AbstractID: 6904 Title: Impact of Respiratory Motion on Helical Tomotherapy Dose Delivery: A Phantom Study with 3-D Volumetric Dose Measurements

Purpose: To investigate the impact of respiratory motion on helical tomotherapy dose delivery with 3D volumetric dose measurements.

Method and Materials: Two helical tomotherapy plans were generated for a polystyrene box phantom with simulated target and critical organs using different filed width. Respiratory motion was simulated by a sinuosoidal motion of 15mm longitudinal and 5mm lateral ranges at 15cycle/min. Tight longitudinal and transverse motion margins of 7mm and 3mm, respectively, were used to expand CTV to PTV. Each plan was delivered to the phantom with and without motion for various numbers of fractions for a total of 16 factions. 3D volumetric doses were measured with films in the transverse planes every 6mm throughout the phantom. These volumetric doses were imported to a treatment planning system for analysis. Dose distributions and Dose-volume-histograms were compared between the plans and the measurements as well as between measurements with and without motion. V_{98}, and V_{100} were also examined for the CTV and PTV.

Results: The doses delivered to the stationary phantom agreed with the treatment plan. The dose delivered to the moving phantom maintained the general shape of the dose distribution in the treatment plan but was affected by the motion. At some spots, the dose discrepancy between deliveries with and without phantom motion could be up to 20%. Dose distributions and DVHs showed that dose coverage to the PTV was noticeably compromised. In some cases, V98 was reduced by over 7% and V100 over 9% compared to those of stationary phantom measurements. However, the coverage of CTV remained as good as the plan and the stationary measurement, with practically no change in V98 and V100.

Conclusion: Respiratory motion can cause significant dose error in helical tomotherapy. However, adequate motion margins on the target can substantially reduce the motion effect on target dose coverage.