

Al-Mustaqbal University Colleg
Medical Physics Department



Medical Imaging

Lecture 4

Plain Radiograph\X-ray

Second Stage

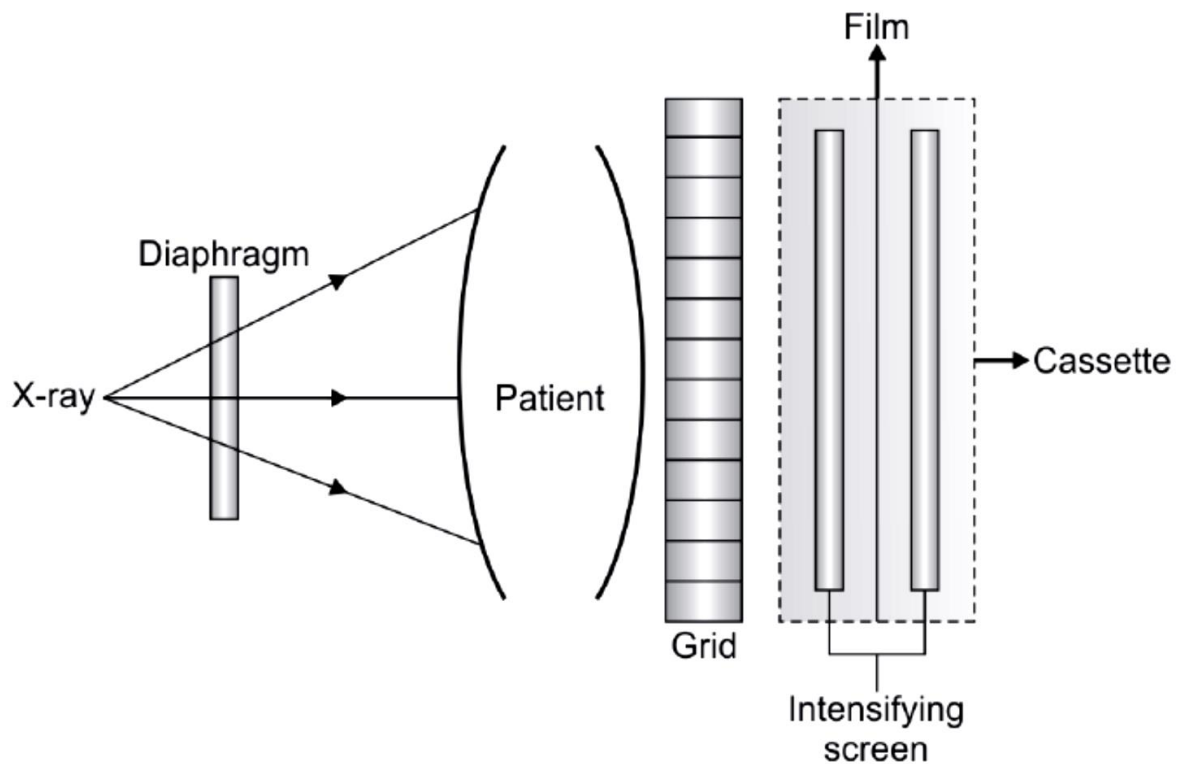
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Definition of plain radiograph/X-ray

- ✓ It is medical imaging of the different parts human body. Using X-rays.
- ✓ It is representing the simplest medical images created using X-radiation.
- ✓ The medical image is produced by passing the X-ray through a human body, according to the density and composition of the bone or tissues.
- ✓ Radiography is a procedure in diagnostic radiology in which X-rays are used to produce a shadow picture of a patient.
- ✓ It is a method of obtaining two dimensional image of patient's anatomy, by using X-ray film as detector.



