

AbstractID: 6540 Title: Radiation dose to tissues from mammography

Purpose: To compute the radiation dose to different tissues of the body from a standard mammogram.

Method and Materials: Using the Geant4 Monte Carlo toolkit, a simulation was developed in which the human body was represented using a mathematical anthropomorphic phantom. A total of 66 different organs and tissues were simulated, including the uterus, which was used to compute the dose to the fetus during early-stage pregnancy. The imaged breast was represented as compressed, and in both the cranio-caudal and the medio-lateral oblique views. At each energy level, the simulation emitted 60 million monochromatic x-rays and recorded the location of each interaction and the amount of energy deposited. The dose to the red bone marrow and to the bone surfaces of each bone was estimated separately. The monochromatic data was used to compute the resulting dose for different typical polyenergetic mammographic spectra, and the values were normalized to the resulting glandular dose to the breast, resulting in the dose ratio. The effectiveness of using a lead shield between the patient and the x-ray field was also investigated.

Results: Only 16 organs and skeletal tissues received a dose higher than 0.10% of the glandular dose to the breast. Of the organs, the contralateral breast received the highest dose ratio with 0.62%. Of the skeletal tissues, the sternum received the highest dose, with a dose ratio of 2.36% to the bone surface and 0.56% to the bone marrow. The dose to the uterus and fetus received a maximum dose ratio of $<10^{-5}$. The lead shield did not lower the dose values substantially.

Conclusion: The radiation dose to all tissues outside the x-ray field, including the fetus, during standard mammography is extremely low.