Mammography

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Contents

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The chapter "Mammography" describes which technical means of a mammography device are used to achieve the special requirements of an X-ray mammography. The effects of compression and magnification in mammography are also discussed.

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3.1 Design and Function of a Mammography Device

A cathode ray also works in mammography. However, since in mammography, on the one hand, the finest microcalcifications and, on the other hand, breast and fat tissue have to be distinguished from each other, particularly soft, low-energy radiation is required. For this purpose, mainly molybdenum anodes are used in order to make use of the part of the characteristic X-ray radiation (17.5 and 19.6 keV). Unlike conventional X-rays, the hard radiation is reduced by filters.

3.1.1 The Heel Effect

If we now look at the distribution of the resulting X-rays at the anode, we find that there is a certain distribution (Herzt's dipole) (Fig. 3.1).

Due to this special distribution and due to the slope of the anode and the resulting self-absorption, a characteristic intensity distribution occurs within the field. The radiation decreases in the direction of the cathode. This phenomenon is called the Heel effect. The mammography tube is therefore constructed in such a way that the cathode is located close to the thoracic wall, since the breast is thicker and denser here than close to the mammilla.

The Heel effect refers to the anode-side dose drop.

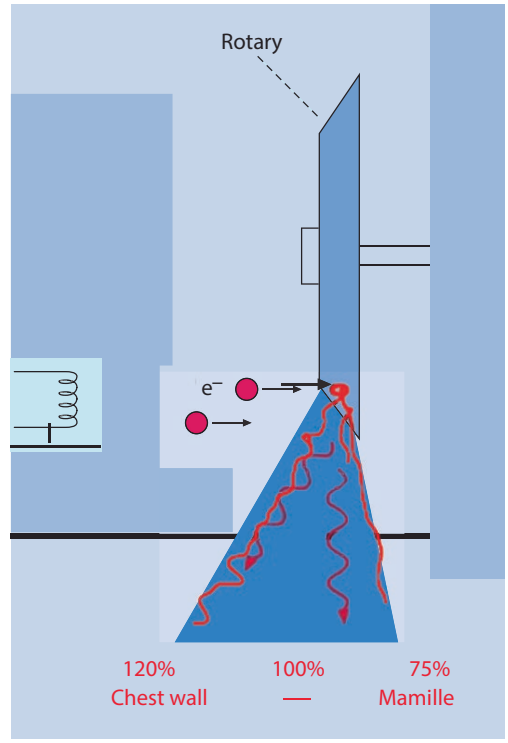

Fig. 3.1 Schematic of the Heel effect. (From Hartmann et al. 2014)

3.1.2 Compression, Scattered Radiation Reduction

Thin objects cause less scattered radiation than thick objects. This dogma is exploited in mammography. The breast is clamped and compressed in the mammography device. This simultaneously minimizes the overlapping of the different structures as well as the motion blur. Another effect is that due to the compression, the breast has at least approximately the same thickness both near the thoracic wall and near the mammilla, thus achieving **homogeneous exposure of** the image (Fig. 3.2).

Due to the compression of the breast, the tissue is distributed homogeneously both thoracic and mammillary and can thus be assessed more precisely.

Fig. 3.2 Mammography image

A scattered radiation grid is also used in mammography. Unlike in conventional X-ray, however, a much more complex grid movement is necessary so that the grid is not imaged in the image due to the soft radiation.

3.1.3 Magnification Mammography

In magnification mammography, the distance between the breast and the image receiver is increased. Due to the imaging laws (► Chap. 2), this results in an enlargement of the structures, e.g. in order to better recognize the shape of microcalcifications, even if the geometric blurring becomes somewhat greater. In addition, the grid can be dispensed with in the enlarged image, since the scattered radiation is already too far attenuated and no longer reaches the image receiver.

3.1.4 Automatic Exposure Control

An automatic exposure system can also be used in mammography. Here, care must be taken to ensure that the measuring chamber is placed in projection onto the gland body. Depending on the size of the mamma or also in the case of breast implants, manual exposure is therefore also frequently selected in order to avoid incorrect positioning of the measuring chamber and thus incorrect exposure of the mammogram.

3.1.5 Image Receiver, Image Viewing

As in conventional X-ray, mammography devices are nowadays equipped with digital image receivers. The requirements for spatial and contrast resolution are significantly higher here. Pixel sizes between 0.05 and 0.1 mm are required for the correct delineation of fine connective tissue strands and microcalcifications.

In order to be able to use this matrix size for diagnostic purposes, appropriate monitors are required. While 2-megapixel monitors are sufficient for conventional images, 5-megapixel are required for mammography.

Practice Questions

1. What is meant by the Heel effect?
2. Why is it necessary to compress the breast during mammography?
3. What is magnification mammography?

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