

Radiology & diagnostic imaging

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Q:1 what are the major differences between mammography & Plain radiology.

Answer:

	mammography	Plain radiology
1	It is a specialized medical imaging that uses a low dose X-ray system to see inside the breasts	1. It is a branch of medicine that uses imaging technology to diagnose & treat disease. Radiography is the imaging of body structures or parts of the body using X-rays.
2	mammography is used as a screening tool to detect early breast cancer in women experiencing no symptoms. or can be used to detect & diagnose other breast diseases.	2. Plain radiography is used mainly for screening fractures following trauma. Plain radiograph is a means of obtaining a picture of obtaining internal structures. However, it can be used to detect other diseases as well e.g cancer, arthritis, heart failure, pneumonia, bone infections etc.
3	It is limited to breast screening	3. It is used for different parts of the body & not just one
4	Annual screening mammograms for all women over 40 is recommended by doctors regardless of symptoms. women can have mammogram before age 40 if there are any changes noticed in the breast.	4. X-ray is taken only if needed to diagnose or detect anything in the body cause of your symptoms & is taken only when advised by the doctor.

mammography

plain radiology

5- It is a modality that is widely perceived to be of use only in women. mammograms are not routinely offered to men & may be difficult to perform of because of small breast tissue.

5. It is used for all ~~sexes~~ genders; Males & females, as well as children.

6 ~~mammograph~~ The procedure of mammography is different than that of an x-ray. in mammography each breast is carefully positioned on a ~~test~~ special film cassette and then gently compressed with a paddle. This compression flattens the breast so that maximum amount of tissue can be imaged.

6. In x-ray the patient is placed ~~in front of~~ standing or laying down on the x-ray table touching cassette. No compression or flattening of the body parts is done.

7 ~~It~~ The mammography machine is designed specifically for breast hence is different than a regular x-ray machine

7. x-ray machine ~~can be~~ of ~~it~~ are designed to for screening all body parts therefore is different than mammography machine.

Q.2 Explain in detail the major ~~are~~ system components of mammography. What are the ~~Answer~~ risks & benefits of using this modality.

Answer.

mammography is a ~~sped~~ specialized medical imaging that uses a low dose X-ray system to see inside the breasts for detection & diagnosing of breast diseases in women.

There are 2 types of mammography:

1. Screening mammography: It is used to detect cancer when that cancer is too small to be felt as a lump. Screening is carried out on women who do not have any symptoms of breast disease.

2. Diagnostic mammography: It is carried out when someone, a person, ~~data~~ health professional or doctor discovers unusual signs & symptoms in one or both breasts.

Benefits:

1. Screening mammography reduces the risk of death due to breast cancer. ~~It is~~ It is useful for detecting all types of cancers.

2. It improves a physician's ability to detect small tumors.

3. It increases the detection of small abnormal tissue growths confined to the milk ducts in the breast.

4. No radiation remains after an x-ray examination

5. X-rays usually have no side effects in the typical diagnostic range for this exam.

RISKS:

1 There is always a slight chance of cancer from excessive exposure to radiation. However the benefit of an accurate diagnosis far outweighs the risk.

2 False positive mammograms: 5% to 15% of screening mammograms require more testing such as additional mammograms or ultrasound. Most of these tests turn out to be normal. If there is an abnormal finding a follow up or biopsy may have to be performed.

3 women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.

Major System Components

- 1) Generator: In mammography we are dealing with soft tissue of the breast.
 - 20-40 kVp of x-ray energy is required for good contrast.
 - Max mA - 200mA

- For homogenous x-ray beam, HFG is required
- 3-10 kw tube rating
- 3-5 lakh HU-heat loading capacity

2) x-ray Tube :

- Anode or target materials :
 - molybdenum
 - Rhodium
 - Tungsten
- + Characteristic radiation produced by Mo & Rh are effective for breast imaging
- + Molybdenum is the most common anode target material used in mammography x-ray tubes.

Effective anode angle : is at least 22-24 degrees for coverage of 24x30cm² field area.

- Cathode :

* the mammography x-ray tube is configured with dual filaments in the ~~focusing~~ focusing cup to produce 0.3 & 0.7 mm focal spot.

- mammographic x-ray tubes of rotating anode
- Anode angle 0-16 degrees
- Tube tilt 6-24 degrees
- Source to image receptor distance is about 60-65 cm.

• Beryllium window is used as it has low atomic no. 4 & lower absorption of less than 5 kVp x-rays. 1 mm of Be is equivalent to 0.1 mm Al material

HEEL Effect :- Positioning the cathode over

the chest wall of the patient and the anode over the anterior portion (nipple) achieves better uniformity of transmitted x-rays through the breast. Orientation of the tube in this way also decreases the equipment bulk near the patient's head.

Focal Spot size :- 0.3 to 0.4 mm for Contact mammography (breast compressed against the grid & image receptor).
0.10 to 0.15 mm for magnification imaging.
It reduces geometric blurring so that micro calcifications can be resolved.

Target & Filter Combination :

The filters used in mammography are based on the "k edge" principle & attenuate the radiation above the k edge energy of the specific filter material, either molybdenum or rhodium.

