

Radiographs

X-RAYS



Vincent Carrasco, MD, MSIS
NLM Postdoctoral Fellow & Doctoral Candidate
Carolina Health Informatics Program The University of
North Carolina Chapel Hill



Radiography

1. Electromagnetic Spectrum

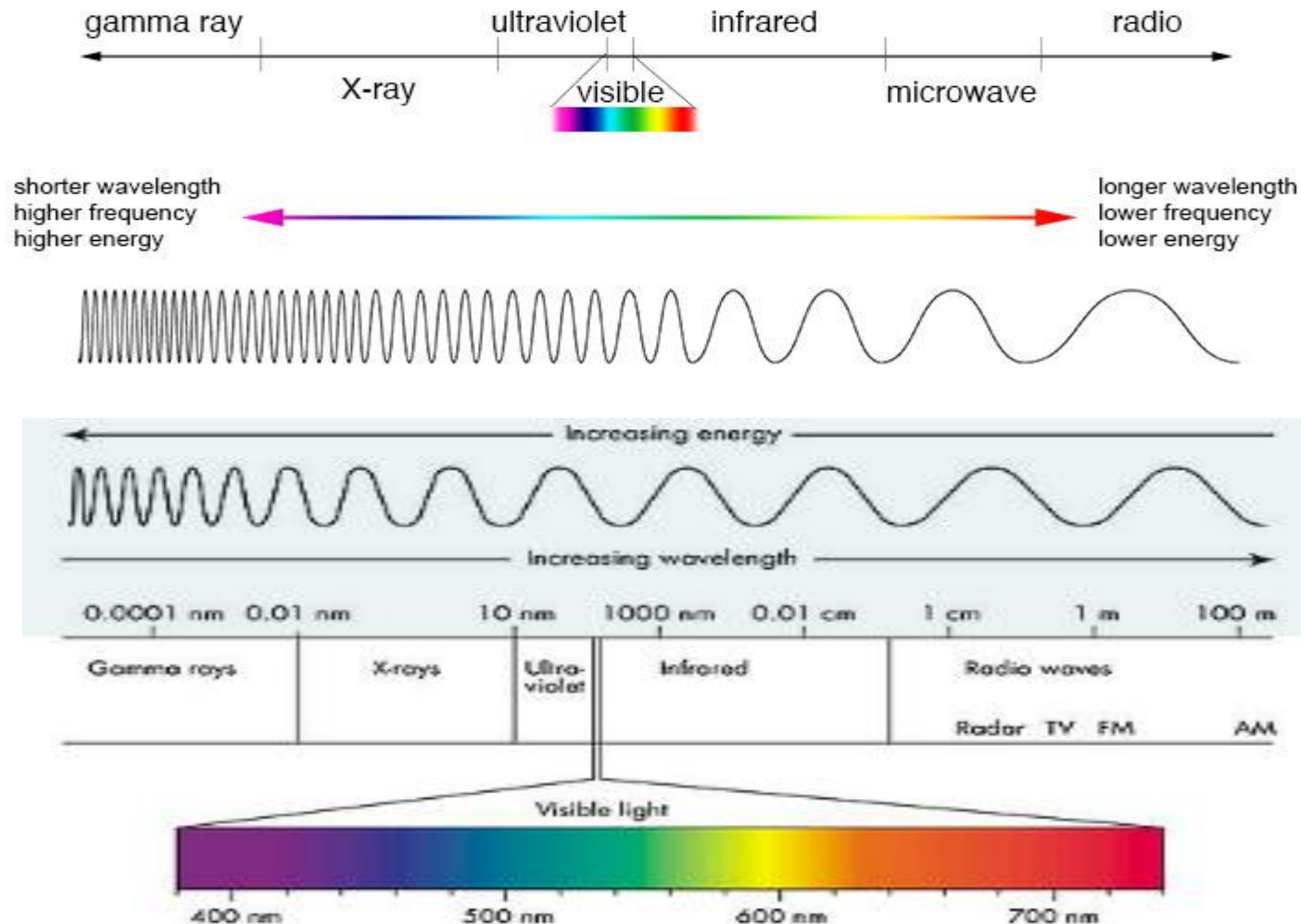
2. X-ray History

3. X-ray Physics

4. Clinical Application



Electromagnetic Spectrum



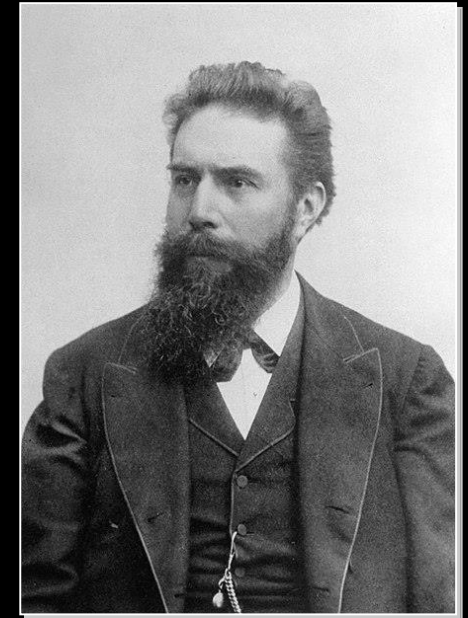
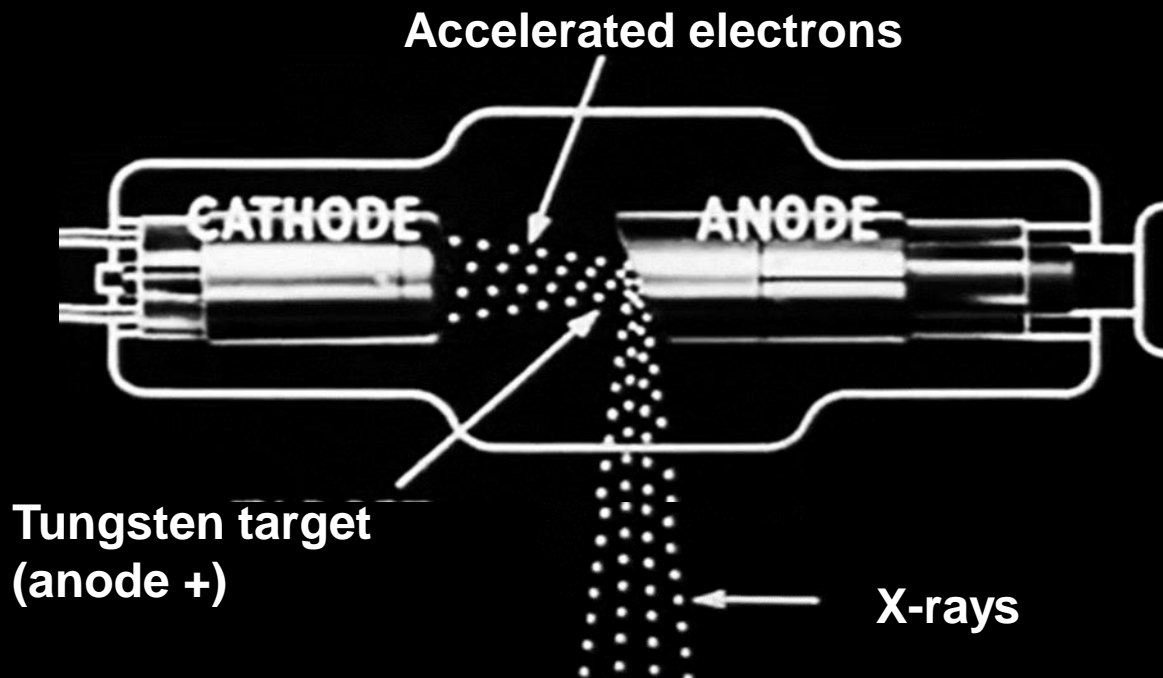