- ✓ In a radiography technique, the radiation from the X-ray tube is transmitted through the patient's body, and then reaches the film. After processing the film, the radiograph is obtained. A radiograph is a negative image.
- ✓ The production of good radiological image requires number of accessories such as:

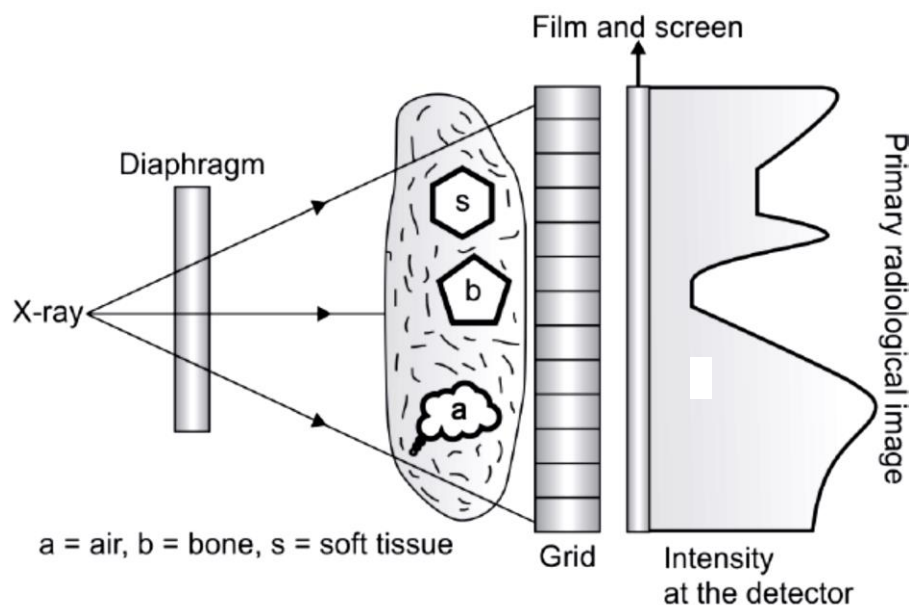
(i) grid, (ii) cassette, (iii) intensifying screen, and (iv) X-ray film, in addition to the X-ray unit.

Properties of plain radiograph/X-ray

- (i) Simplest medical images created using X-radiation
- (ii) Provides fast
- (iii) High-resolution images.
- (iv) Low-cost
- (v) Does not require special preparation for the patient.
- (vi) plain X-rays system can provide medical imaging of different parts of human body, as chest, arms, legs, spine, bones and joints.

Primary Radiological Image

- ✚ Human body is **heterogeneous**. It is mainly made up of **air, fat, water, soft tissue and bone of differing density and atomic number**.
- ✚ When X-rays passes through the body, it gets attenuated differentially by different tissues, and results in a variation of transmitted radiation.



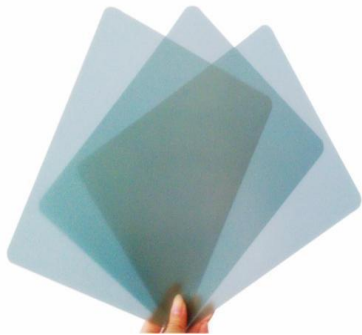
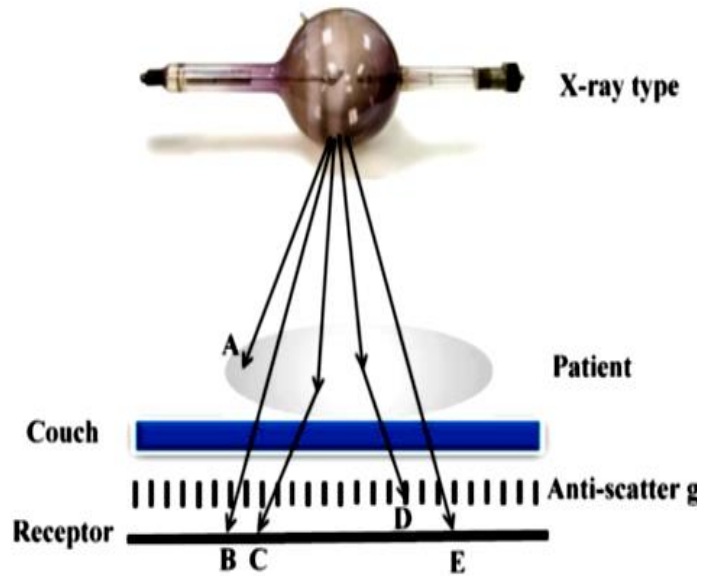
- ✚ This variation is referred *as primary radiological image*.
- ✚ Since eye is insensitive to X-rays, this image is converted into visible image either by using an *X-ray film or fluorescent screen*.
- ✚ The beam that emerges from the patient contains *primary and scattered radiation*. Only *the primary beam* contains the useful information of the patient. Hence, *the scattered radiation* must be removed, before reaching the film.
- ✚ In the diagnostic range, the X-ray interact mostly by *photoelectric effect*, which is proportional to Z^3 . *The Compton interaction* is minimum and mostly with low Z materials.
- ✚ Overall, photoelectric effect dominates over Compton scattering at this energy level. Hence, bone, soft tissue and fat will offer differential attenuation to X-rays.
- ✚ As a result, the transmitted radiation will also have variation. Thus, bone, soft tissue, and fat can be distinguished from one another.

