AbstractID: 5858 Title: Dose Reconstruction Quality Assurance for Helical Tomotherapy

Purpose: To determine if the dose calculation accuracy is suitable for the daily dose verification of patient treatment; and develop quality assurance tests for dose reconstruction with a commercial dose reconstruction system.

Methods and Materials: Dose reconstruction accuracy was evaluated using MVCT and kVCT images of three test phantoms: 1.) A Electron Density Phantom phantom (*Gammex*); 2.) A water-equivalent cylindrical phantom (*TomoPhantom*), and 3.) an anthropomorphic RANDO phantom. A parotid-sparing head & neck plan was created for the phantoms. Using the kVCT images, inverse treatment plans simulating clinical prostate and head & neck helical tomotherapy treatments were created. The phantom MVCT images were fused with the kVCT images using a co-registration algorithm. Planned-Adaptive software was then used to re-calculate the doses on the MVCT images. The kVCT-based and MVCT-based doses were then exported to the RIT113 Dosimetry System. Accurate dose reconstruction is dependent on the quality of the MVCT images used.As such, a genetic algorithm was developed to ensure proper image fusion and a principle component analysis was used to determine the most influential factors for image quality.

Results: Based on the phantom results, the calculation accuracy of MVCT and kVCT images are typically within ±3% of each other. The greatest discrepancy occurs in the high-dose gradient regions, which is most likely due to slight alignment errors between the two dose files. PCA indicated a correlation with the person performing the machine warm-up and image quality. This was confirmed as MVCT dose reconstruction suffered due to an individual's error.

Conclusions: Based on comparisons of calculated doses in phantom plans, the accuracy of using MVCT image data in dose reconstruction is typically within ±3%, subject to image quality. A process was developed for assessing the image contrast and resolution on a daily basis.