

AbstractID: 10858 Title: Study of the variability of the dosimetric outcome produced by patient organ-movement and dynamic MLC delivery with focus on intra-fraction effects

Purpose: The study of the variability of the dosimetric outcome produced by patient organ-movement and dynamic MLC delivery with focus on intra-fraction effects. During IMRT delivery, different amounts of radiation will be delivered to different phases of the breathing cycle. If no intra-fraction effects are present then all phases should get approximately equal doses. However, if intra-play is present the dose maps for each breathing phases should yield distinct dose volume histogram (DVH) maps.

Materials & Methods: A Monte Carlo (MC) algorithm based on DPM was used to calculate dose for a group 3 lung cancer patients. The time dependence was incorporated into the MC code by correlating the MLC leaf-sequencing motion with the patient organ movement. The organ motion pattern was obtained with the use of the RPM signal and 4D-CT. A voxel displacement map is used to quantify the motion of the organ in the voxelized geometry.

Results: When accounting for temporal effects comparison between dose distributions for free breathing, inhale and exhale phases show that dose coverage of the primary/secondary tumors was significant worse in the inhale phase relative to the exhale/free-breathing phases. For inhale phase, more than 5% of the volume was receiving several Gray less than in the exhale or the free breathing phases, leading to large cold spots inside the tumor. This is a consequence of the motion of the diaphragm, where superior-inferior of 2 cm is observed.

Conclusions: Intra-fraction effects between organ movement and MLC leaf motion can lead to under- or over- dosage of the ITV region. If IMRT treatment is gated, however, then the interplay effect can be reduced but not eliminated. This work was sponsored by NIH grant R01-CA 111590.