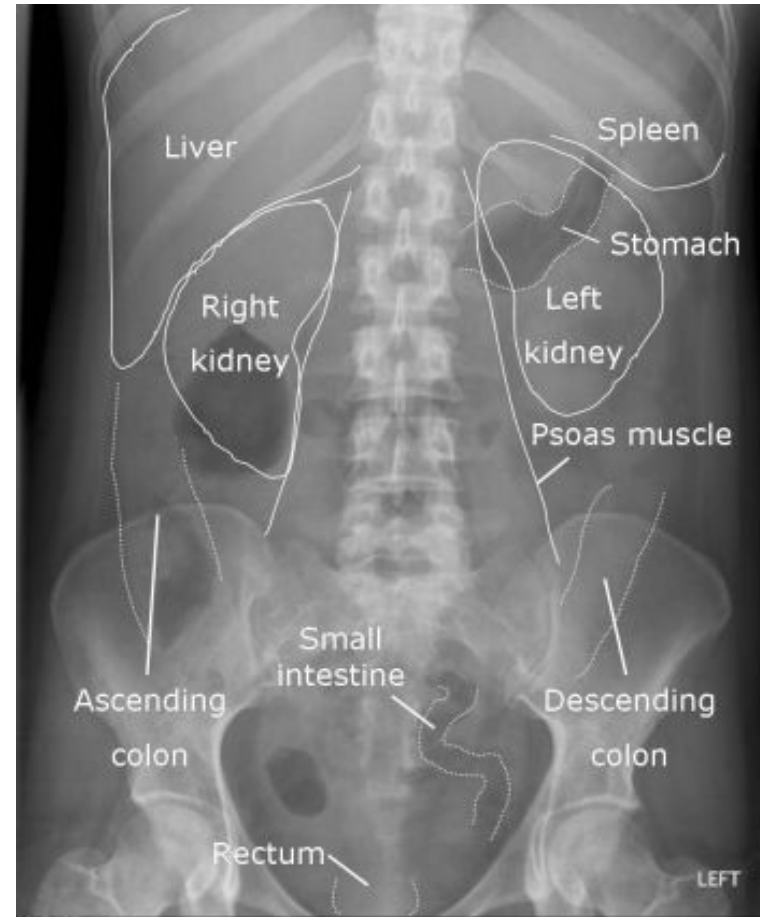
- Deceleration of charged particles („Bremsstrahlung“)
- Attenuation of beam by passing thorough tissue
- Image detector



X-ray chest- anatomy

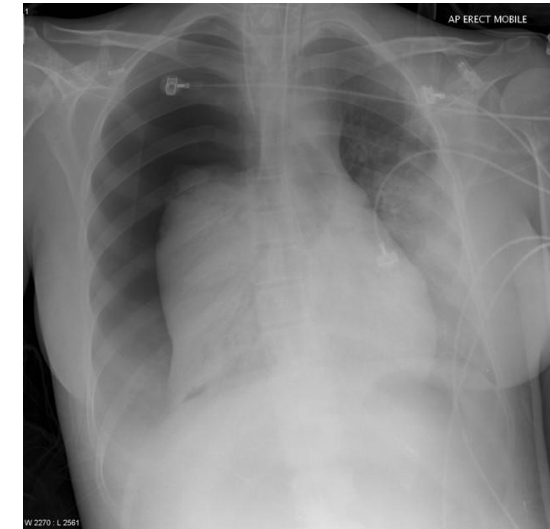


X ray abdomen -anatomy



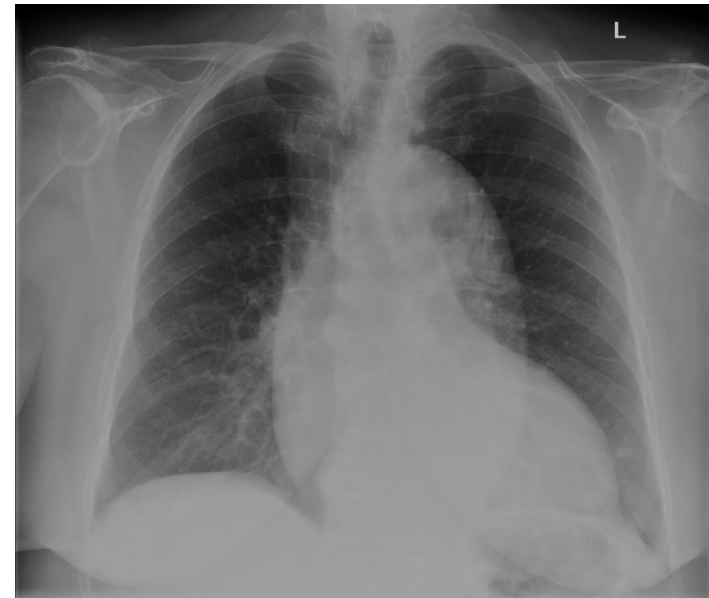
X-Ray: what we can diagnose

- Indications for X-Ray
 - Chest X-Ray: pneumonia, pleural effusion, pneumothorax,...



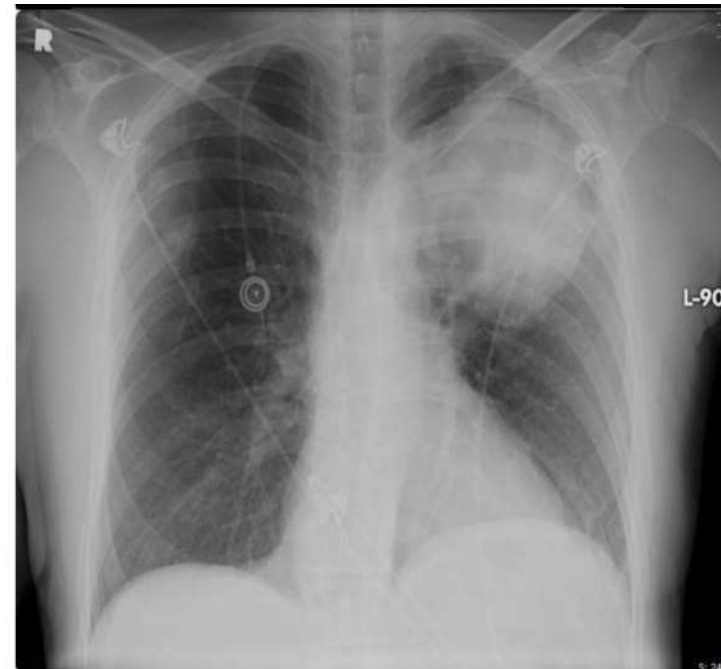
X-Ray: what we can diagnose

- Indications for X-Ray
 - Chest X-Ray: rough assessment of the heart and vessels



X-Ray: what we can diagnose

- Indications for X-Ray
 - Chest X-Ray: things that should not be there



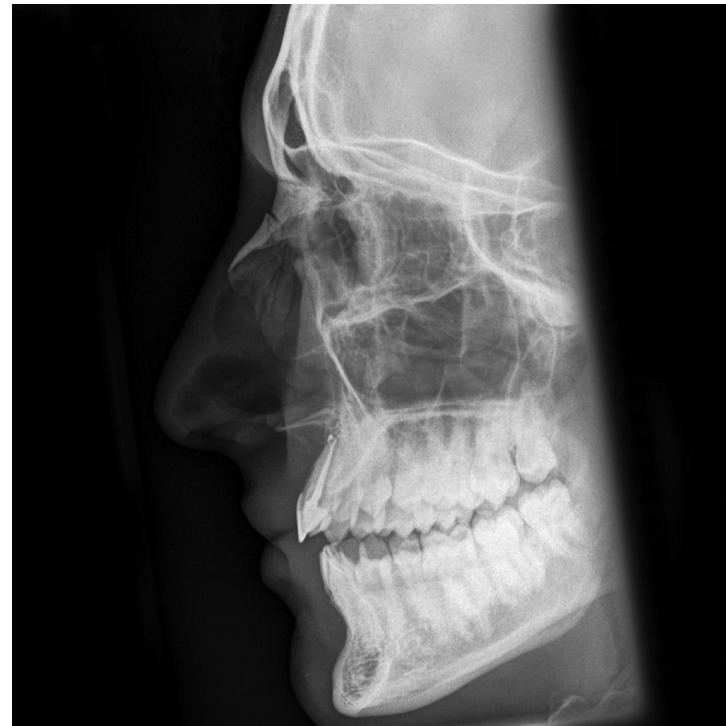
X-Ray: what we can diagnose

- Indications for X-Ray
 - Abdominal X-Ray (Ileus, free gas, kidney stones,...)



