

Purpose: To account for the energy dependence of film- or solid state-based dosimeters used in CT, they are often calibrated in air. However, they are used in a CTDI phantom, which may produce a significantly different spectrum due to scatter. The purpose of this study is to use Monte Carlo simulations to investigate the change in CT x-ray energy spectra between exposures in air and in CTDI phantoms.

Methods: The x-ray fluence in air, and inside both 16 and 32 cm phantoms were estimated using Monte Carlo simulations. A Siemens Sensation 64 CT scanner using 24x1.2mm beam collimation, and a Toshiba Aquilion 64 CT scanner using 8x4mm beam collimation were simulated. In addition, simulations were performed using 2mm collimation for the Toshiba Aquilion 64. For all conditions, the spectra were estimated by tallying at within the phantom to estimate x-ray fluence. Based on these spectra, the average energy and estimated Half Value Layer were obtained and compared.

Results: For Sensation 64 scanner, the HVL decreased from 9.8 mm Al in air to 7.9 and 7.2 mm Al in center of head and body phantoms, respectively. For Aquilion 64 scanner the HVL decreased from 6.2 mm Al in air to 5.9 and 5.8 mm Al in center of head and body phantoms, respectively; however results also showed that the HVLs increased at 12:00 position (to 6.4 and 6.8 mm Al). For Aquilion scanner at narrow collimation setting, the HVLs increased at all positions.

Conclusions: The spectra inside phantoms are nearly always different from that of air – under some conditions it is harder and under others it is softer. These differences in spectra should be taken into account when calibrating dosimeters that have energy dependence.