

Purpose:

The purpose of this study was to evaluate volumetric kV Cone Beam CT (CBCT) image quality at different scan parameter settings in context to treatment planning tolerances

Method and Materials:

Both large and small density phantoms with eight density inserts were scanned by GE LS CT/PET system, as well as the Varian's OBITM system in half fan and full fan scanning modes. Scans for CBCT images were performed at different tube currents (20-, 40- and 80-mA) and source-imager distance (SID) (150cm and 160cm) after prior calibration of each mode. Deviation of the Hounsfield Unit (HU) values at different settings compared to conventional kV CT images were obtained for further evaluation. We also adjusted the CT number in CT images to simulate CBCT artifacts that was not produced by our experiments, and to see how much degradation of image would violate dosimetric feasibility of CBCT based treatment planning. Treatment plans for single beam or multiple beams were calculated based on CT, CBCT and modified CT images for various phantoms geometries and patients.

Results and Conclusions:

Results show that the HU for different anatomies in the body have different amount of change for different scan parameters settings (including current, SID and fan angle used) for CBCT image acquisition. Larger variations in HU appeared in lung and dense bone regions, compared to those with HU closer to tissue. Maximum variations in HU were found in the images with data truncation. Dose profiles, dose volume histograms, isodose distributions and Gamma values of CBCT based plan with images scanned at full fan mode agree relatively well with CT based plan. Larger dose discrepancy appears in lung or dense bone region. Results from the CT-modified images based plans show that the dosimetric error becomes significant as the HU variation goes beyond 50.