X-Ray: what we can diagnose

- Indications for X-Ray
 - Imaging of bone fractures



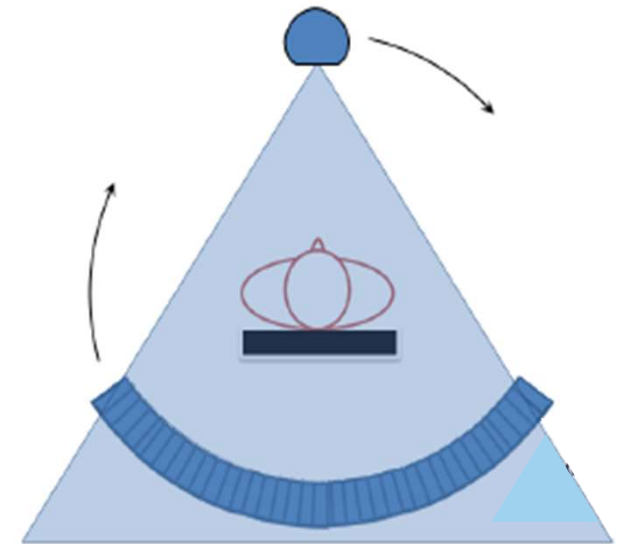
X-Ray: what we can diagnose

- Indications for X-Ray
 - Teeth X-ray (dentistry)



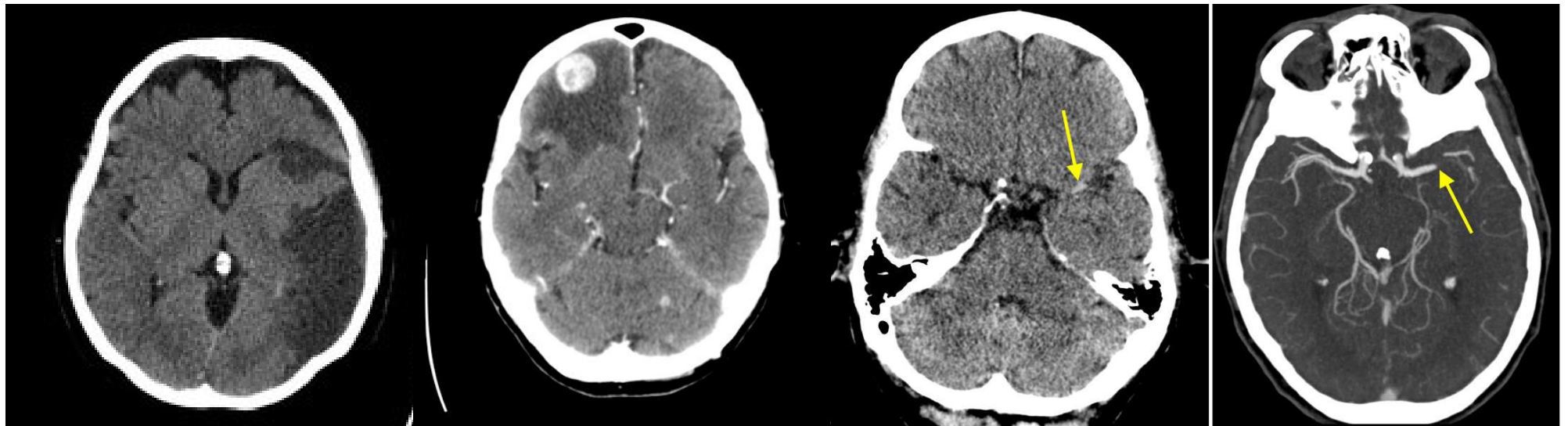
Computed Tomography (CT)

- Multiple X-Ray images calculated into one transaxial image
- Better tissue contrast
- Better localisation of pathologies
- Excellent imaging quality with lower radiation doses



CT indications

- Head: Infarction, hemorrhage, tumors, pre-and posttherapeutical assesement



CT indications

- Lungs: pneumonia, emphysema, fibrosis, tumor



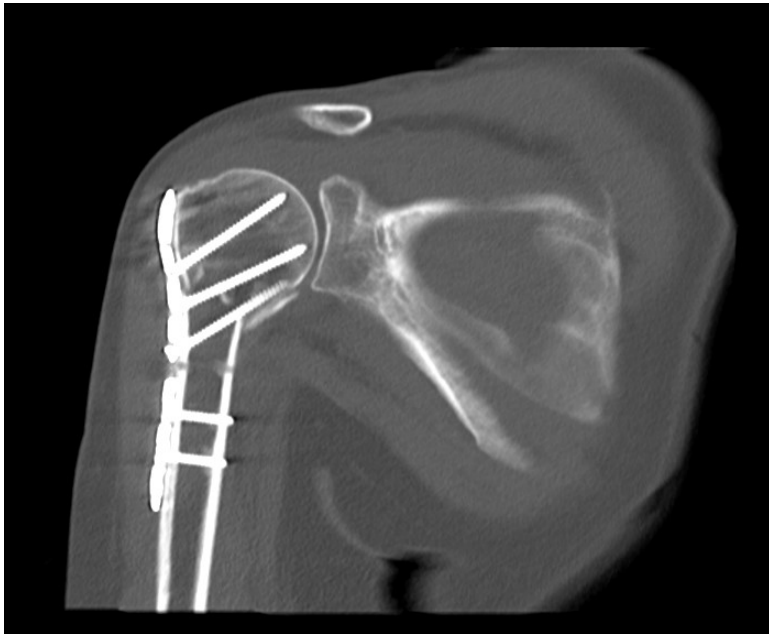
CT indications

- Abdomen: tumor, pre-and posttherapeutic imaging, kidney stones, diseases of intestines



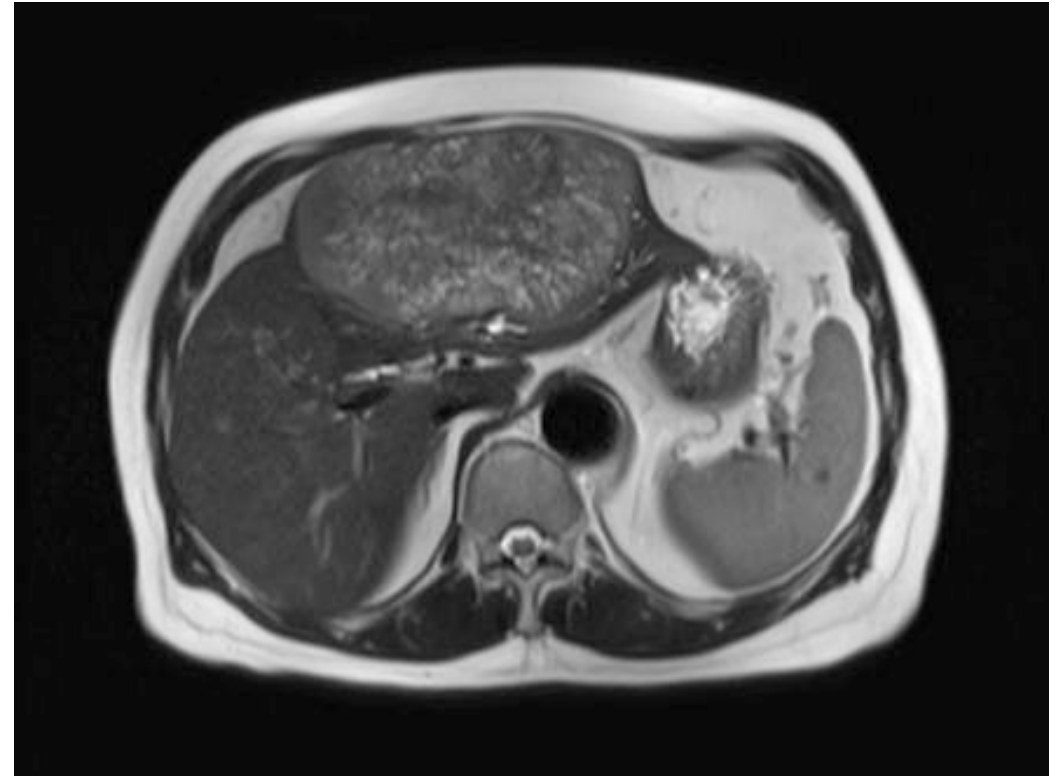
CT indications

- MSK: post-therapeutic assessment, tumor



Magnetic Resonance Imaging (MRI)

