

# Numerical dosimetry in brachytherapy to variable mama sizes using two different types of $^{125}\text{I}$ seeds

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A very common type of cancer among women is the breast cancer. The treatment choice depends on the clinical stage of the disease, the age, among other factors. The most common treatment to breast cancer is the breast surgery, with a complementary external beam radiation therapy. Another technique is the permanent breast seed implant. These seeds may be Iodine-125 ( $^{125}\text{I}$ ) because they present some advantages: possibility to treat solid tumors, high dosimetric precision and low trauma [1]. Nowadays, the Monte Carlo simulation has become an essential dosimetry tool to clinical applications and research. In the research field the most common application is the dose determination around radiation sources. In Brazil, recently, a new  $^{125}\text{I}$  seed was developed at the *Instituto de Pesquisas Energéticas e Nucleares (IPEN/CNEN-SP)* to be applied in brachytherapy. Given the large number of women diagnosed with breast cancer, and the versatility of the Monte Carlo Method, in this work, the dose determination in organs and tissues was undertaken, considering this new kind of seed and also commercial ones. Moreover, the mama sizes were modified. The volumes considered were: 347.02 cm<sup>3</sup>, 400.47 cm<sup>3</sup> and 436.77 cm<sup>3</sup>. For this purpose, the MCNPX Monte Carlo code was utilized coupled with a female virtual anthropomorphic phantom [2]. The results pointed out the highest dose values for breast, lung, skin, stomach, esophagus, liver and salivary glands. The main reason for these organs and tissues to present the highest values is due to its proximity to the seeds. Moreover, the dose results for the two types of seeds were very similar.

*Keywords:* Brachytherapy, Dosimetry, Monte Carlo simulation

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[1] Q. Tan, Q. Qinghong, Y. Weiping, B. Lian, Q. Mo, C. Wei, *Medicine* 95 (44), 2016, 1-6.

[2] V. F. Cassola, V.J. de Melo Lima, R. Kramer, H. J. Khoury, *Physics in Medicine and Biology* 55, 2010, 133-162.