History

Think of an x-ray as photo using x-rays



History of X-rays



Wilhelm Conrad Röntgen
November 1895



History of X-rays



Wilhelm Roentgen's first
x-ray of his wife's hand
Anna Bertha Ludwig
(wearing wedding ring),
in 1895



Physics

Think of a radiograph as picture using x-rays



X-Ray Physics

Radiographs

Generated
De novo

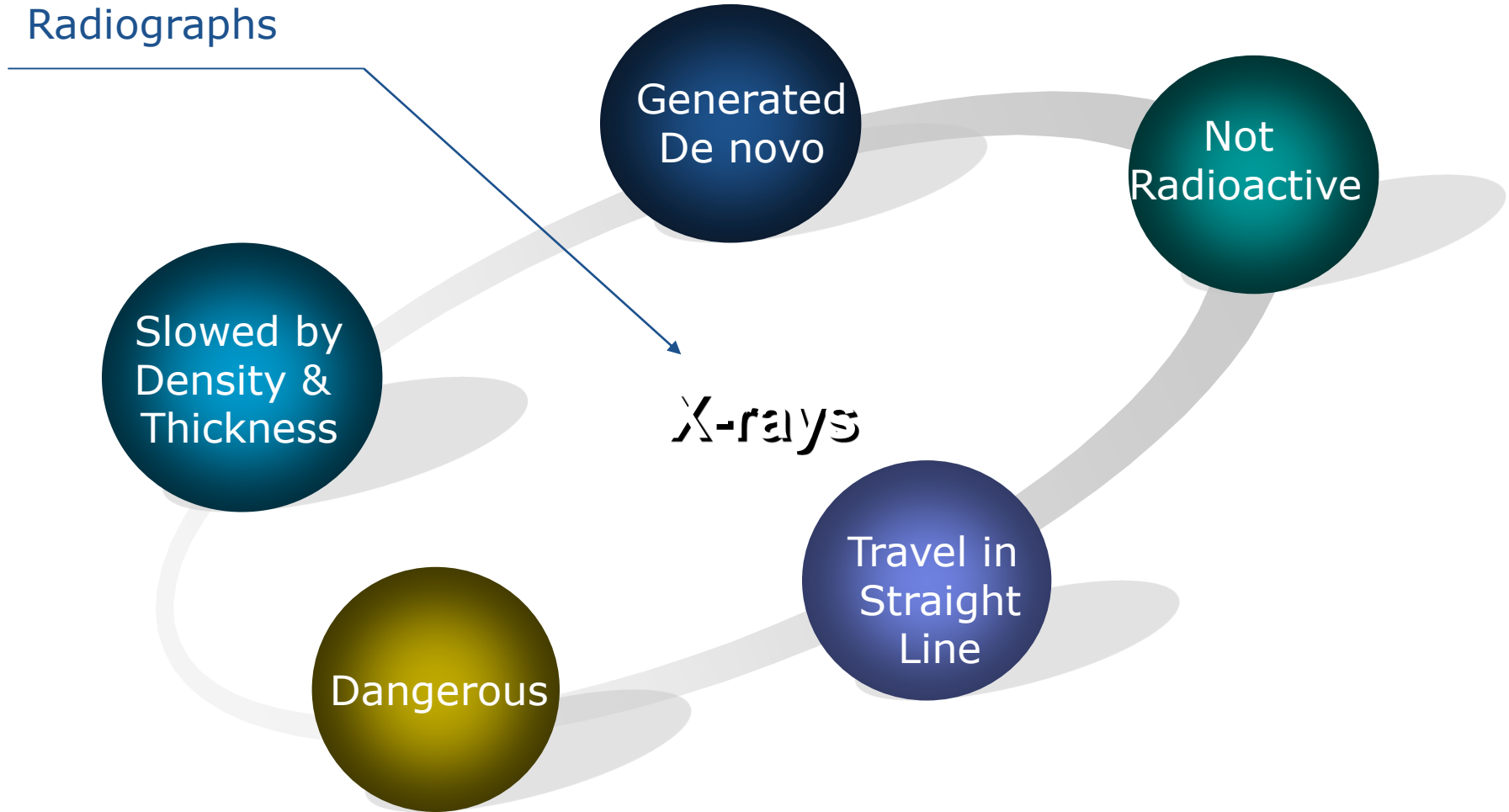
Not
Radioactive

Slowed by
Density &
Thickness

X-rays

Travel in
Straight
Line

Dangerous

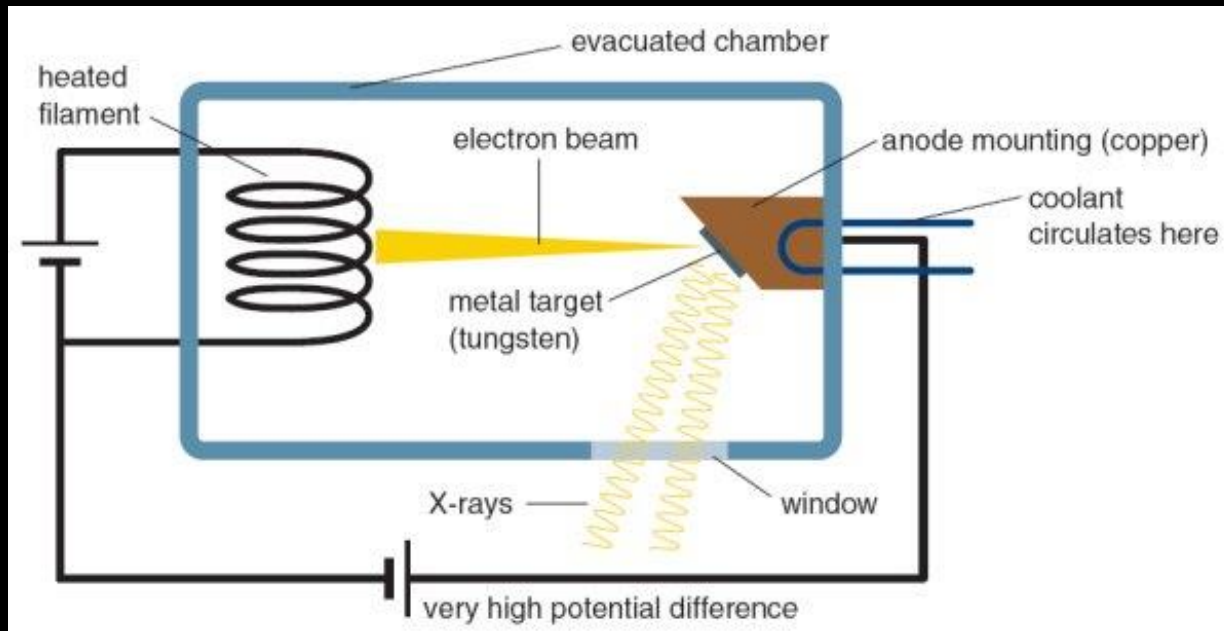




Physics of X-rays

“Filament”(cathode -)

Anode (+) with Tungsten Target



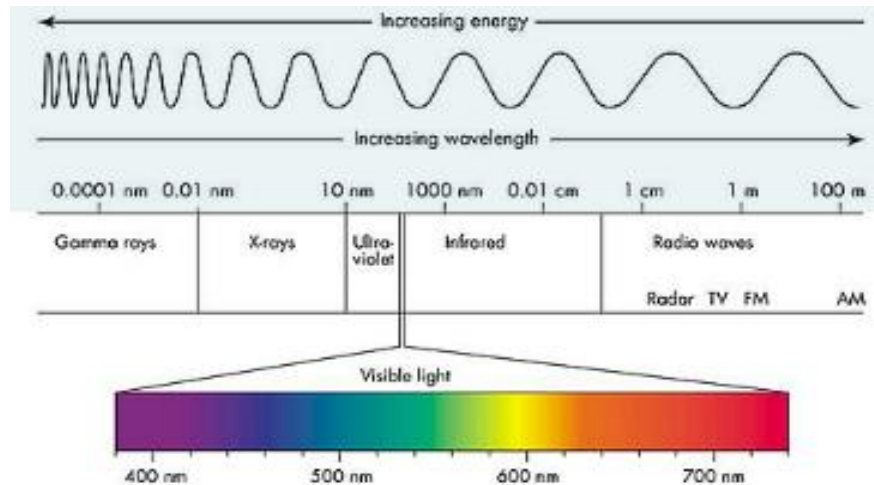
Energy is released as heat
Tungsten target mounted on copper
Spinning the target helps to dissipate heat

X-rays



Physics of X-rays

- Ionizing radiation and have a
