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Dosimetry in CR Mammography Using Breast Phantom

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1. Introduction

To estimate the dose that a patient's mammary tissue receives during mammographic screening, PMMA simulators are used, as this material interacts with X-rays in a similar way to tissue [1]. Estimating the dose absorbed by a tissue is important to verify that the dose is within the recommended limits and in this way minimize the undesirable effects that radiation can cause and optimize the radiation dose that patients receive [2].

In this work, the entrance surface air kerma was measured with a PMMA simulator and the absorbed dose between its plates.

2. Methodology

The VMI Graph Mammo AF mammograph, which has a computed radiography (CR) system, was configured to exposures with an RQR-M2 quality X-ray beam. Using GafChromic XR-QAR2 radiochromic film strips, the entrance surface air kerma was measured with a PMMA compressed breast simulator, which has a total thickness of 50 mm. The dose was then measured between the PMMA plates.

Prior to the measurement, the response of the radiochromic film was calibrated with a 10X6-6M Accu Gold ionization chamber.

3. Results and Discussion

The radiochromic film response calibration was performed to correlate the dose values with the intensity of darkening of the film after exposure to the X-ray beam.

With the intensity of the film positioned at different thicknesses between the PMMA plates, it was possible to determine the dose in the upper (0 mm) and lower surface (50 mm) and in the middle (20, 25 and 30 mm) of simulator. The behavior of the dose values is shown in Fig. 1 and the polynomial fit is described by Eq 1.

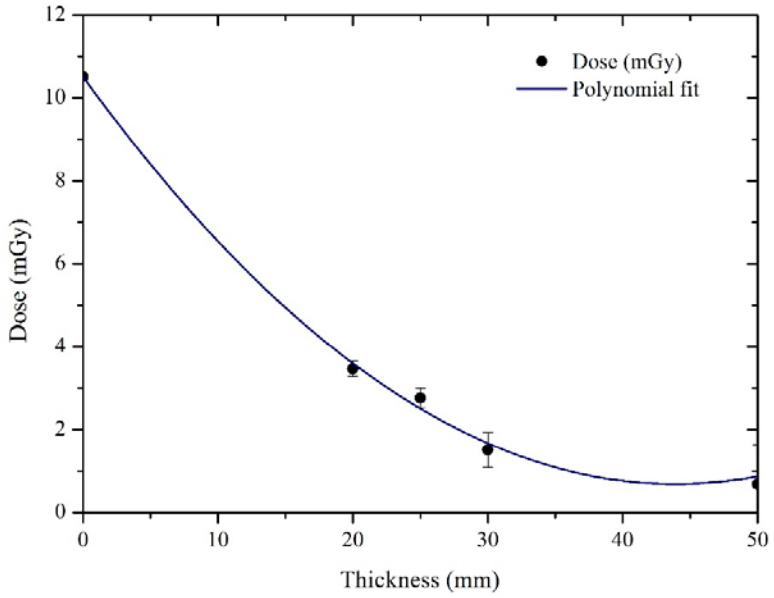

Figure 1: Behavior of the dose with the PMMA simulator with 50 mm thickness.

$$D = a + bx + cx^2 \quad (1)$$

Where, *D* is the dose (mGy), *x* is the thickness (mm), the coefficients of the fit curve are: *a=10.50± 0.23, b=-0.44±0.02, c=0.0050±0.0003* and correlation coefficient is *R=0.9965*.

The entrance surface air kerma was 10.5 mGy. Most of the dose is absorbed in the first 20 mm that the X-ray beam passes through the PMMA plates, with 3.5 mGy being the measured dose. At 25 mm, 2.8 mGy was measured, which corresponds to only 26% of the entrance surface air kerma.

4. Conclusions

Radiochromic film was used to measure the dose between the plates of a PMMA simulator, mainly due to its thin thickness, which allowed it to be positioned between the plates.

The behavior of the dose decreases as expected, this decrease being more evident at the beginning, then it decreases more slowly. The dose values are within the recommended limits for the thickness of the simulator used.

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References

[1] D. White, et al., *Tissue Substitutes in Radiation Dosimetry and Measurement. ICRU Report 44*, International Commission on Radiation Units and Measurements, Bethesda, USA (1989).

[2] C. D. Almeida, J. E. Peixoto, L. T. L.Sardo, "Avaliação da dose e do contraste em sistemas de mamografia computadorizada–CR", *Brazilian Journal of Radiation Sciences*, vol. 6, no. 1, pp 1-13 (2018).