MAMMOGRAPHY

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Radiology Equipment Technician I (X-Ray)

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Outline

- Mammography
- Image system equipment
- Types of mammography systems
- Film screen system

Objectives

The student should be able to do the followings;

- Explain Mammography
- Mention image system equipment
- Differentiate between types of mammography systems
- Explain Film screen system

Mammography

- Mammography: is an x-ray imaging technique using low-dose radiation to examine the breast for early detection of breast cancer, identifying abnormalities in the breast

- Mammography involves:

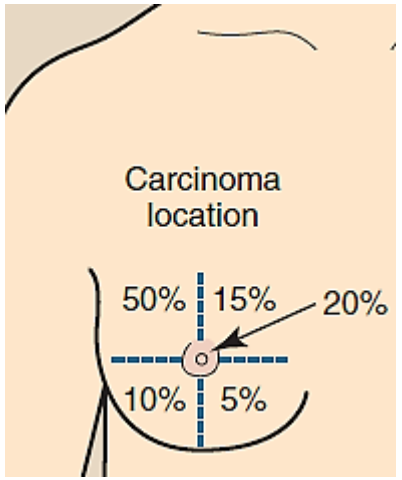
1- **Screening mammography** is performed on asymptomatic women with the use of a two-view protocol, usually medial lateral oblique and cranial caudad, to detect an unsuspected cancer.

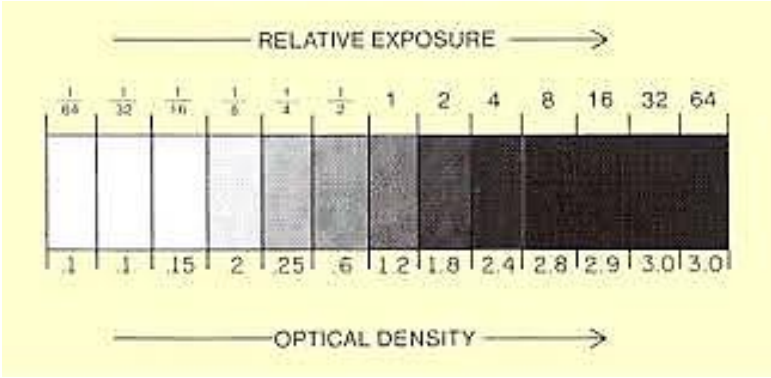
2- **Diagnostic mammography**: is performed on patients with symptoms or elevated risk factors. Two or three views of each breast may be required.

* The risk of radiation-induced breast cancer resulting from x-ray mammography has been given a lot of attention. Mammography is considered very safe and effective. The ratio of benefit (lives saved) to risk (possible deaths caused) is estimated at 1000 to 1.

Mammography

- Young breasts are dense and are more difficult to image because of glandular tissue. Older breasts are more fatty and easier to image.
- Adipose tissue appears dark on film with higher optical density (**OD**) and requires less radiation exposure.
- If a malignancy is present, it appears as a distortion of normal ductal and connective tissue patterns. Approximately 80% of breast cancer is ductal and may have associated deposits of microcalcifications that appear as small grains of varying size. In terms of detecting breast cancer, microcalcifications smaller than approximately 500 µm are of interest. The incidence of breast cancer is highest in the upper lateral quadrant of the breast.





Mammography

- X-ray mammography requires a low-kVp technique. As kVp is reduced, the penetrability of the x-ray beam is reduced, which in turn requires an increase in mAs.
- Technique factors of approximately 23 to 28 kVp are used as an effective compromise between the increasing dose at low kVp and reduced image quality at high kVp.
- The emulsion surface of the film must always be next to the screen, and the film must be on the x-ray tube side of the radiographic intensifying screen.

THE MAMMOGRAPHIC IMAGING SYSTEM

1- High-Voltage Generation: All mammography imaging systems incorporate high frequency

generators with a single-phase input, to produce a direct current (DC) voltage waveform. high-frequency generators are smaller and less expensive to manufacture. They provide exceptional exposure reproducibility, which contributes to improved image quality. A maximum limit of 600 mAs is standard.