- very high frequency (7×10^8 Hz)
- very short wavelength (0.001 to 10 nm)





Clinical Application

Think of a radiograph as picture using x-rays



Types of X-rays

- Abdominal x-ray
- Barium x-ray
- Bone x-ray
- Chest x-ray
- Dental x-ray
- Extremity x-ray
- Hand x-ray
- Joint x-ray
- Lumbosacral spine x-ray
- Neck x-ray
- Pelvis x-ray
- Sinus x-ray
- Skull x-ray
- Thoracic spine x-ray
- Upper GI and small bowel series
- X-ray of the skeleton



Clinical Applications

X-rays best for imaging bone

- High resolution
- Attenuation (absorb X-rays). increases with atomic density (number of protons in the nuclei).
- Bones have high attenuation -dark
- Soft tissue low attenuation - faint

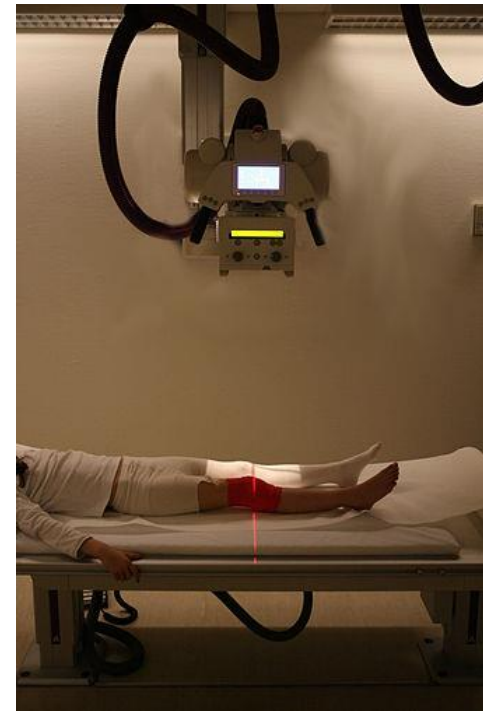
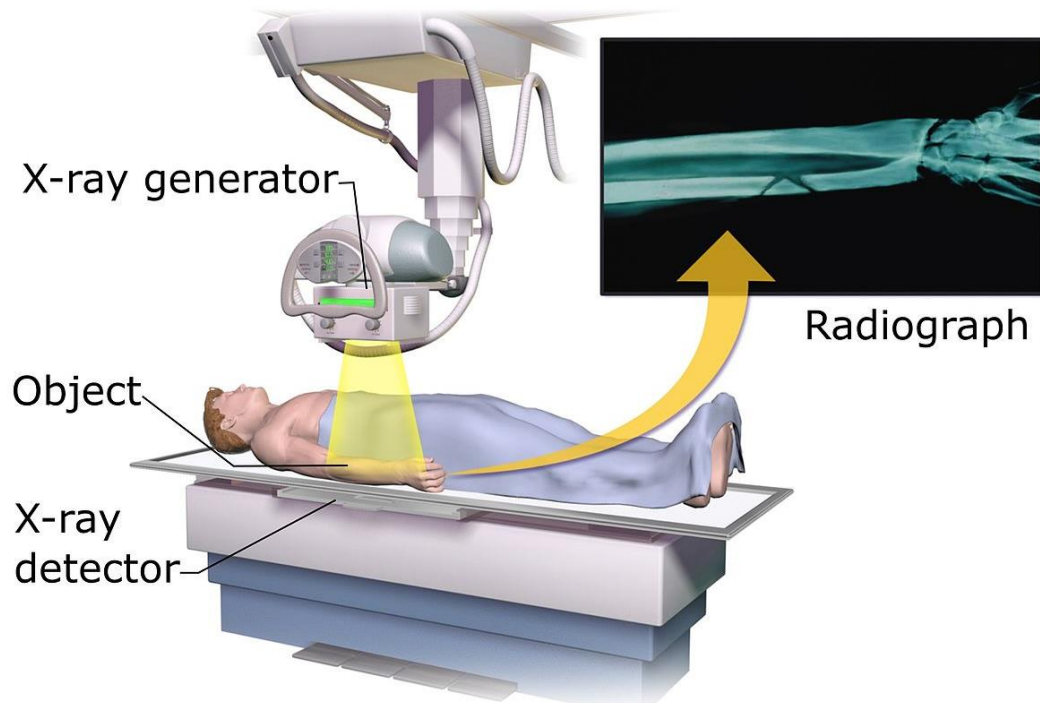