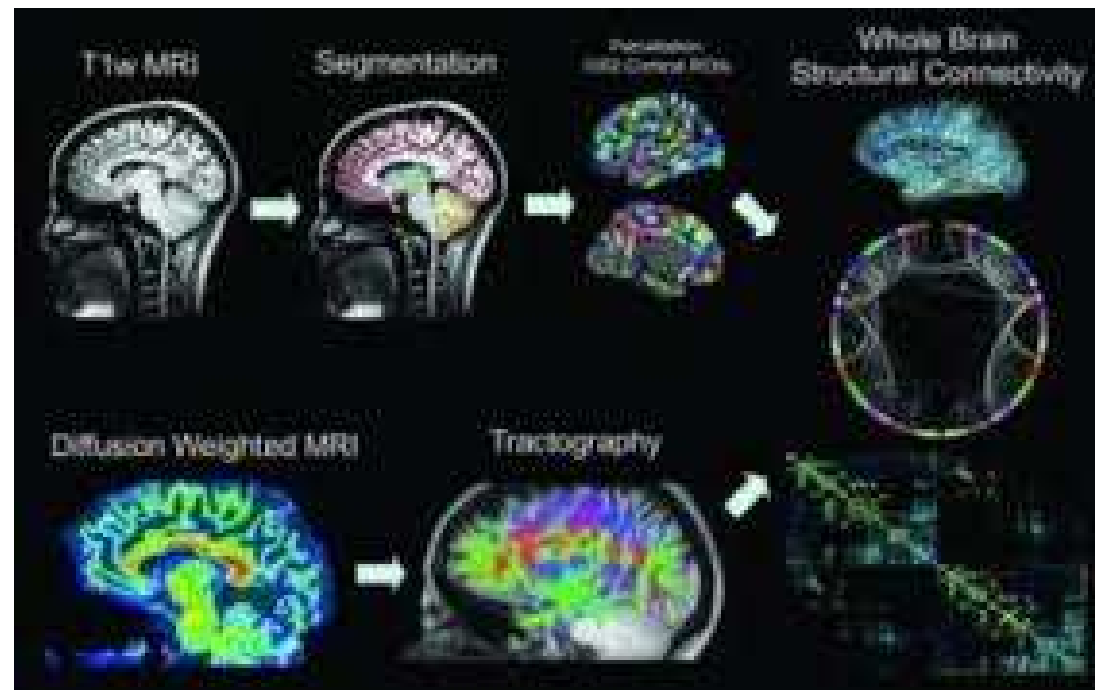
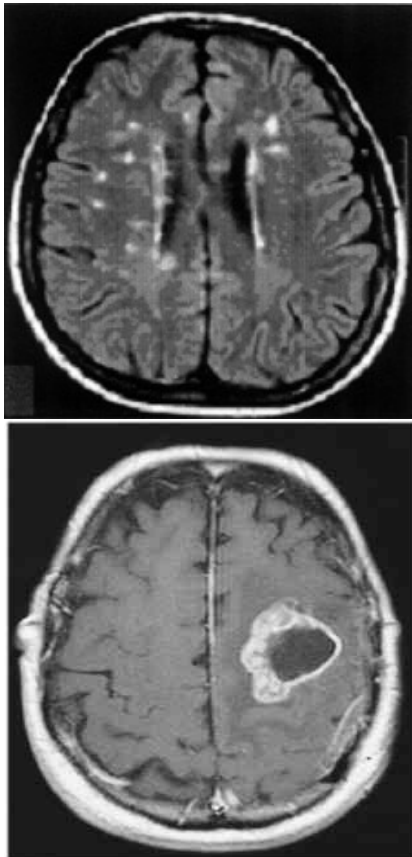
- Alteration of spin using strong magnetic fields
- Detection of return to normal spin
- Very good tissue contrast
- No ionising radiation



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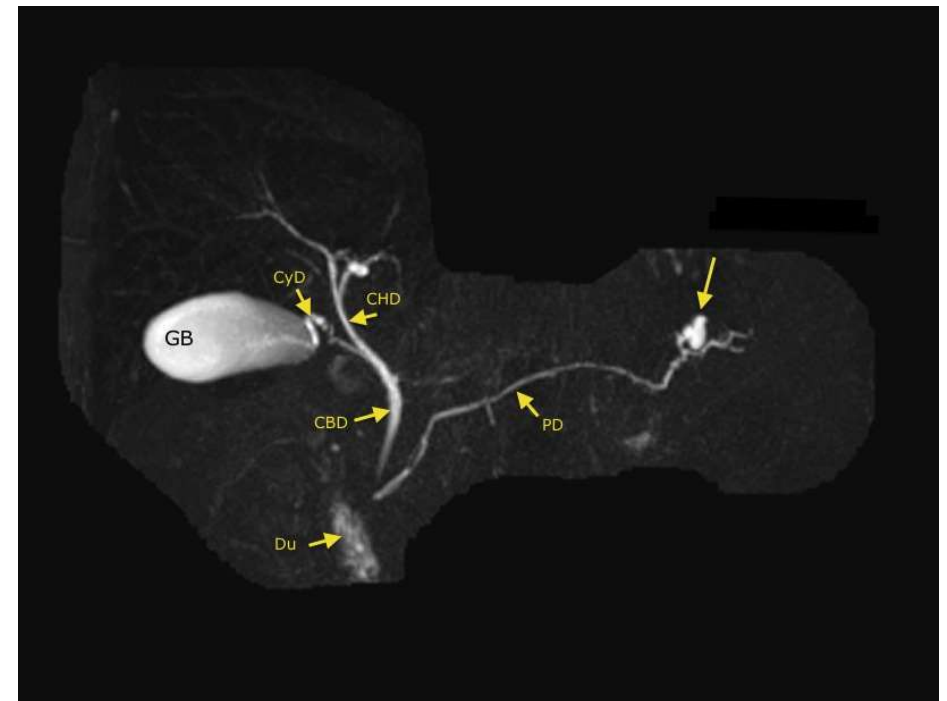
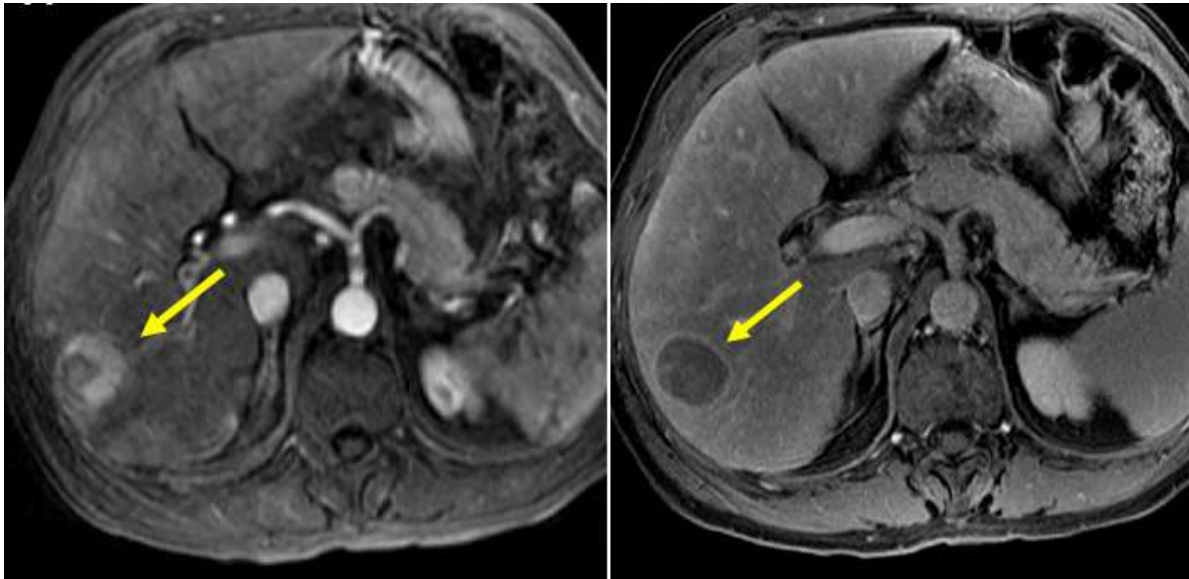
MRI indications

