AbstractID: 1232 Title: Interference between dynamics of intra-fractional organ motion and segmental MLC-IMRT delivery for motion-pattern-based 4D IMRT

Dosimetric differences between planned 4D MLC IMRT treatment designed without considering the interference between delivery and organ motion dynamics and the actual treatment are investigated in a phantom study. The motion-pattern-based optimization uses an index-dose gradient minimization and a large fluid image deformation, which provides voxel-voxel correlation among dose distributions at different motion phases. A moving phantom with 3-cm peak-to-peak motion was optimized for cumulative dose uniformity in target volume using a single beam. The treatment delivery timing information recorded in LANTIS was used retrospectively to compute the cumulative dose received by the moving target. The sinusoidal motion was represented by 15 frames/images. The irradiation of each segment in the motion frames to which it was exposed was computed, and the cumulative dose throughout the motion cycle was analyzed. The intensity map, delivered by seven segments, was verified using MapCHECK on the Siemens Primus accelerator. When the 6.0s motion cycle and 500 MU/min were used to deliver 174 MU (10 Gy), noticeable deterioration of the received target DVH from the planned DVH was observed. The deterioration, however, is largely diminished for weekly dose accumulation. For segmental MLC-IMRT delivery our results indicate that high MU rate, large number of beams, and large numbers of segments might cause noticeable deterioration in daily but not weekly treatment dosimetry when used to deliver motion-pattern-based 4D IMRT. Further radiobiological modeling is necessary to evaluate the clinical impact of daily DVH variation.

The research is partially supported by Siemens Medical Solutions.