

AbstractID: 6951 Title: Monte Carlo benchmark for radiation dose assessment in Varian On-Board Imager

Purpose: To evaluate radiation dose in kV cone-beam computed tomography (CBCT) and to benchmark Monte Carlo (MC) simulations in the PMMA CT phantoms

Method and Materials: Using an On-Board Imager (Varian Medical Systems), we measured absorbed doses to the air in the head and body CT phantoms. The default x-ray scan parameters were: 125kVp, 80mA, 25msec. The head phantom was scanned in “full-fan” mode and the body phantom was scanned in “half-fan” mode. Absorbed dose was measured with TLD-100 chips (Harshaw); four TLD chips were placed at the midpoint of cylindrical cavities located in the center and peripheral locations of the phantom. We established a MC model for OBI x-ray tube using BEAMnrc/EGSnrc code. XTUBE CM was used for the target and PYRAMID CM was used to build both full- and half-bowtie filters. Directional bremsstrahlung splitting was adopted from the study (Mainegra-Hing) to reduce the simulation time. The x-ray spectrum obtained from MC was compared with that of IPEM report 78 for verification. DOSXYZnrc calculated dose to the head and body phantoms. To match the MC calculations with measurements, we normalized the MC simulations to the measurements at the isocenter of the phantoms.

Results: The center-to-periphery dose ratios were 1.14 (TLD) and 1.0 (MC) for the head phantom and 0.57 (TLD) and 0.59 (MC) for the body phantom. The percentage differences between TLD and MC were 12% and 4% for the head and body phantoms, respectively.

Conclusion: The differences were within 12% between MC and the TLD measurements. To our knowledge, this work was one of the first attempts to benchmark MC code for a clinical CBCT scanner. It provided a simple and effective method to benchmark MC code in CBCT. The large difference between MC and TLD should be investigated further.

Partially supported by Varian research grant