

Conventional radiography (x ray, plain film)

X-ray is an imaging technique that has been used since 1895 . It is the use of x-rays to visualize the internal structures of a patient.

X-rays are a type of high-energy electromagnetic radiation that is like light waves but higher in energy produced by an x-ray tube

X-ray tube

An **X-ray tube** functions as a specific energy converter, receiving the electrical energy and converting it into two other forms of energy: x-radiation and heat. X-radiation is created by taking the energy from the electrons and converting it into photons.

The X-ray tube contains two principal elements:

1. [cathode](#): provides a source of electrons
2. [anode](#): acts as the target for electrons and releases x-rays

. The x-rays are passed through the body and captured behind the patient by a detector; film sensitive to x-rays or a digital detector. As a beam of x ray passes through the body , some of the x ray are absorbed or scattered. There is variance in absorption of the x-rays by different tissues within the body, dense bone absorbs more radiation & are shown as lighter grey or white on a radiograph, while soft tissue allows more to pass through & appear darker on radiograph. This variance produces

contrast within the image to give a 2D representation of all the structures within the patient.

Five principal densities are recognized on plain radiographs , listed in order of increasing density:

Air

Appears the blackest on a radiograph e.g. lungs, bowel & stomach.

Fat

Is a lighter shade of gray than air such as retroperitoneal fat.

Soft tissue or fluid

both soft tissue and fluid appear the same on conventional radiographs, such as heart muscle and the blood vessels , solid organs, fluid filled structure like urinary bladder.

Calcium

Usually contained within bones appear off white

Metal & contrast

material

Appear the whitest on a radiograph

Common clinical applications

- Chest: to assess lung pathology
- Skeletal: to examine bone structure and diagnose fractures, dislocation or other bone pathology
- Abdomen: can assess abdominal obstruction, free air or free fluid within the abdominal cavity
- Dental: to assess common dental pathologies such as cavities or abscesses

Conventional radiography has the disadvantage of a lower contrast resolution & use ionizing radiation, it has the advantage, is inexpensive, easy to use, and widely available. Conventional radiography can give high quality results if the technique selected is proper and adequate

Contrast X-rays use a substance (called a contrast medium) that makes hollow or fluid-filled structures visible. This means that structures such as the digestive tract, blood vessels or urinary system that do not usually show up on X-ray, can be seen. The substance is injected or swallowed and X-rays cannot pass through it, so the area will appear white on the X-ray.

Fluoroscopy

Fluoroscopy is an imaging modality that uses x-rays to allow real-time visualization of body structures. During fluoroscopy, x-ray beams are continually emitted and captured on a screen, producing a real-time, dynamic image. This allows for dynamic assessment of anatomy and function. High density contrast agents may be

introduced into the patient to allow for greater differentiation between structures.

Common clinical applications

- Barium studies: Barium swallow, barium meal and follow-through, barium enema for evaluation of the gastro-intestinal tract.
- Hysterosalpingography (HSG): for evaluation of the uterine cavity and the fallopian tubes.
- Retrograde urethrogram, micturating cysto-urethrogram: for the evaluation of the abnormalities of the urinary system.
- Fistulography: for the evaluation of fistulae.
- Reduction of fractures under image guidance

Advantages

Allows a physician to see a live image of the body's internal organs in order to observe their size, shape and movement.

Provide dynamic and functional information.

Readily available.

Inexpensive.

Allow real time interaction.

Good for visualized bony structure.

Disadvantage

Because the patient must be exposed to a continuous source of x-rays instead of a momentary pulse, a fluoroscopy procedure generally subjects a patient to a

higher [absorbed dose](#) of radiation than an ordinary [radiograph](#)

Tomography

Is a special type of imaging that is used to obtain image of specific layer of tissue or an object that is super imposed by other tissue or objects.

Simple representation of the tomographic principle. During the X-ray exposure the tube moves from position T_1 to T_2 , while the film moves in the opposite direction from position F_1 to F_2 . All points of the object located in the section plane (A) will be projected to the same points on the film (A_1, A_2) during the exposure and hence will be recorded in sharp focus on the film. Points of the object outside of the section plane (B) will be continuously projected to different positions on the film during the exposure (B_1, B_2) and, therefore, will be blurred or effaced from the final image. Changing the section plane can be accomplished