AbstractID: 13283 Title: Investigation of the interplay effect between field segments and tumor motion during VMAT and IMRT delivery

Purpose: The objective of this study is to investigate the impact of the interplay effect between multi-leaf collimator (MLC) sequences and tumor motion in the delivery of lung radiotherapy using both volumetric modulated arc therapy (VMAT) and fixed-field intensity-modulated radiotherapy (IMRT).

Methods and Materials: For 10 patients with Stage I/II non-small-cell pulmonary tumors, a respiratory-correlated four dimensional computed tomography (4DCT) study was acquired. The internal target volume was determined based on the maximum intensity projection 4DCT dataset, and a 3 to 5 mm margin was used for generation of the planning target volume. VMAT and 5-field IMRT (step-and-shoot) plans were generated using Pinnacle^3 SmartArc and direct machine parameter optimization (DMPO), respectively. All plans were generated for an Elekta Synergy linear accelerator using 6-MV photons. A model was developed to simulate the interplay between MLC sequences and target movement during the delivery of VMAT and IMRT, respectively. The 4D dose distributions were calculated using a non-rigid deformable image registration algorithm. Target volume coverage and doses to critical structures calculated using 4D methodology were compared with those calculated using 3D methodology.

Results: For all patients included in this study, the interplay effect was found to present limited impact (less than 0.5%) on the target dose distribution, especially for stereotactic body radiation therapy, in which fewer fractions (3~5) are delivered. The dose to the GTV was slightly decreased on average (1% of prescription) in the 4D calculation compared with the 3D calculation. The motion impact on target dose homogeneity was patient dependent and relatively small. Negligible effects were observed on the doses to critical structures.

Conclusions: Both VMAT and IMRT plans experienced negligible interplay effects between MLC sequence and tumor motion. For the most part, the 3D doses to the GTV and critical structures provided good approximations of the 4D dose calculations.