AbstractID: 10137 Title: Is Respiratory Gating More Prone to Dosimetric Errors Due to Irregular Respiratory Motion?

Purpose: The aim of this study is to investigate the dosimetric effects of the irregular respiratory motion of lung tumors treated using respiratory gating techniques. Several treatment parameters such as the gating window, average target motion, and the inclusion of respiratory coaching techniques are also investigated for their effect on target dosimetric coverage.

Methods and Materials: Respiratory motion traces of 11 lung cancer patients are used to reflect the typical respiratory irregularities. From the entire respiratory motion data, an average respiratory cycle is calculated to represent the corresponding regular motion for the patient. Using the regular motion amplitude, target volume is expanded by the amount of residual motion observed within the gating window and a treatment plan is generated. The target is then subjected to both regular and irregular motions without affecting anatomical topology. Target dosimetry under regular and irregular motion conditions is compared for quantitative evaluations.

Results: The reduction in D_{min} due to irregular motion was less than 1% (4%) for a mean target motion of 1.0 cm (2.0 cm) when no gating technologies utilized. The drop in target D_{min} increased as the shorter gating window sizes are implemented. For gated treatments with 50% duty cycle, largest change in D_{min} was 2% and 9% for 1.0 and 2.0 cm mean target motions respectively. More importantly, gated treatments were observed to undermine target dosimetry in cases where the synchronization between the target motion and the external respiratory signal doesn't stay constant as observed by other investigators. Within the parameter space investigated here, up to 35% reduction in target D_{min} was observed.

Conclusion: Being a more aggressive treatment strategy, respiratory gated treatments were observed to be more susceptible to dosimetric uncertainties as compared to traditional delivery techniques in presence of irregular respiratory motion.