AbstractID: 5396 Title: Determination of Beam Margins for SRT/IMRT of Small Lung Cancers Based on Monte Carlo Simulations

Purpose: This work investigates the beam margins used in treatment planning for stereotactic radiotherapy (SRT) and intensity-modulated radiotherapy (IMRT) of small lung lesions based on Monte Carlo (MC) simulations.

Method and Materials: Ninety SRT/IMRT treatment plans generated in a commercial treatment planning system were recalculated using MC simulations with different combinations of beam margin (0 to 18 mm), lung density (0.1 to 0.5 g/cm3) and planning target volume (PTV) (10 to 50 cc) based on the patient geometries built from CT images. Each plan was normalized at D_{95}, of the dose-volume histogram (DVH) so that the comparison between different plans could be made quantitatively in terms of minimum dose (D_{99}) and maximum dose (D_1) in the PTV. The relationship between the beam margin and lung density/tumor size was fitted into modeled functions. The beam margin needed for a particular plan with certain lung density and PTV size can be determined based on the clinical acceptance criteria based on maximum/minimum doses and other normal tissue constraints.

Results: The maximum and minimum doses were found to vary with beam margins, the volumes of PTV and lung densities. The relationships between them have been quantitatively generalized into functions from the simulation data. It was found that the maximum dose decreased with increasing beam margin while the minimum dose increased with beam margin when the beam margin was less than 1.5 cm. The trends were reversed with the increasing PTV volume.

Conclusion: The generalized formulas for maximum and minimum doses can be used for the estimation of the minimal beam margin required in SRT/IMRT for adequate dose coverage for small lung tumors.