X-ray of a broken leg



Clinical Applications

Projectional X-ray





Clinical Applications



L





Clinical Applications





Αν Επεντ □ Ρελατεδ Τασκ Παραδιγμ

- Α νεω μετηοδολογψ φορ στυδψινγ ινφορματιον βεηαπιορ ις
- βεινγ δεπελοπεδ το ινπεστιγατε τηε βιολογιχ υνδερπιννινγς οφ
- σεαρχη βεηαπιορ. Τηερε αρε μανψ ματυρε βεηαπιοραλ μοδελς
- βυτ φεω ιφ ανψ, τηατ διρεχτλψ εξαμινε πηψσιολογιχ προχεσσες
- ωιτηιν τηε ηυμαν βραιν ωηιλε τηεσε βεηαπιορς αρε οχχυρρινγ. Ουρ
- γοαλ ις το εξπλορε νεω τεχνηνολογιες τηατ αρε υσεδ φορ τηε στυδψ
- οφ βραιν φυνχτιον. Ιν τηις παπερ ωε ωιλλ δισχυσς δεπελοπμεντ οφ α
- φυνχτιοναλ μαγνετιχ ιμαγινγ (φMRI) μετηοδολογψ ινχλυδινγ τηε
- δεπελοπμεντ οφ α σπεχιαλιζεδ τασκ σετ, δατα πρε-προχεσσινγ ανδ
- στατιστιχαλ παραμετριχ δατα αναλψσις.

