AbstractID: 13151 Title: First demonstration of image-based dynamic MLC tracking of a moving target during intensity modulated arc therapy

Purpose: Intensity modulated arc therapy (IMAT) enables efficient and highly conformal dose delivery. However, the dose distribution can be compromised by intrafraction target motion. Dynamic MLC (DMLC) tracking can potentially maintain the planned target dose distribution. The purpose of this study was to use a single kV imager for DMLC tracking during IMAT and to investigate the ability of this tracking to maintain the planned dose distribution.

Method and Materials:A motion phantom carrying a 2D ion chamber array and build-up material with an embedded gold marker was programmed to reproduce eight representative tumor trajectories (four prostate, four lung tumors). For each trajectory, a low and high intensity modulated IMAT plan were delivered with and without DMLC tracking, and the resulting 2D dose distributions were measured. The 3D real-time target position signal for tracking was provided by fluoroscopic kV images acquired immediately before and during treatment. Each kV image was used together with all previous images to estimate the 3D target position and then the MLC leaves were refitted to this estimated target position. For lung, a prediction algorithm was used to compensate for the tracking latency. A 3%/3mm γ-test was used to quantify the discrepancy between the measured dose distributions and a reference dose distribution delivered without target motion.

Results: For the low modulated plans, tracking reduced the mean 3%/3mm γ-failure rate from 32% to 0.2% for prostate and from 14% to 1% for lung. For the high modulated plans, the γ-failure rate reduction was from 17% to 6% (prostate) and from 36% to 11% (lung). The finite MLC adaptation speed was a major cause for the residual γ-failures during tracking.

Conclusion: Image-based tracking with IMAT was demonstrated for the first time. The tracking greatly improved the dose distributions to moving targets.

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