- Neuroimaging: tumor, demyelinating diseases, structural epilepsy



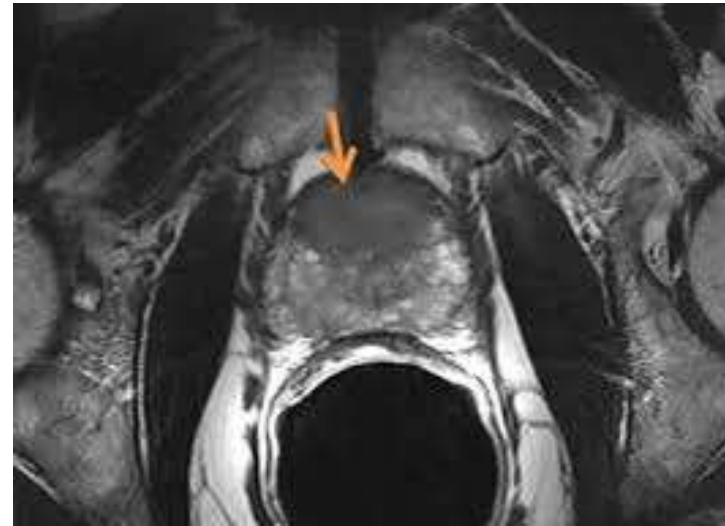
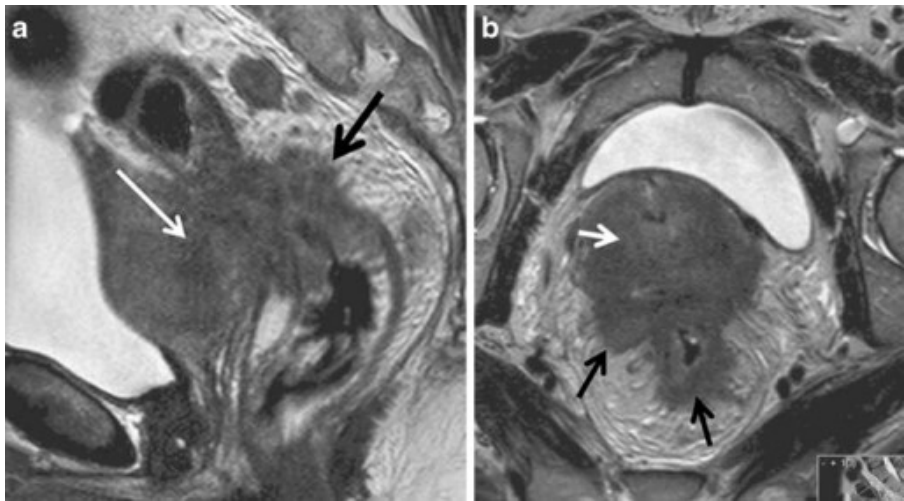
MRI indications

- Abdominal: liver, pancreas, MRCP



MRI indications

- Pelvis: Tumors and radiation treatment planning



Ultrasound (US)

- Production of soundwaves using Piezo-electric crystals
- Reception of the resulting echos in the same detector
- Uses soundwaves and no ionising radiation



