AbstractID: 9080 Title: Evaluation of Tumor Motion Effects on Dose Distribution for Hypofractionated Radiotherapy of Non-small-cell Lung Cancer

Purpose: Hypofractionated Radiotherapy (HFRT), 1-4(12-30 Gy) fractions of intensity modulated radiation therapy (IMRT) treatments, may be advantageous in treating early-stage non-small-cell lung cancer (NSCLC). But motion of dynamic multileaf collimator (DMLC) leaves relative to respiration-induced tumor motion could cause substantial differences between doses predicted from the planning scan and delivered doses. Such effects average out for conventionally fractionated IMRT (20-40 fractions, 1.8-2 Gy/fx) but must be evaluated for HFRT.

Methods and Material: We performed numerical simulations to investigate effects of respiratory motion on HFRT IMRT of 20 Gy $\times$ 3 fractions. Using the clinical treatment plans and DMLC leaf motion files for 9 NSCLC patients (11 tumors), the planned Clinical Target Volume (CTV) and Gross Tumor Volume (GTV) dose distributions were retrospectively compared with the distributions calculated for simulated periodic motion for amplitudes, periods and directions typical of normal respiration (0.2-1.26 cm, 3-8 sec, superior-inferior and anterior-posterior).

Results: For the largest amplitude (1.26 cm, excursion ~2.5 cm), the average ± standard deviation of the ratio of simulated to planned values of mean dose, minimum dose, D95 and V95 was 0.98±0.01, 0.88±0.09, 0.94±0.05 and 0.94±0.07 respectively for the CTV and 0.99±0.004, 0.99±0.03, 0.98±0.02 and 1.0±0.008 for the GTV. For 0.9 cm amplitude, corresponding ratios were 1.0±0.004, 0.97±0.07, 0.98±0.02, and 0.99±0.02 for CTV, and 1.0±0.004, 0.99±0.05, 0.99±0.01, and 1.0±0.01 for GTV. There was minimal dependence on motion period and initial phases. Graphical dose distributions showed respiration induced broadening of the beam penumbras in the motion direction. More severe effects were seen with intensity patterns that are more highly modulated than typical for clinical NSCLC HFRT fields.

Conclusion: For our IMRT lung cancer HFRT technique, motion effects on target coverage are minimal for amplitudes below 1 cm but could be significant for larger amplitudes, more highly modulated fields and smaller field margins.