

Purpose: To systematically evaluate, in phantom and patient, dosimetric differences obtained by applying metal-artifact reduction (MAR) algorithm in CT for treatment planning algorithms.

Method and Materials: Helical CTs were acquired for six phantom configurations and three patient cases (bilateral hip prostheses, femur, humerus rods). MAR was applied to reconstructed images using Matlab (v7.8) integrated into Extended Brilliance Workspace research platform (Philips Healthcare, Cleveland, OH). Two Cerrobend rods were fabricated for CIRS thorax phantom to investigate interfaces and simulated clinical configurations including bilateral hip prostheses. Dose was calculated on original and MAR-corrected CTs using Anisotropic Analytic Algorithm (AAA), Pencil Beam Convolution (PBC) in Eclipse, Pencil Beam Convolution (PBC-BL) and Monte Carlo (MC) algorithms in Brainlab, with and without heterogeneity correction. Dose matrices were evaluated. Statistics from the same regions of interest evaluated sensitivity and accuracy of algorithms between original and MAR-corrected CTs.

Results: In phantom, with heterogeneity correction off, no appreciable dose differences were observed between original and MAR-corrected CTs. $\sim 4.0\%$ mean dose difference was observed between original and MAR-corrected scans for single Cerrobend rod interfaced with lung-mimicking tissue when calculated with MC. For double Cerrobend configuration, lung-metal-bone interfaces yielded 3.0% and 5.0% difference in mean dose for AAA and MC, respectively. For the patient data, dose differences between the original and MAR-corrected CT scans could be substantial. With the exception of PBC in Eclipse, up to 8 +/- 24% mean dose differences were observed for the 3D conformal plans. The most substantial dosimetric changes were revealed for the MAR-corrected bilateral hip prostheses scan, with 12 +/- 29% mean dose differences observed for both PBC and MC implemented in Brainlab.

Conclusion: Dosimetric differences revealed between original and MAR corrected CT scans can be substantial, and the results can be used to facilitate implementation of MAR corrected images in treatment planning.

Funding Support, Disclosures, and Conflict of Interest:

Henry Ford Health Systems holds a research agreement with Philips Medical Systems.