<http://babyexpressions3d4d.com/wp-content/uploads/2015/02/be1.jpg>

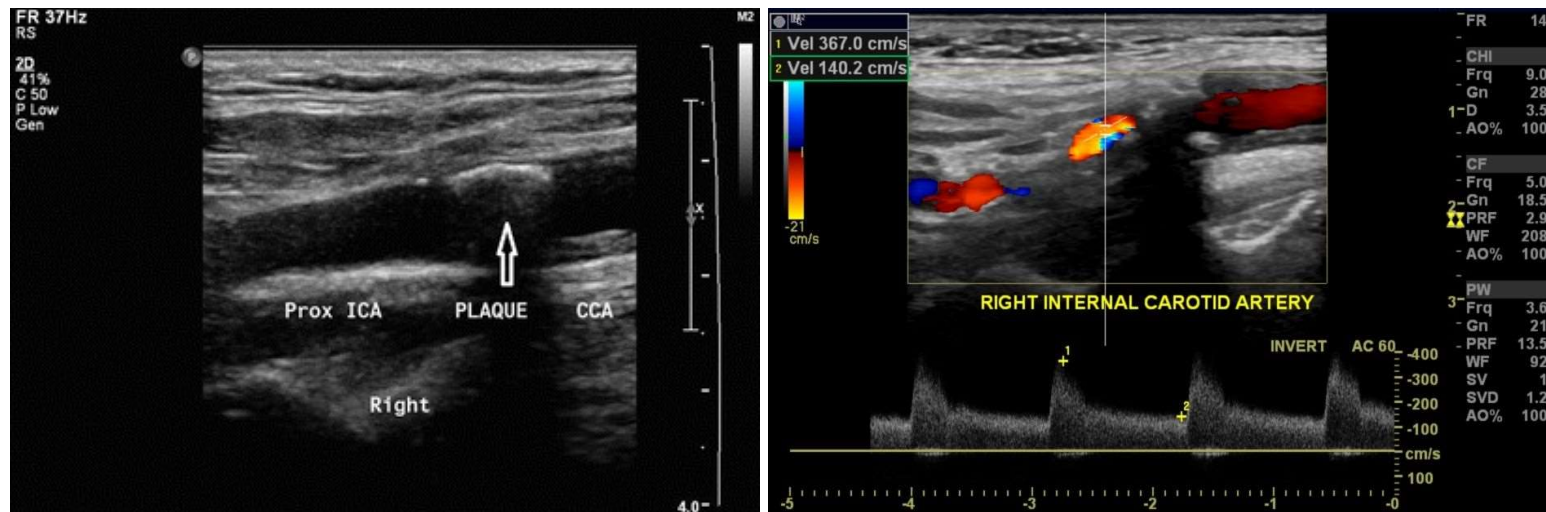
US indications

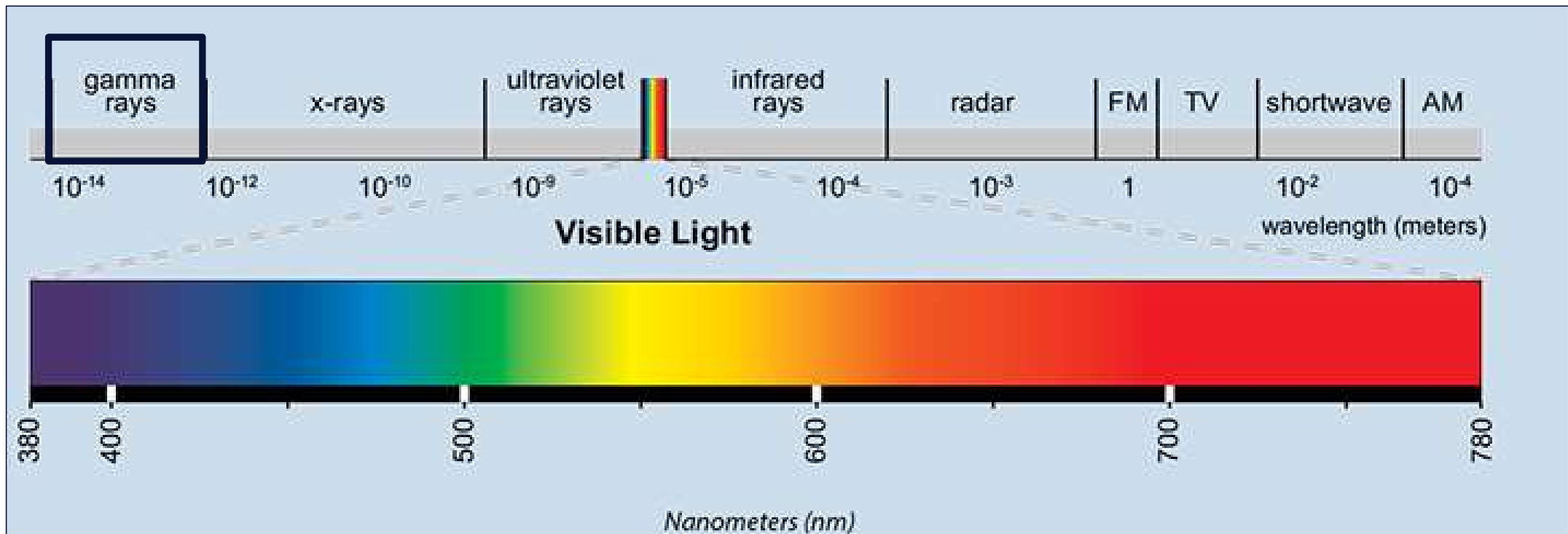
- Indications:
 - Gynaecology
 - Prenatal screening
 - Transvaginal ultrasound
 - Abdomen
 - Assessment of gallbladder, kidney, pancreas, liver, spleen



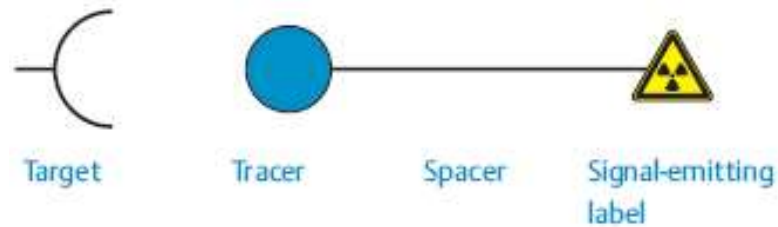
US indications

- Thyroid
 - Detection of nodules
- Angiology
 - Deep vein thrombosis

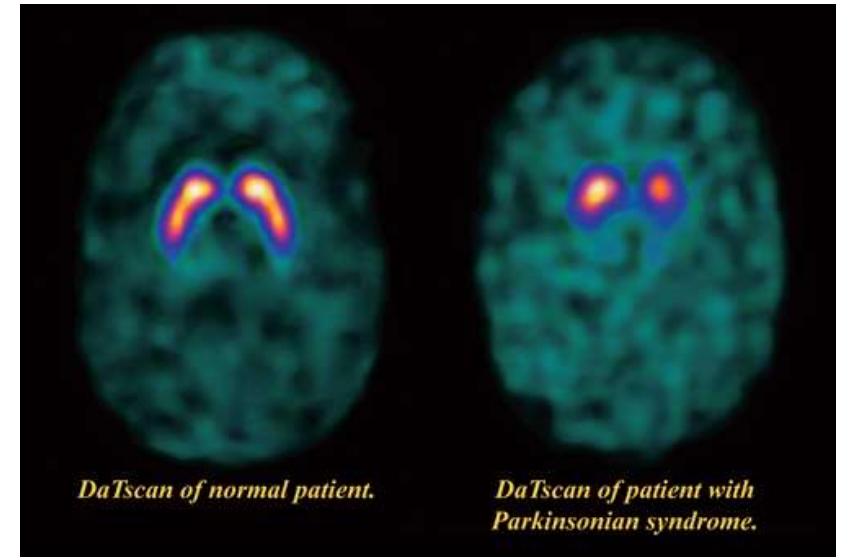




Nuclear Medicine(NM) imaging techniques



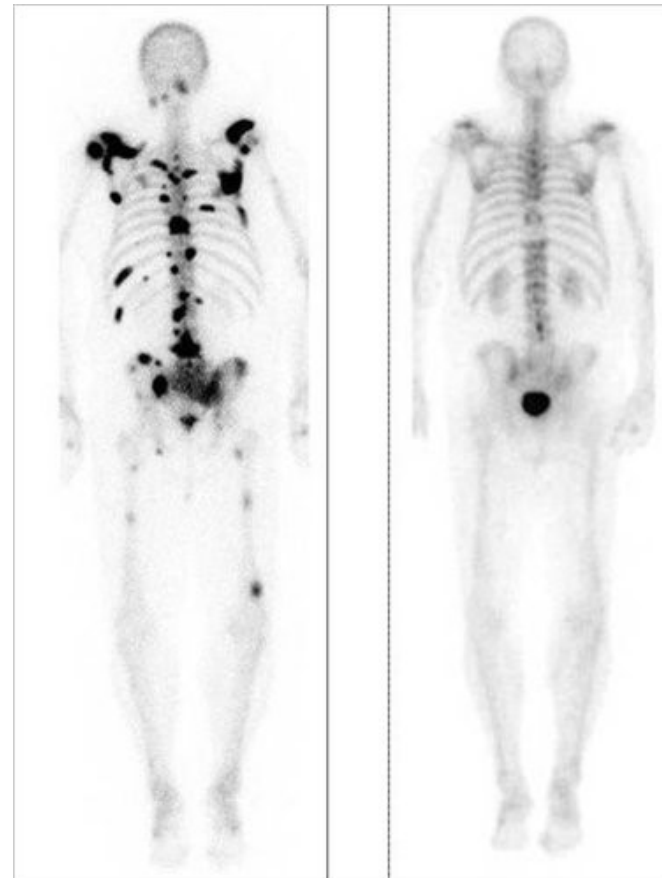
- Tracer principle
- Scintigraphy
 - Gamma-Radiation
 - Planar or SPECT (single photon emission computed tomography)
 - ...



<https://www.cedars-sinai.edu/Patients/Programs-and-Services/Imaging-Center/For-Patients/Exams-by-Procedure/Nuclear-Medicine/DatScan/DaTscansmall.jpg>

