AbstractID: 9089 Title: Dosimetric effects caused by interplay between MLC-delivery dynamics and organ breathing-motion in IMRT for lung

Purpose: Interplay between IMRT multi-leaf collimator (MLC) delivery and patient's breathing motion can affect the delivered dose distribution. Interplay is the correlated effect between MLC-delivery and organ-motion, due to either MLC motion or initial breathing phase dependence of MLC-delivery. This study investigated the clinical relevance of interplay for lung IMRT plans assuming free-breathing delivery.

Method and Materials: An in-house developed 4D Monte Carlo system was used for patient dose calculations. Three patients with lung carcinoma were studied, where motion-amplitude was 1-2cm. A voxel-displacement-map was used to quantify the non-rigid motion of organs in the CT-geometry. In order to quantify the MLC position relative to the breathing phase, each photon going through the linac head is tagged to indicate the associated breathing phase during which it will enter the patient. 4DCT data was sorted into 6-phases, inhale, exhale, 2 phases from inhale to exhale, and 2 phases from exhale to inhale. The exhale phase was used as reference phase. Interplay effects were studied on a beam-by-beam basis for a treatment in 30 fractions. Different starting initial MLC phases relative to the breathing motion were selected per daily fraction.

Results: The volume of ITV covered by 5-15Gy isodose lines can vary up to 10% relative to the average volume covered per beam over 30-fractions. Organ motion causes in some instances the dose to be primarily delivered to phases close to inhale and in other cases delivered to phases close to exhale, i.e. the reference phase. For hypo-fractionation (10-15 fractions), the volume of ITV covered by 5-15Gy isodose lines can vary up to 12-15% relative to mean volume covered over 30-fractions.

Conclusions: Interplay between MLC-delivery and organ motion can lead to under-dosed regions in the ITV volume.