AbstractID: 7555 Title: Investigation of convergence and systematic dosimetric errors resulting from endorectal balloon-based heterogeneity in conformal and IMRT planning of prostate cancer

Purpose: To investigate dosimetric errors caused by endorectal balloon-based heterogeneity in prostate cancer forward and inverse planning.

Method and Materials: Five prostate cancer patients, treated with air-filled rectal balloons, were retrospectively recalculated assuming air-equivalent density and were compared to plans in which unit-density was assigned to the air. Each plan was performed using 3D-CRT (4- and 6 field) and IMRT techniques. For IMRT plans, systematic dose errors were estimated as follows: $\Delta_{sys}^{wat} = D_{wat}^{air} - D_{air}^{air}$, where the superscript, "air" assumes the true air density in the rectal balloon and indicates the dataset upon which beam weights were optimized. The subscript represents the final dose calculation dataset based on the optimized beam weights. The convergence dose error may be approximated as follows: $\Delta_{conv}^{wat} = D_{air}^{air} - D_{air}^{wat}$, where the final dose calculation dataset is equivalent (assumes air density) while the initial dataset, upon which beam weights are optimized, is changed between the water-based and air densities. DVHs, and biological dose indices, generalized EUD (gEUD), and NTCP were used to assess the dosimetric consequences of assigning unit-density to the air in the rectal balloon.

Results: Although the posterior aspect of the prostate (prostate/rectum junction) was consistently under-dosed when air-densities were assigned to the rectal balloon, these differences did not significantly affect the prostate gEUD. Average differences were approximately 0.5 Gy, with a maximum difference of 1.5 Gy observed in one IMRT plan. Rectal %NTCPs sometimes differed significantly (up to 7%) between the water- and air-density assignment and were more pronounced for the 3D-CRT plans. IMRT systematic dose errors were generally found to be larger than convergence errors, with the greatest effect observed in the rectum where NTCP differences ranged from 1 to 5%.

Conclusion: Tissue heterogeneity effects resulting from use of endorectal balloons may be dosimetrically important and must be considered for accurate 3D-CRT and IMRT prostate cancer planning.