QUESTIONS

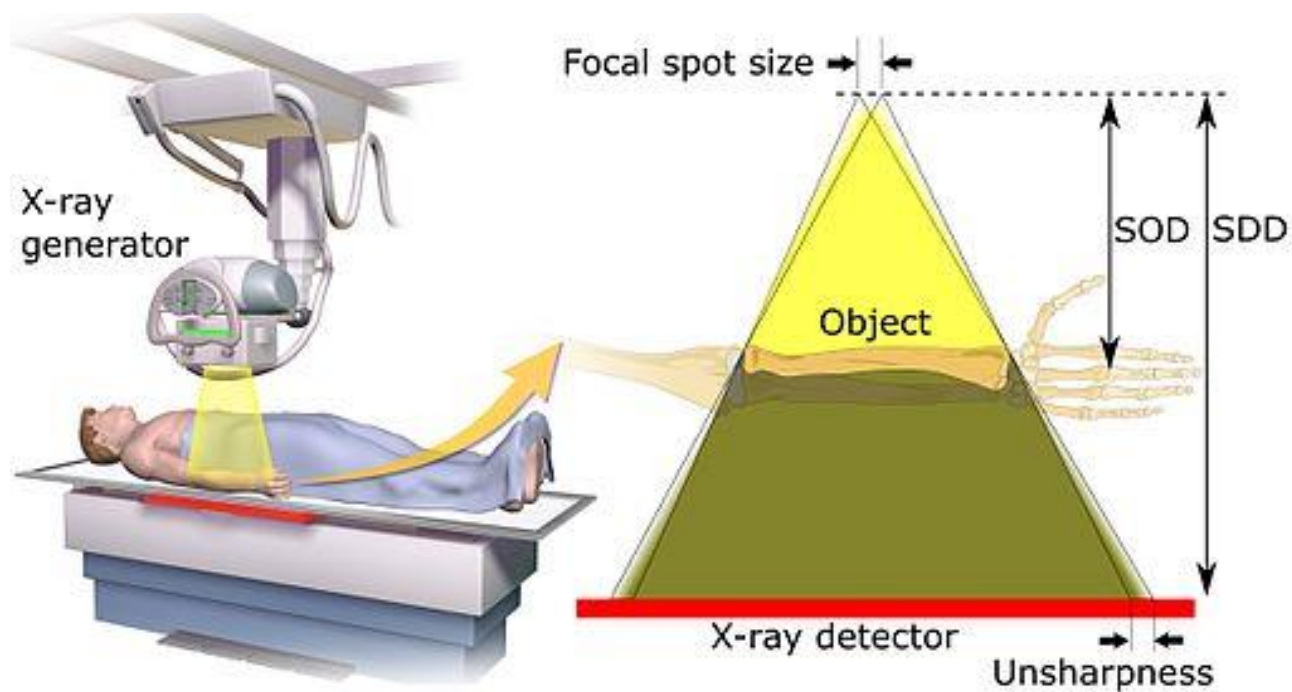




BREAK

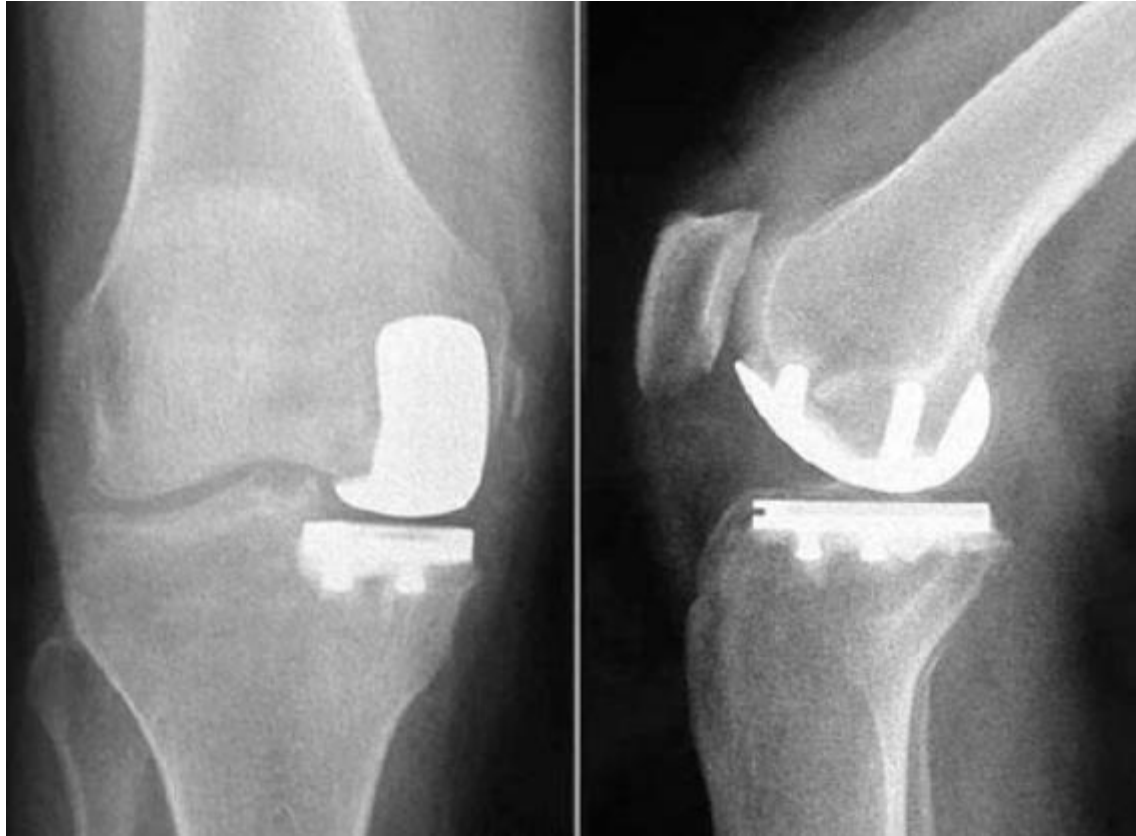


X-rays





X-rays





Chest X-rays





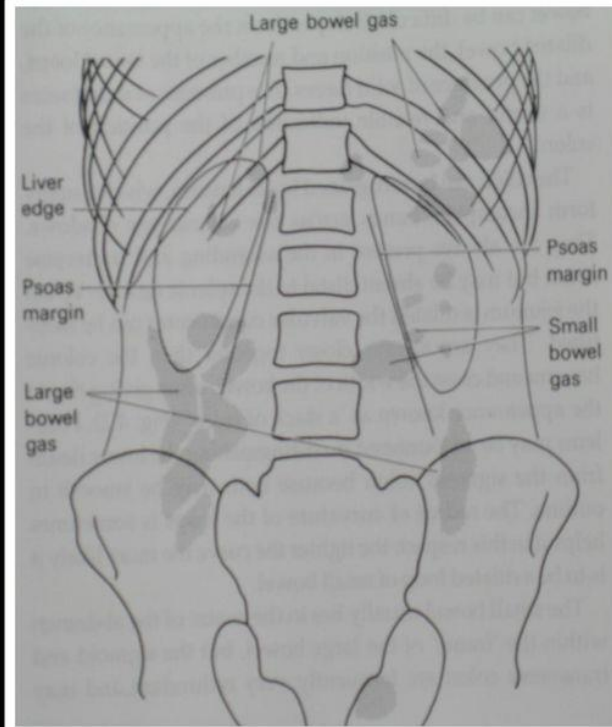
Chest X-rays





Abdominal X-rays

Normal plain abdomen





Abdominal X-rays



Broad
spectrum of
"Normality"
for AXR





Abdominal X-rays

KUB

- ❑ KUB stands for: kidneys, ureter & bladder.
- ❑ No contrast material is used, it is the same for plain abdominal X-ray to show the different abdominal & pelvic organs as soft tissue shadows.
- ❑ It is useful also to show radio-opaque renal stones.





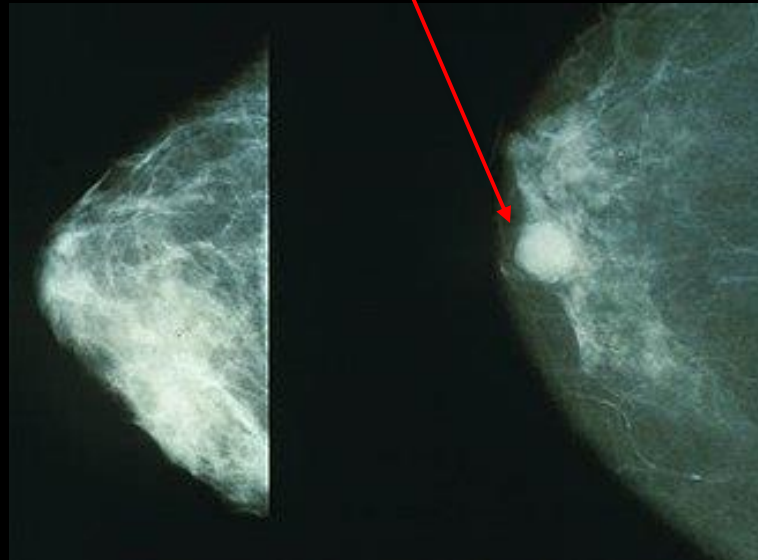
Abdominal X-rays





Clinical Applications

Mammography!



Normal (left) versus cancerous (right)
mammography image



Clinical Applications





Τι με φοβ Λυνχη?

