

AbstractID: 13628 Title: A Monte Carlo simulation of the imaging of low MV cone beam computed tomography

Purpose: Megavoltage (MV) cone beam computed tomography (CBCT) using softer spectrum by either lowering the accelerating potential or using low-Z targets has been considered for image-guided radiotherapy (IGRT). In this study, projection images for 250 kVp, 1 MV and 6 MV photons were simulated and the image qualities of reconstructed CBCT were compared.

Method and Materials: The Monte Carlo code EGSnrc/DOSXYZnrc was used to simulate the projection images for CBCT reconstruction using 250 kVp, 1 MV and 6 MV photons. The voxel phantom used for calculation was created from the CT images of an ACR accredit phantom with four (air, adipose, muscle, and bone) cylindrical inserts of 25 mm in diameter. For each energy, 51 projection images were simulated every 4° for 200° gantry rotation. Volumetric CBCT images were reconstructed from the calculated projection images using the Feldkamp algorithm. The image qualities of the 2D projections and 3D volumetric images were compared.

Results: For 2D projection images, only the concave produced by the insert of air in the ACR phantom was observed. For 3D reconstructed CBCT images, the inserts of air and bone were quite distinguishable for all three energies. However, the inserts of adipose and muscle were only discriminated for the 250 kVp and 1 MV photons, but were barely identified for the 6MV photons. The contrast-to-noise ratios (CNR) of the 250 kVp and 1 MV images were comparable and significantly better than the 6 MV images. The imaging dose of the 1 MV and 6MV photons were respectively 5 and 18 times of the 250 kVp photons.

Conclusion: The 1 MV photons could be a good option for IGRT with an image quality comparable to the 250 kVp photons and an acceptable imaging dose.