DETERMINATION OF RADIATION DOSE IN SURFACE BREAST USING TWO TYPES OF PMMA SIMULATORS

Jacqueline S. Barreira, Sarah D. P. Huet, Vitor Vivolo
Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN
Av. Lineu Prestes, 2242, São Paulo – Brazil
jacsales@usp.br

Abstract

The use of X rays for diagnostic radiology is very common and important to Medicine, including mammographic diagnosis.
Evaluate the radiation dose given to patients is very important to protect them the deleterious effects of ionizing radiation.
The Instruments Calibration Laboratory (LCI) of IPEN perform calibration in dosemeters used in radiation dosimetry (in diagnostic radiology) for many years.
The objective of that paper were the measurements of the dose given in the surface breast, using VMI Graph Mammo AF Phillips and two simulators made of PMMA (poly methyl methacrylate), one based on the IAEA TRS 457[1], and another based on the standard IEC 61267[2].

Keywords: X-Rays; Mammography; Radiation detection; Breast dose; Breast simulators

Introduction

Breast cancer accounts for nearly 25% of all cases and is the most common type among women in the world. Estimates for 2014 indicate 57 000 new cases of breast cancer in Brazil, the third highest incidence, only behind melanoma and prostate cancer.

The World Health Organization (WHO) estimates 27 million new cancer cases for 2030 worldwide, and 17 million deaths from the disease. Developing countries will be most affected, including Brazil. These numbers show the importance of maintaining a control among women, so that a possible condition is detected as early as possible.

But to get an early and reliable diagnosis is necessary that mammography is calibrated and working properly, otherwise there may be a loss in image produced, which can generate a false diagnosis, and possible harm to the patient.

Therefore it is important to control these devices, especially in relation to the radiation produced by them. A quality control must be performed periodically in order to ensure that the radiation emitted by the X-ray tube present in such equipment is well known, so that the image produced has sufficient quality to perform an accurate diagnosis, the patient receives without unnecessary dose

According to the Code of Practice published by the IAEA, the simulator (or phantom, in English) is an object used to absorb and / or scatter equivalent to radiation scattered by a patient during a procedure (diagnostic or terpeutico) thus helping to

estimate the dose and test radiation imaging systems without the necessity of exposing the patient. Can be di anthropomorphic type of an object or physical test.

In the case of mammography, in general, the simulations do not have the shape of a breast in mammography to be compressed. Some plates are made of polymethylmethacrylate (TRS 457), which is a material easy to handle and its density is one that most closely approximates the density of water, and are used in assays for determining the dose absorbed and spread. Other simulators are made of acrylic and have structures that simulate fibers, calcifications in ducts and tumorais[3] masses, being used in control of image quality tests.

Materials and methods

Philips mammography-VMI, Graph Mammo AF, which operates in a range 20-35 kV, has target of molybdenum and molybdenum and rhodium filters. It was not possible to perform tests with the automatic exposure control (AEC), as this is inoperable equipment.

Radcal model 9015, collector dosage, used in conjunction with the ionization chamber Radcal10x5-6M.

For dose measurements entrance surface of the breast, two separate simulations were used, one based on the standard TRS 457 IAEA, comprising rectangular slabs of PMMA, 5 mm thickness each, and one based on IEC 61267, also of PMMA plaques with a thickness of 5 mm each, but with a semicircular shape. These simulators were developed by Correa[4].

For testing, simulated be different breast thicknesses, by changing the amount of semi-circular or rectangular plates, to mimic different breast thicknesses, according to information available in the Code of Practice TRS 457, shown in Table 1:

Thickness Simulator pmma (mm)	Equivalent breast thickness (mm)
20	**21**
45	**53**
60	**75**
80	**103**

Table 1: Equivalent Thickness x Thickness breast simulator, according to the TRS 457 is here shown only the thicknesses used in this work

The ionization chamber followed the height of the simulator.

Conclusions

In Brazil, with the publication of Ordinance 4535 was established as the reference level for mammography, the value of 10 mGy to the skin entrance dose for a compressed breast thickness of 4.5 cm, up 50% fat and 50% glandular, incidence skull-Caudal (CC), anode and molybdenum filter for exams with grills. This value was based

on studies conducted by the International Standards Básicos[6] Security. Using the technique of 28 kV and 100 mAs, the values were below the standard established by both using the simulator based on IEC 61267, as the simulator based on the TRS 457, as shown in Table 2:

Thickness of the simulator (mm)	**Dose with the simulator based TRS 457 (mGy)**	**Dose with the simulator based on IEC 61265 (mGy)**
20	**7,76**	**7,8**
45	**7,89**	**8,06**
60	**8,24**	**8,4**
80	**8,51**	**8,96**

Table 2: entrance surface dose of both simulators. The dosage increased proportionally to the thickness of the simulator.

The thickness of the breast is one of the factors that most influence the radiation dose in the patient. Several studies have shown that incident air kerma increases with the thickness of mama7, which is visible in the table above.

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