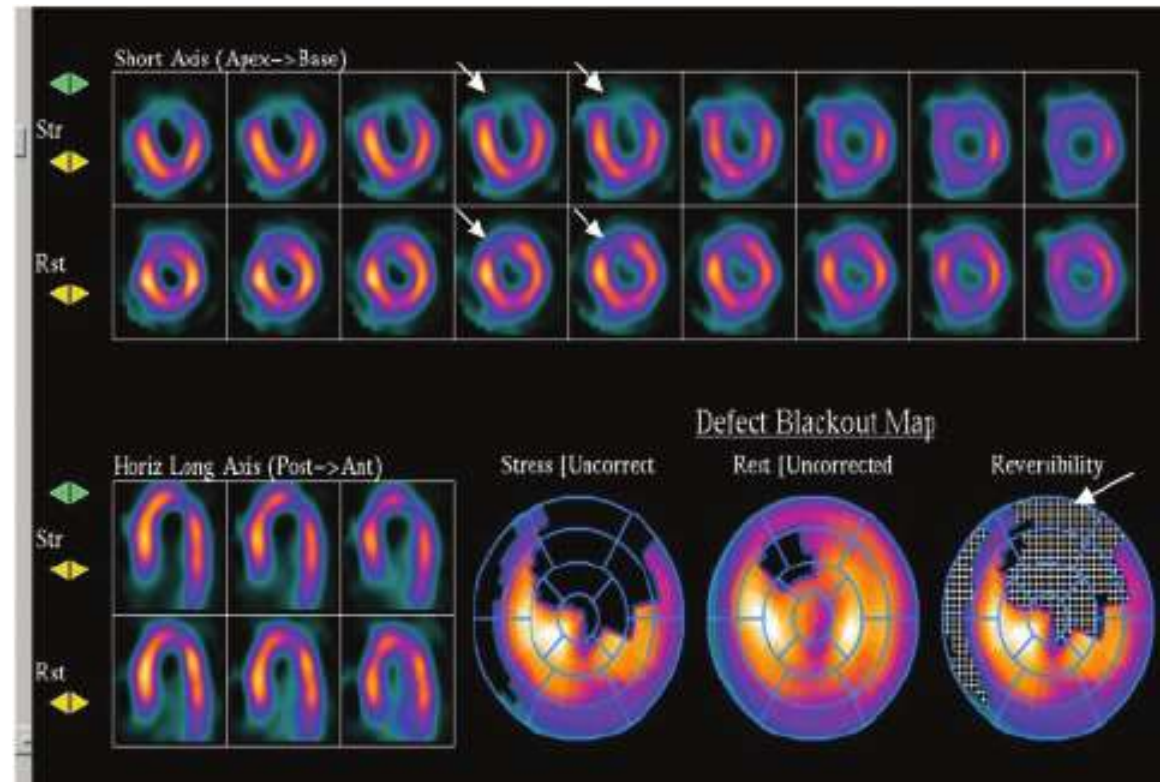
NM indications

- Indications for scintigraphy
 - Bone
 - Prostate, breast, lung cancer
 - Thyroid
 - Renal and urinary tract system
 - Obstruction
 - Brain
 - Perfusion



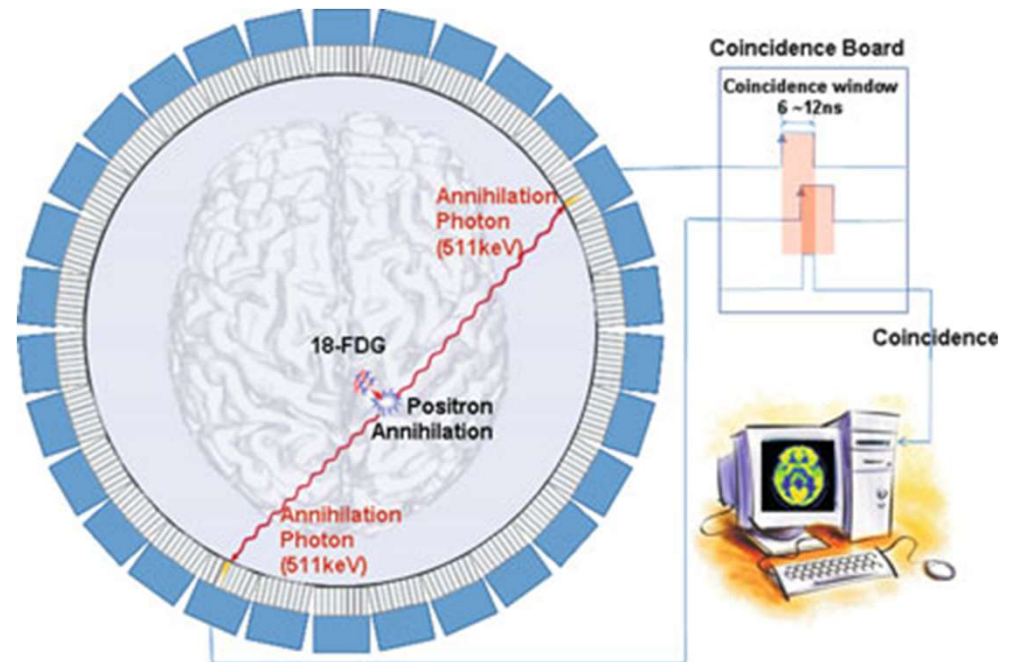
NM indications

- Lung
 - Pulmonary embolism
- Heart
 - Vascularisation



Nuclear medicine imaging techniques

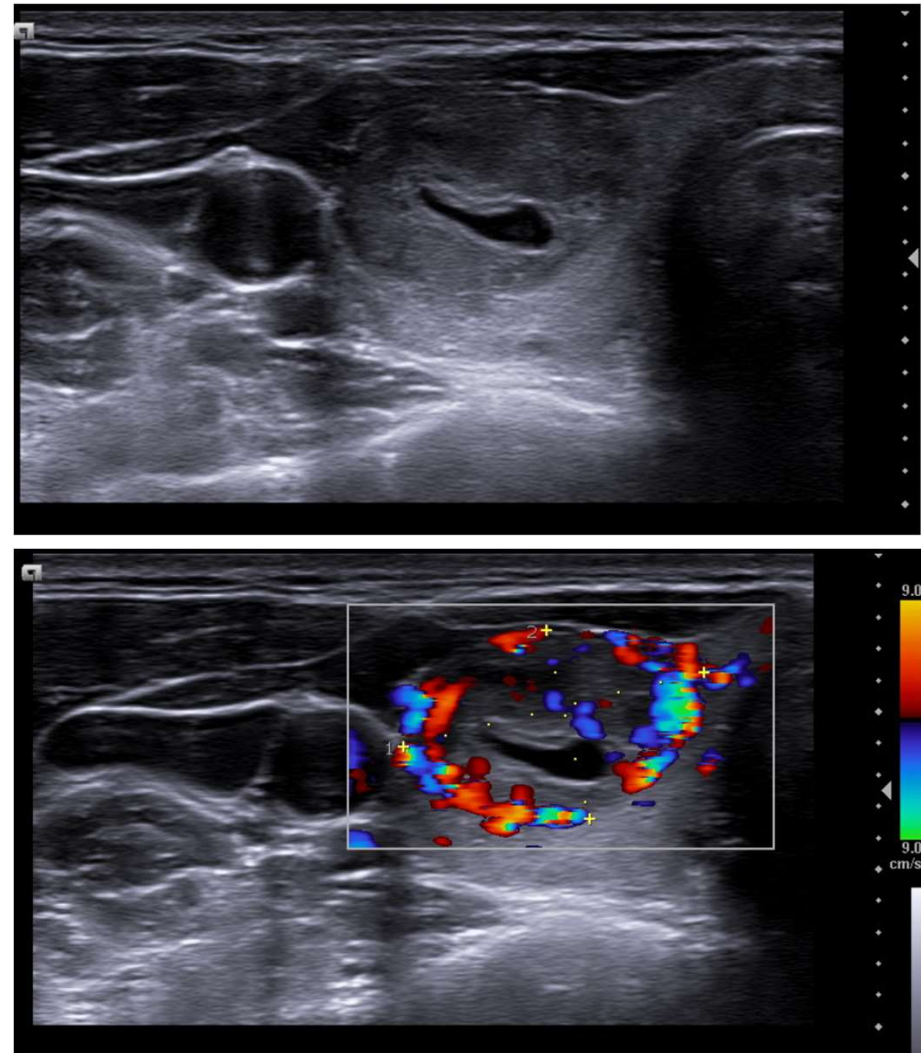
- Positron emission tomography (PET)
 - Annihilation of positron with electron
 - Annihilation radiation (511keV)
 - Coincidence
- Indications
 - Tumor primary and recurrence diagnosis/staging
 - [^{18}F]FDG
 - [^{11}C]Methionine
 - [^{68}Ga]DOTANOC
 - [^{68}Ga]PSMA
 - Therapy response assessment
 - [^{18}F]FDG
 - Inflammation
 - [^{18}F]FDG
 - Neuroimaging
 - [^{18}F]FDG
 - [^{11}C]PIB, [^{18}F]Flutemetamol



