AbstractID: 5459 Title: Evaluation of Dose Calculation of SRT/IMRT for Small Lung Lesions Using Monte Carlo Simulations

Purpose: To assess the heterogeneity effect on stereotactic radiotherapy (SRT) of small lung lesions using Monte Carlo (MC) simulations and to evaluate the accuracy of dose calculation in a commercial treatment planning system (TPS) (Radionics, XKnifeRT) for SRT planning.

Method and Materials: Five patients were randomly selected for this study. For these patients, the sizes of the planning treatment volume (PTV) ranged from 4.2 and 36 cc, and the average densities of the GTV and the ipsilateral lung ranged from 0.659 to 0.93 g/cm3 and from 0.244 to 0.358 g/cm^3, respectively. The SRT treatment plans (9 photon beams) for these patients were first generated by the TPS and then recalculated by a MC dose calculation system with the same beam configuration and beam weights as in the TPS. Comparisons between the MC and the TPS calculations were made to assess the differences in isodose distributions, median dose (D_{50}), maximum dose (defined as D_1) and minimum dose (defined as D_{99}).

Results: Dose indices of D_1, D_{50} and D_{99} calculated by the TPS for all patients are found to be significantly larger than those of the MC calculations for the PTV. The degree of dose overestimation by the TPS increases with decreasing target volume and target and ipsilateral lung densities. Specifically, for PTV volume sizes from 36 to 4.2 cc, the dose calculated from the TPS in D_1, D_{50}, and D_{99} are overestimated by up to 24.7 %, 32.3%, and 38.9% respectively.

Conclusions: Although the TPS can produce accurate (3%/3mm) treatment plans for homogeneous geometry and for large target volumes in the lung, for small lung lesions the dose calculated by the TPS can be significantly overestimated due to inaccurate heterogeneity corrections.