Some medical image using plain radiograph/X-ray



Component of plain radiograph/X-ray system

- (i) X-ray tube.
- (ii) X-ray detector (receptor).
- (iii) Anti-scatter grid.
- (iv) Couch
- (v) Bucky table.
- (vi) Silver halide film.
- (vii) Control unit



Silver halide film

i) X-ray tube: is an electrical device used for generation of X-ray, which constant from glass tube, cathode, and anode.

ii) X-ray detector (receptor): are devices used to measure the flow amount and distribution of X-rays.

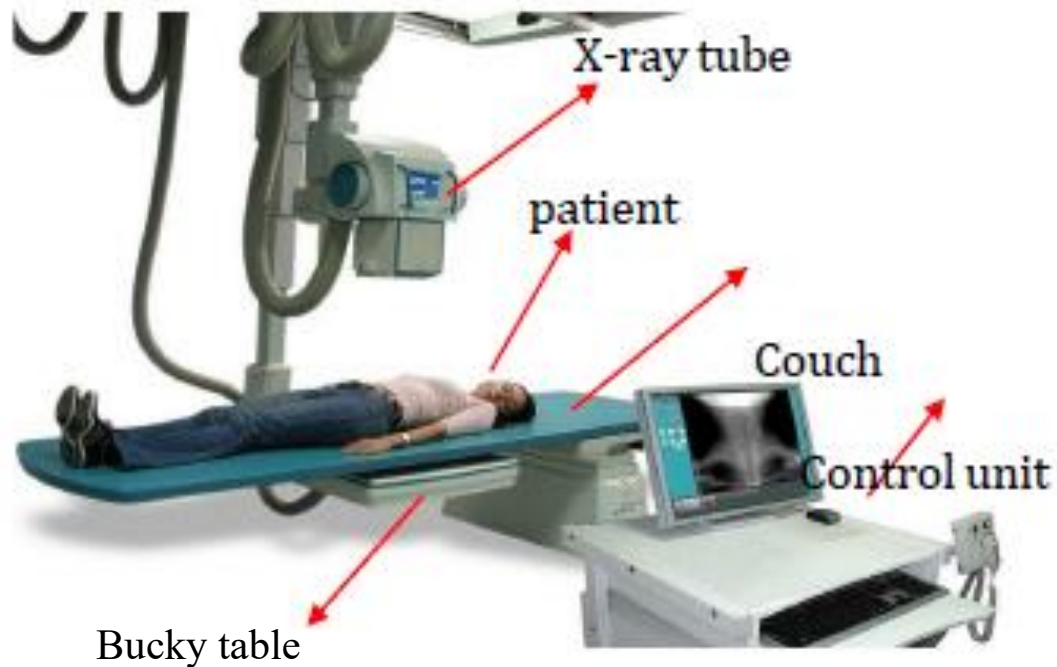
iii) Anti-scatter grid: is a device placed between the patient and the receptor, which will transmit the radiation but reject the scatter radiation

iv) Couch: it represents the bed used to sleep the patient.

v) Bucky table: it represents the x-ray cassette place of silver halide film.

vi) Silver halide film: it represents the film that shows the medical image consisting of silver bromide (AgBr). This film when exposed to light, produces a silver ion (Ag^+) and an electron, and it convert to dark color.

vii) Control unit: X-ray systems have a control on plain radiograph/X-ray system.



How the plain radiograph/x-ray is formed on the silver halide film?

- The photons of x-ray emitted by the X-ray tube enter the body of patient.
- Patient is placed between X-ray tube and silver halide film.
- X-rays that passed through the body are absorbed or transmitted in direct to bone or tissue.
- More exposure of silver halide film to x-ray lead to be more dark.

- Bone represents the highest to absorb X-rays photons. So, the silver halide film will be more white.
- Soft tissues represents the lowest to absorb X-rays photons. So, the silver halide film will be more dark.