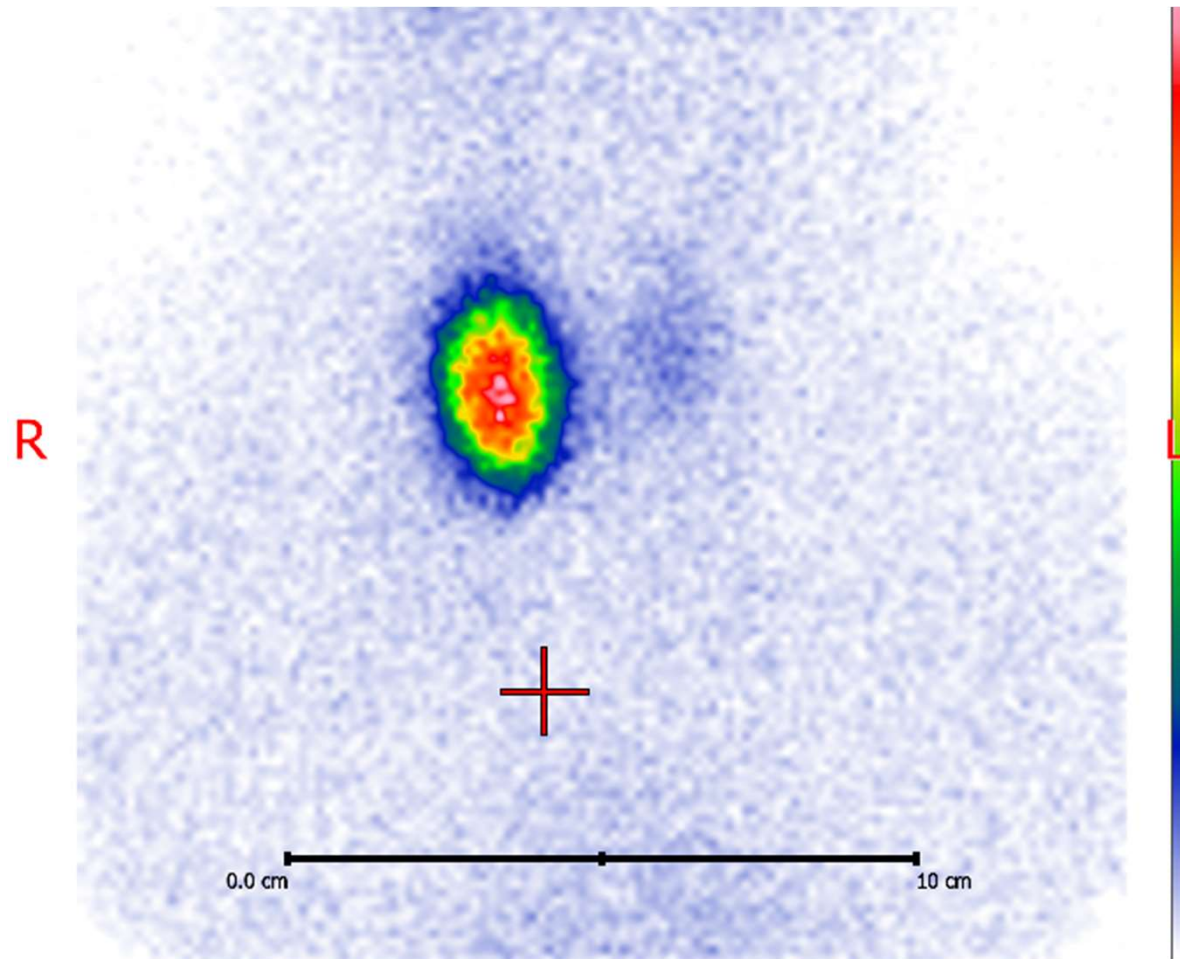
<https://www.cedars-sinai.edu/Patients/Programs-and-Services/Imaging-Center/For-Patients/Exams-by-Procedure/Nuclear-Medicine/DatScan/DaTscansmall.jpg>

Case 1

- Female, 31 yrs
- Referral: hyperthyroidism



Case 1

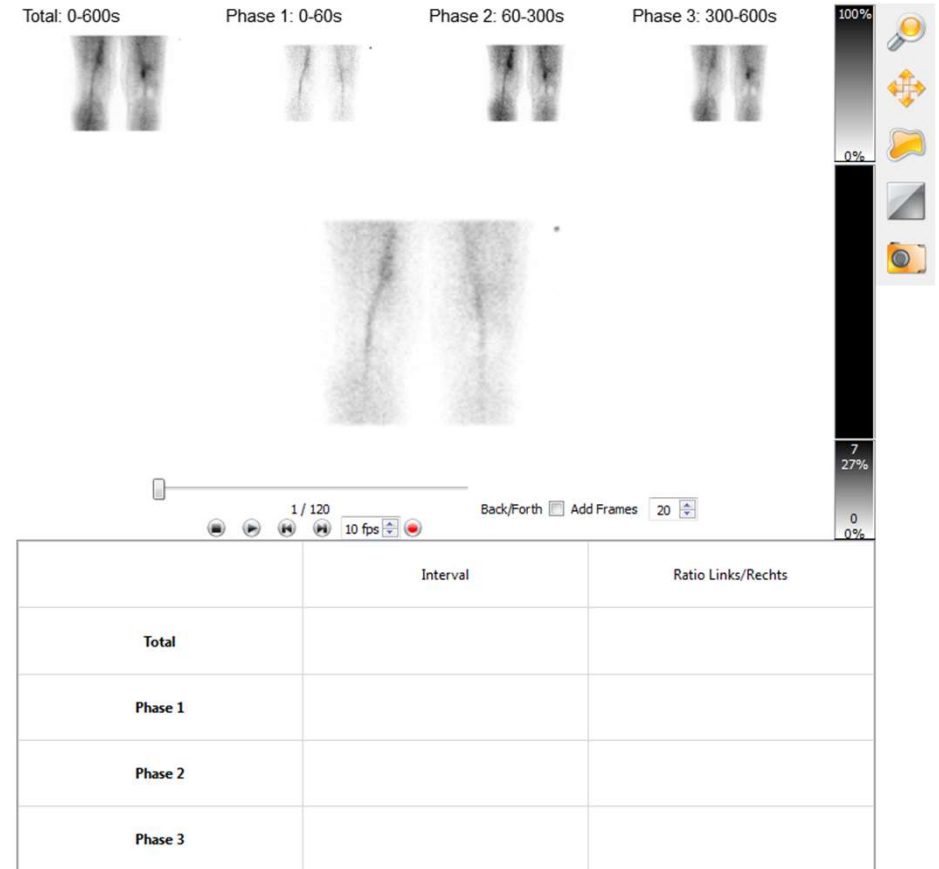
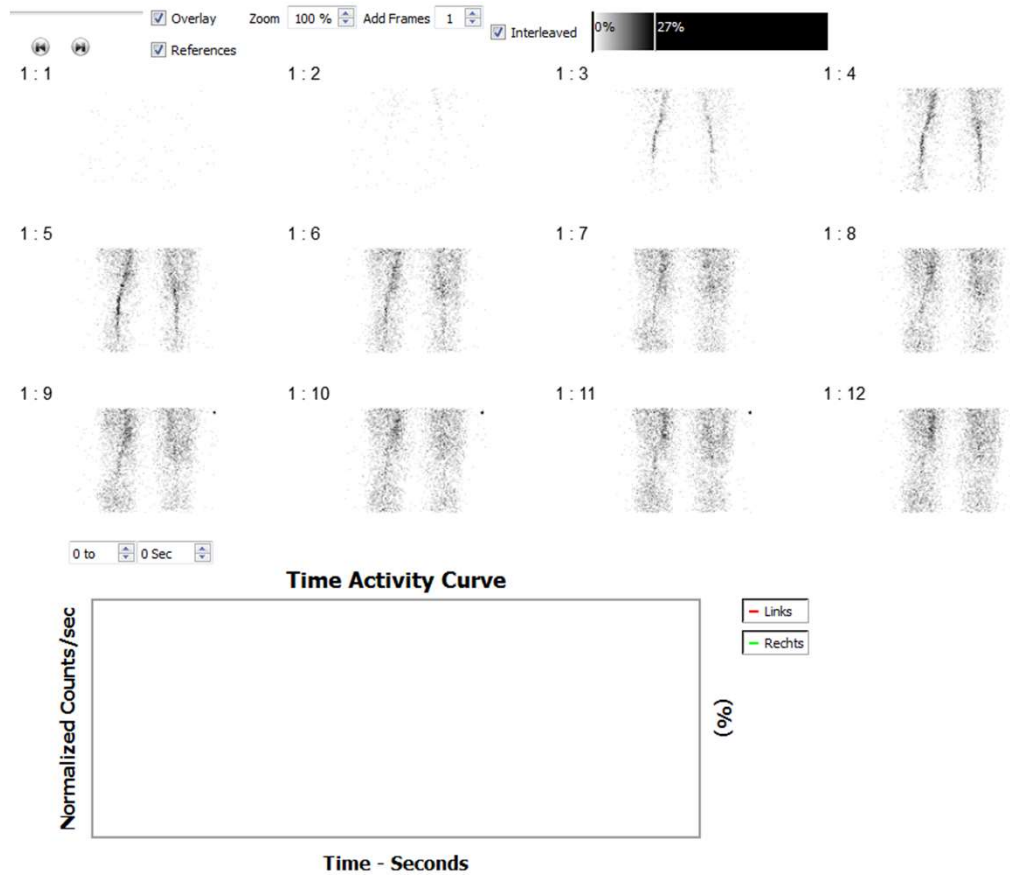