2- Target Composition: Mammographic x-ray tubes are manufactured with a tungsten (W), molybdenum (Mo), or rhodium (Rh) target.

3- Focal-Spot Size: the higher demands for spatial resolution. Imaging of microcalcifications requires small focal spots. x-ray tubes usually have stated focal-spot sizes—large and small of 0.3 mm and 0.1 mm, respectively. the smaller is the better.

THE MAMMOGRAPHIC IMAGING SYSTEM

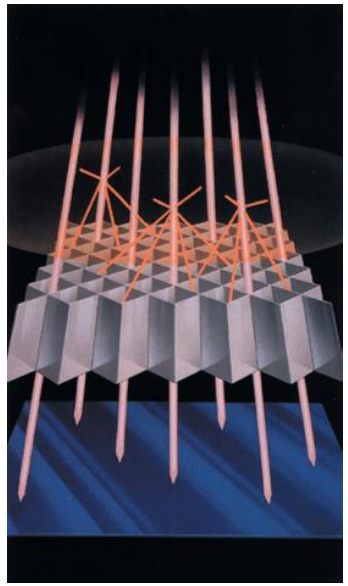
4- Filtration: At the low kVp used for mammography, it is important that the x-ray tube window not attenuate the x-ray beam significantly. Therefore dedicated mammography x-ray tubes have either a beryllium (Z = 4) window or a very thin borosilicate glass window. Most mammography x-ray tubes have inherent filtration in the window of approximately 0.1 mm Al equivalent. Beyond the window, the proper type and thickness of x-ray beam filtration must be installed.

5- Heel effect: The conic shape of the breast requires that the radiation intensity near the chest wall must be higher than that to the nipple side to ensure near-uniform exposure of the image receptor.

- The source-to-image receptor distance (SID) of 60 to 80 cm, with the cathode to the chest wall and the x-ray tube tilted.
- The use of long SID and vigorous compression makes the change of the heel effect in focal-spot size over the image receptor insignificant.

THE MAMMOGRAPHIC IMAGING SYSTEM

6- Compression : A compressed breast is of more uniform thickness; therefore, the response of the image receptor is more uniform, When vigorous compression is used, all tissue is brought closer to the image receptor, and focal-spot blur is reduced. Compression also reduces absorption blur and scatter radiation.



7- Automatic Exposure Control: Phototimers for mammography are designed to measure not only x-ray intensity at the image receptor but also x-ray quality. These phototimers are called **AEC devices**, and they are positioned after the image receptor to minimize the object-to-image receptor distance (OID) and improve spatial resolution.

8- Magnification Mammography : it is used in mammography, producing images up to twice the normal size. It requires special equipment such as microfocus x-ray tubes, adequate compression, and patient positioning devices.

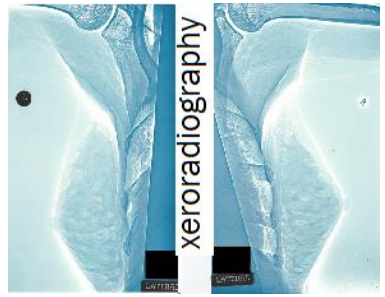
- Effective focal-spot size should not exceed 0.1 mm.

- magnification mammography is usually unnecessary because the patient radiation dose is approximately doubled.

SCREEN-FILM MAMMOGRAPHY

- Four types of image receptors have been used for x-ray mammography:

1- direct-exposure film: an older type of x-ray film that directly captures X-ray energy without using intensifying screens, resulting in very sharp but often grainy images, requiring longer exposure times (such as dental x-rays)



2- **xeroradiography**: recording radiographic images electronically on a selenium plate

3- **screen film**: is a traditional x-ray technique for breast imaging where x-rays pass through the breast to a cassette containing a phosphor screen and photographic film

4- digital image receptors: devices that capture X-ray information and convert it into digital images.

Only screen film and digital image receptors are used today.

- Spatial resolution in digital mammography is limited by pixel size.
- Digital mammography has superior contrast resolution principally because of postprocessing.

References

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- Hendee W., and Ritenour E.,. (2002). *Medical Imaging Physics*. Willy-Liss,Inc