AbstractID: 4748 Title: Prostate contouring uncertainty in mega-voltage computed tomography (MVCT) images acquired with a helical tomotherapy unit during image-guided radiation therapy (IGRT)

PURPOSE: To evaluate the image guidance capabilities of helical tomotherapy-based MVCT, this work compares the inter- and intra-observer contouring uncertainty in KVCT used for radiotherapy planning with MVCT acquired with a tomotherapy unit.

METHODS AND MATERIALS: Five prostate cancer patients who underwent tomotherapy treatment (with daily MVCT) at our institution were selected. One planning KVCT and one randomly selected MVCT from each patient were used. Slice spacings for KVCT and MVCT were 3 mm and 6 mm, respectively. Retrograde urethrography was performed on the KVCT studies only. For inter-observer study, seven observers contoured the prostate on the 10 CT studies. For intra-observer study, the same seven observers repeat-contoured one patient's KVCT and MVCT studies. Quantitative analysis of contour variations was performed using volumes and radial distances. F-test was performed to detect statistically significant differences between KVCT and MVCT.

RESULTS: The inter- and intra-observer contouring variability was larger in MVCT than KVCT. The largest variability was mainly found in the prostate apex and base regions. Up to 1 cm (SD) was found in MVCT. In the prostate apex region, interestingly, large but similar variability between KVCT and MVCT was observed. This suggest that the use of urethrography during KVCT simulation was not very helpful. For F-test, generally, the regions with significant differences were patient-dependent and uniformly distributed in all directions. In terms of prostate volume, observers consistenly contoured larger prostate in MVCT (by 10 %). This reflects the poorer soft-tissue contrast in MVCT than KVCT since observers tend to over-estimate or over-draw target volumes under less visible conditions.

CONCLUSIONS: Based on our data, the application of MVCT for estimating daily organ motion and deformation during image-guided radiotherapy (IGRT) is somewhat discouraging. Optimization of slice thickness and dose utilization may result in better imaging performance for prostate delineation and adaptive tomotherapy.