AbstractID: 12921 Title: Quantitative Analysis of Dosimetric Effects due to Irregular Respiratory Motion in Stereotactic Body Radiotherapy of Lung Cancer

Purpose: A dosimetric analysis of respiratory motion irregularities is presented for stereotactic body radiotherapy (SBRT) of lung cancer. The changes in target dosimetric coverage is quantified in terms of random and systematic variations in the respiratory motion and correlated with average tumor motion.

Method and Materials: Treatment plans and respiratory motion data of 12 lung cancer patients treated under SBRT protocols are retrospectively analyzed. In addition to actual respiratory motion data, a set of simulated motion data is also generated demonstrating irregularities in form of random fluctuations as well as systematic variations. Delineated clinical target volumes (CTV) of patients are subjected to the motion pattern while the target voxels are individually tracked in three dimensions. These trajectories are finally used to map the dose accumulated in the voxels of CTV in its own frame-of-reference enabling dosimetric evaluation.

Results: The reduction in target minimum dose (Dmin) due to irregular respiratory motion was -1.1% (s=0.7%) for mean target motion of 1.0 cm and -2.6% (s=1.4%) for 2.0 cm. Changes in tumor control probability (TCP) associated with these reductions were negligible. When investigated separately, random fluctuations in the respiratory motion accounted for no change in Dmin (s=0.2%) for 1.0 cm target motion and only -0.8% (s=0.4%) for 2.0 cm. However, systematic variations in the respiratory motion such as a change in the average target motion between the simulation and treatment sessions was observed to play a greater role, with -1.6% and -3.7% changes in Dmin for 1.0 and 2.0 cm target motions respectively.

Conclusions: Dosimetric impact of irregular respiratory motion was observed to be minimal in the use of SBRT for lung cancer treatments. When individual types of uncertainties are evaluated, the systematic shifts in breathing pattern were observed to have larger effect than commonly observed random breathing fluctuations.