AbstractID: 12742 Title: Treatment of moving tumors: An inter-modality comparison under realistic clinical conditions

Purpose: To compare the effect of respiration on delivered dose for different treatment techniques under realistic clinical conditions.
Methods and Materials: Twenty MOSFETs were inserted into a soft resin tumor model positioned in a anatomical respiring phantom. The phantom motion was programmed using the trajectory of a real patient. A 4DCT was taken, and treatment plans created using different treatment techniques: Conformal plan (Eclipse), step-and-shoot IMRT (Pinnacle), step-and-shoot IMRT (XiO), dynamic IMRT (Eclipse), complex dynamic IMRT (Eclipse), hybrid IMRT (60% conformal, 40% dynamic IMRT [Eclipse]), VMAT (single arc [Eclipse]), VMAT (double arc [Eclipse]) and complex VMAT (Eclipse). The complex plans were created by artificially pushing the optimizer to give complex MU sequences. Each plan was treated 5 times (10 times for VMAT), each irradiation starting at a random point in the respiratory cycle. The effect of fractionation was calculated by randomly summing the measured doses. The maximum deviation for each point per fraction, and the probability of 95% of the tumor having dose deviations less than 2% and 5% were calculated as a function of number of fractions.
Results: After 5 fractions, measured dose deviations were less than 2% with 95% probability for all plans except the complex IMRT, step-and-shoot IMRT (XiO), complex VMAT, and single-arc VMAT. Reducing the dose rate of the complex IMRT plans to 200MU/min reduced the dose deviations to less than 2%. Dose deviations were less than 5% after 5 fractions for all plans except the complex VMAT plan.
Conclusions: For most treatment techniques, the dose deviations averaged out after several fractions. Treatments with unusually complicated MLC had larger dose deviations. Dose deviations are reduced for IMRT treatments by reducing the dose rate. Using two arcs instead of one is effective for RapidArc treatments.