Τι με φοβ γολαχι;

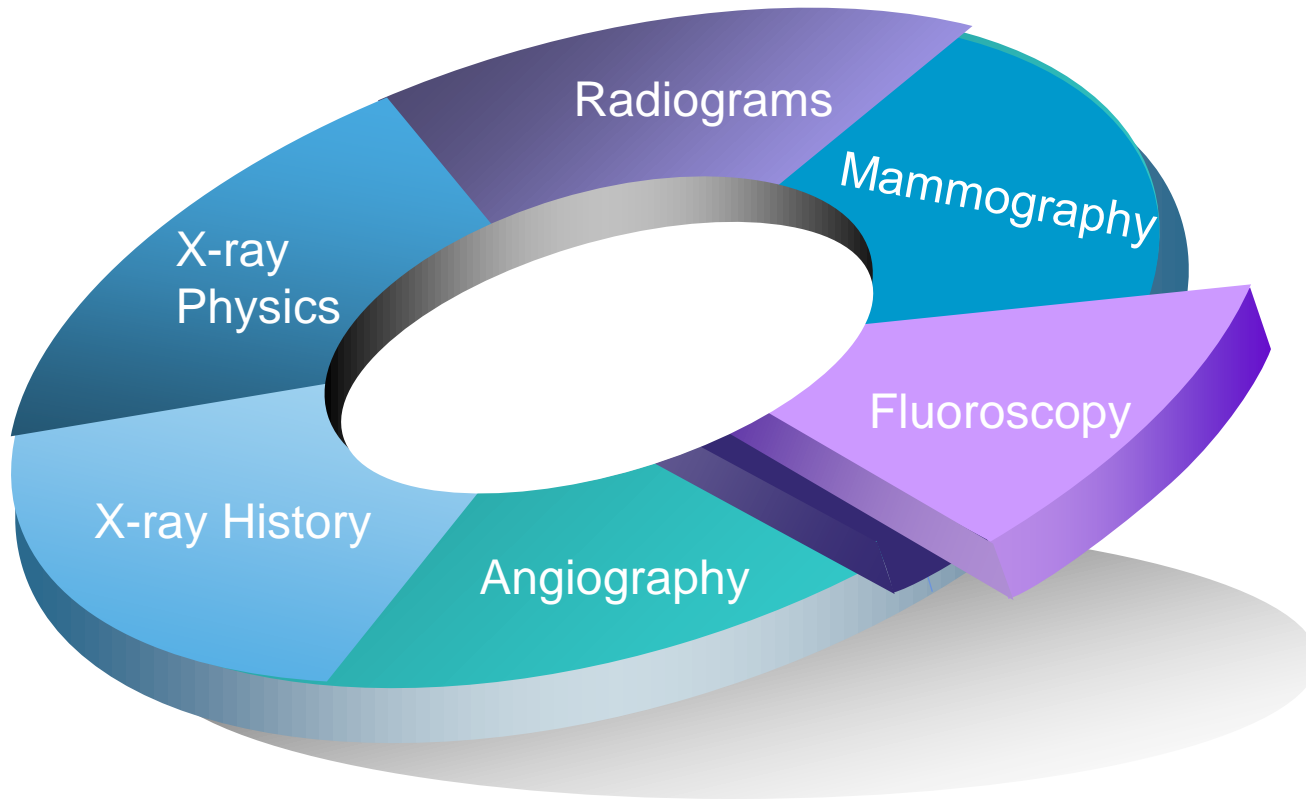


Are we there yet?

Are we there yet?



Technologies using X-rays





Clinical Application

Fluoroscopy



Edison and Dally



Thomas Edison examines Clarence Dally's, his assistant, hand thru a fluoroscope of his own design.
(Science Source / Photo Researchers)

- 1896-Clarence Dally was one of Edison's "muckers" (researcher). He saw Roentgen's x-ray.
- Exposing himself to poisonous radiation for hours on end
- 1900 - lesions and degenerative skin conditions on his hands and face. His hair began to fall out, then his eyebrows and eyelashes, too. His left hand was especially swollen and painful.
- **Carcinoma** appeared on his left arm, Dally agreed to have it amputated



X-rays are Damaging Radiation

C-Arm- real-time x-rays –portable fluoroscopy



- X-ray burn causing deformity.
- Accident: not shielded when first discovered

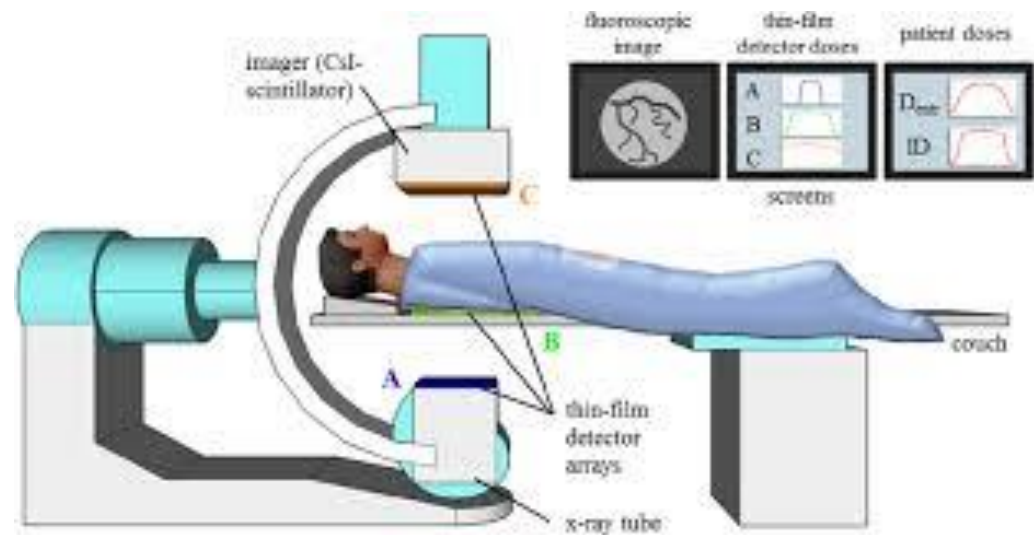


Fluoroscopy

C-arm- real-time x-rays
(portable fluoroscopy)



- Fluoroscopy term invented by Edison
- fluorescence observed when a glowing plate bombarded with X-rays
- View movement (of tissue or a contrast agent)





Fluoroscopy

C-Arm- real-time x-rays –portable fluoroscopy



A fluoroscopy X-ray machine is a great asset during surgery for implants



High Resolution Fluoroscope



- Radiography fixed still images
- Fluoroscopy provided live moving pictures
- Now all digital imaging modes and data storage and retrieval.