Case 2

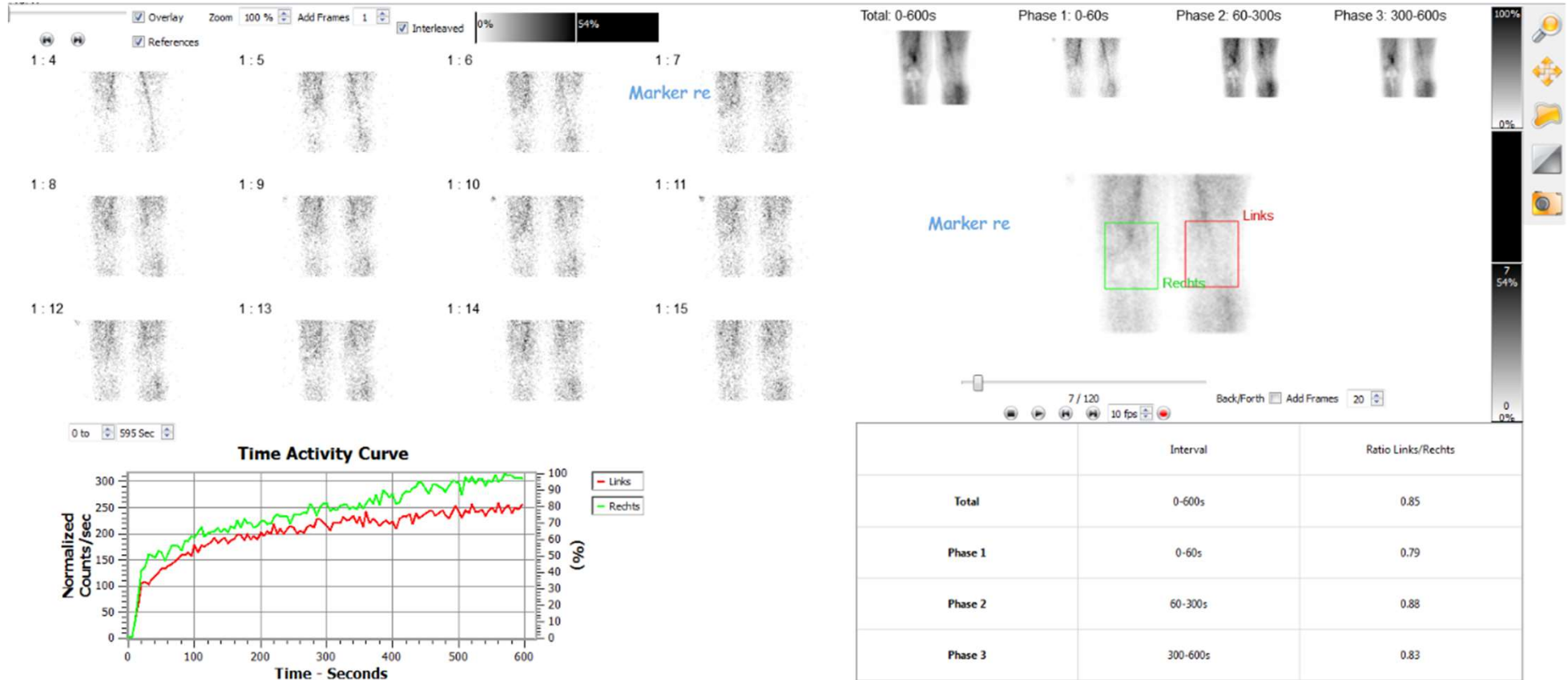
- Male, 52 yrs
- Referral: pain in the knee 4 months after motorcycle accident and surgery



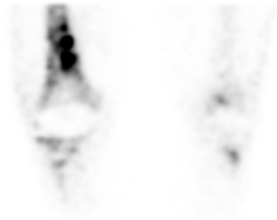
Case 2



Case 2



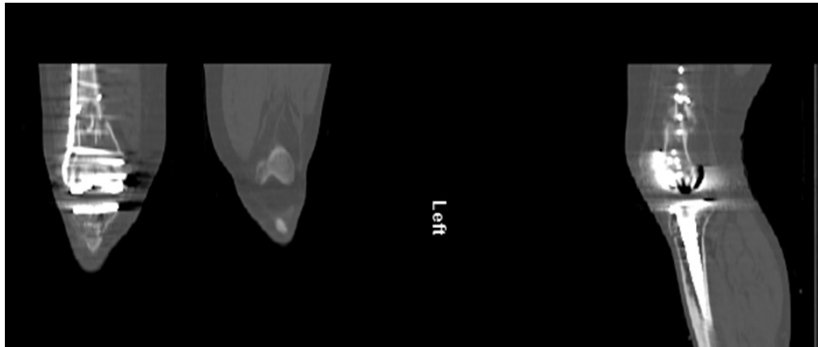
Case 2



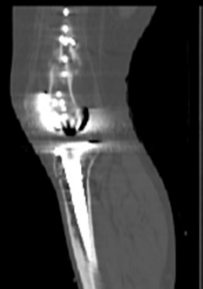
Left



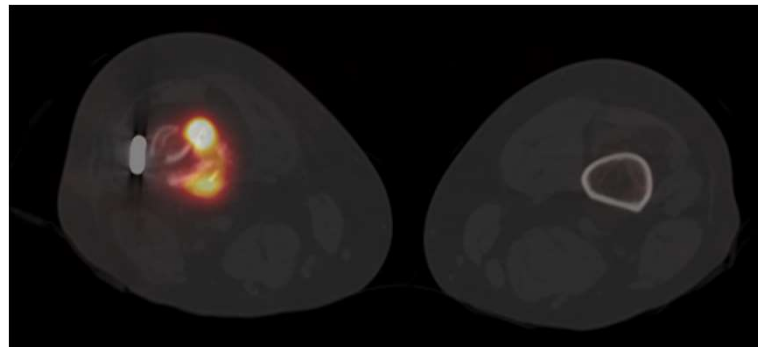
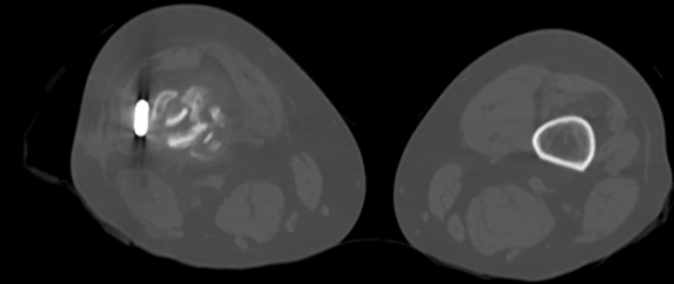
Posterior



Left



Posterior



Thank you for your attention!