- Mo target with 0.3 mm (30 μ m) Mo filter (42)
- Rh Target with 0.025 mm (25 μ m) Rh filter (45)
- W target with 0.05 mm (50 μ m) Rh filter (74)

3) Collimator / Cones :

Cones are required for proper direction of x-ray beam, proper collimation, for rejecting scatter radiation & protection of chest wall & lungs from unnecessary radiation.

Three designs are currently used :-

- 1 fixed aperture
- 2 A set of interchangeable cones for various sizes of breast
- 3 An internal set of collimating blades.

• for magnification & spot compression studies, manually adjusted shutters allow the x-ray field to be more closely matched to the volume being imaged.

4) Anti ~~Grid~~ Scattered Grid

- The anti scattered grid must be a ~~moving~~ moving grid.
- Carbon fiber is the preferred interspace material
- focused grid, with a grid ratio 3:1 or 5:1
- Grid frequencies of 30-40 lines/cm
- Use of such grid doesn't compromise the spatial resolution but it does increase the patient output
- Use of 4:1 ratio grid approximately double the pt. dose as compare to non grid Contact mammography
- A unique grid is developed especially for the mammography (HTC) high transmission, cellular grid.
- It reduces the scattered radiation in 2 directions. HTC grid has copper as a grid stripe & air as a interspace, physical dimension grid ratio 3:8:1

5) Compressor devices / Breast Compressors.

- Compression plates flat surfaced plate used for uniform compression
- In convention compression plate anterior portion of breast is not compressed properly.
- Newer slanted S.O.F.T paddles are now

available for equal compression to all areas of the breast.

All components of Mammography

- Generator
- Support system
- X-ray tube
- Collimator / cone
- Breast compressor
- Anti scatter grids
- Cassette holder
- ~~#~~ Automatic exposure control → Phototimer
- ↳ Detector Systems.

Q:3 Briefly describe X-ray imaging system. What is the role of X-ray imaging in physiotherapy?

Answer:

X-ray imaging is the imaging of the body structures or parts of the body using X-rays.

X-rays are a form of radiation (X-radiation) similar to visible light, radio waves & microwaves.

X-radiation is special because it has a very high energy level that allows the X-ray beam to penetrate through the body and create an image or picture. Any image created ~~through~~ using an X-ray is due to different X-radiation absorption by different structures or parts of the body. A dense structure such as bone absorbs a high percentage of the X-ray beam which appears light grey on the image, whereas low density structures such as soft tissue

absorb small %, which appears dark grey on the image.

X-Ray Imaging System

X-Ray has three main components

1. Operating Console
2. High frequency generator
3. X-ray tube
 - Internal
 - External

Other parts include

4. Collimator & grid
5. Bucky
6. X-ray film

1) Operating Console

The operating console allows the radiologist to control the x-ray tube current & voltage so that the useful x-ray beam is of proper quantity & quality.

Radiation quantity refers to the the number of x-rays or the intensity of the x-ray beam. Radiation quantity is usually expressed in milliroentgens (mR) or milliroentgens/milliampere-second (mR/mAs).

The operating console usually provides for control of line compensation, kVp, & exposure time. Meters are provided for monitoring kVp, mA, & exposure time.

2) High frequency generator

A high frequency generator ~~attaches~~ ^{powers} the X-ray tube, before high voltage generators were used. High frequency generators are used for X-ray because they operate on single phase & give less voltage ripples. Another reason is its small size, which makes it portable.

3) X-ray tube

The X-ray tube can be classified as internal & external

- External: part includes

- ↳ tube support

- ↳ protective housing

- ↳ Glass or metal envelope

- Internal: Part includes

- ↳ Cathode: The filament that causes thermionic emission

- ↳ Anode: A flat disc made of tungsten that draws the electrons across the tube

4) Collimator & Grid.

Collimator is device used to minimize the field of view, avoid unnecessary exposure using lead plates. Lead shutter are used to restrict the beam. The Collimator is attached to the X-ray below the glass window where the useful beams are emitted.

Grid is similar to a collimator except they have different positions. Grid is placed right after the patient. It is made up of lead strips, that allow rays at 90° ~~angle~~

5) X-ray Film

It is film that is placed after the Bucky. It turns black where x-rays interact with it and stays white ~~where~~ where the x-rays are absorbed. This causes an image to be formed that is in black, greys & white.

Role of x-ray in Physiotherapy

x-rays are used in the field of ~~the~~ medicine to diagnose, ~~detect~~ detect & see how well the patient is responding to the treatment. It is important in the field of medicine, physiotherapy as well as dentistry.

In physiotherapy x-ray are taken to get a clear & an depth view & understanding of the injury or diseases such as: ~~for~~ observing

- 1) → It is used for fractures (broken bone)
- 2) → ~~to~~ to see & diagnose ~~the~~ arthritis or severity of arthritis
- 3) → it is used to look for bone infections

- 4) X-ray is used to look joint diseases or injuries
- 5) X-ray is used to check for spinal diseases
- 6) X-ray is used for the assessment of bones & joints malunion, malformation, calcifications, disruptions etc
- 7) X-ray is used for observation of broken bones torn ligaments, cancers etc.
- 8) Overall X-rays are important for ~~the~~ detecting & monitoring pathologies of the skeletal system as well as respiratory system.