X-ray and Fluoroscopy

Contrast



Types of Contrast

- Iodinated (intravascular)
 - Organic iodine molecules used for contrast include iohexol, iodixanol and ioversol
- Barium (gastro-intestinal)
 - Barium sulfate (insoluble)
 - Swallowed as a slurry

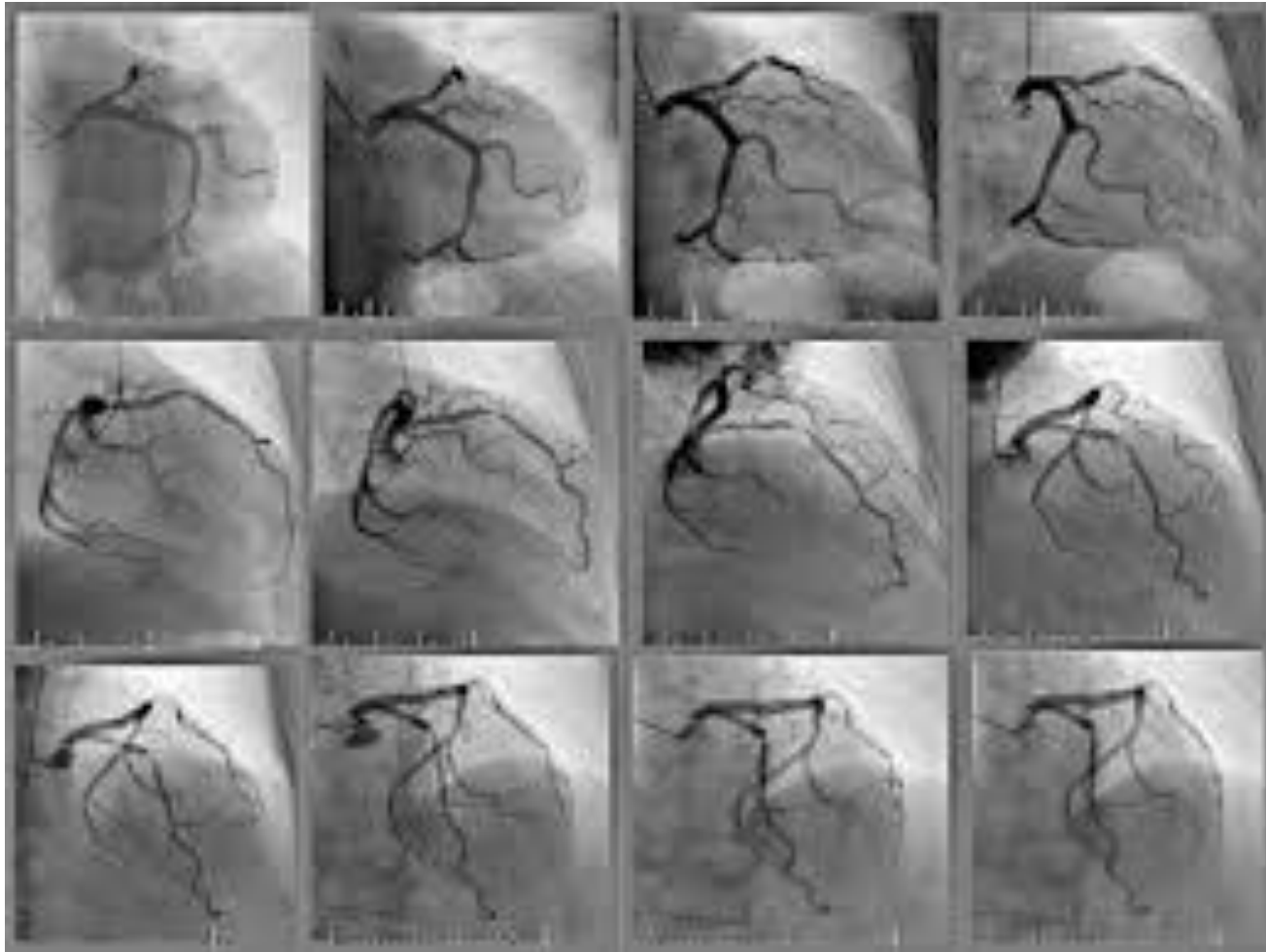


Barium Swallow





Cardiac Angiography



- Angio-radiography fixed still images



Cardiac Angiography



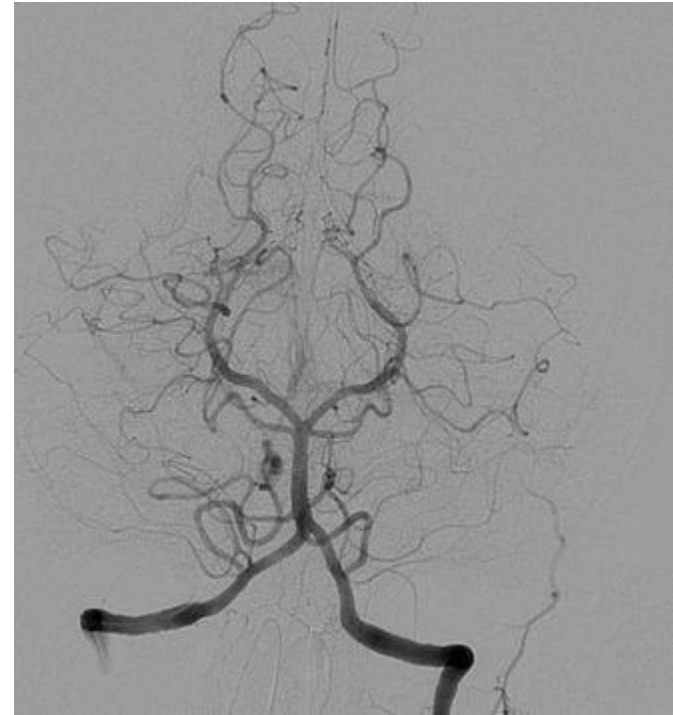
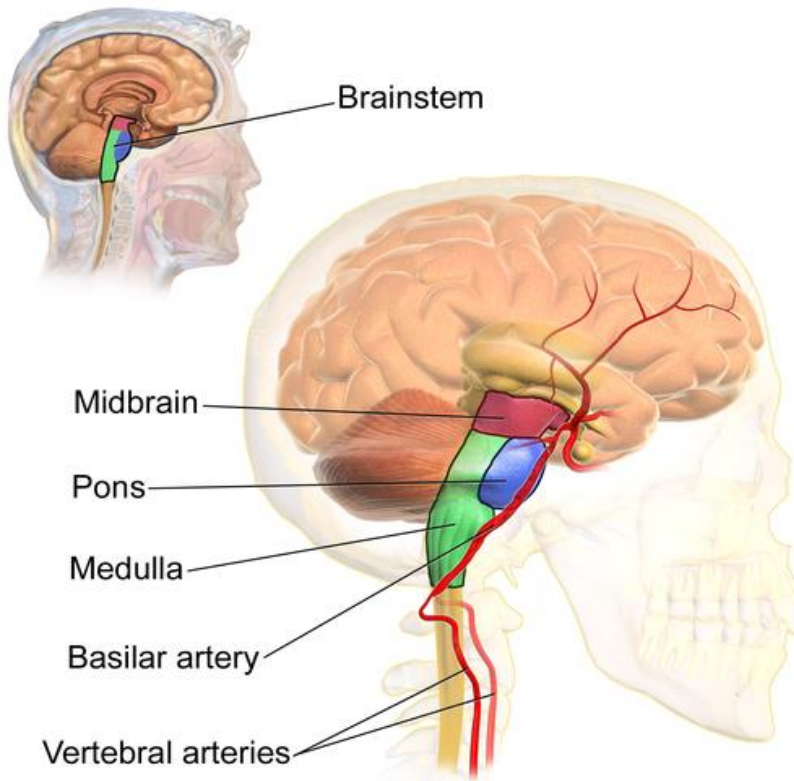
- Video of procedure



- Angiography “footage”



Cerebral Angiography



Early cerebral angiography radiography were fixed still images



Cerebral Angiography



- Video of Cerebral procedure



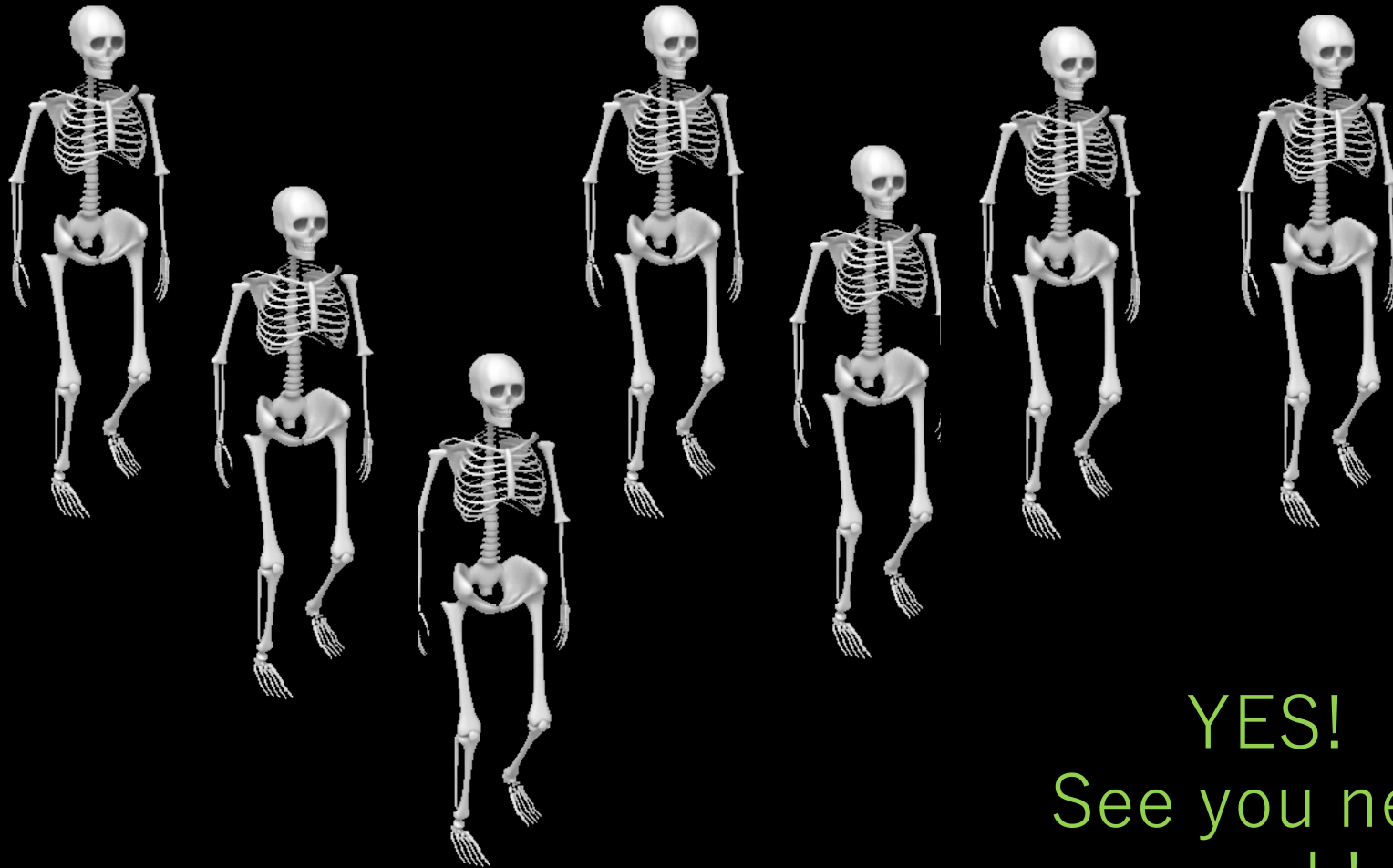
- Cerebral Angiography “footage”

3 min/1.5min

QUESTIONS







YES!
See you next
week!



References

Geleijns J, Tack D. Medical physics: radiation risks. In: Adam A, Dixon AK, Gillard JH, Schaefer-Prokop CM, eds. *Grainger & Allison's Diagnostic Radiology: A Textbook of Medical Imaging*. 6th ed. Philadelphia, PA: Elsevier Churchill Livingstone; 2015:chap 1.

Medical Physics - X-Rays. (n.d.). Retrieved May 30, 2018, from http://www.genesis.net.au/~ajs/projects/medical_physics/x-rays/index.html