

AbstractID: 10389 Title: Monte Carlo-guided improvement of therapeutic ratio in pencil beam dose-based IMRT plans of small tumors in lung

Purpose: IMRT plan optimization commonly uses pencil beam (PB)-based dose calculation with limited inhomogeneity correction, often predicting better target coverage than is delivered for small tumors in lung. We examine using Monte-Carlo (MC) dose calculation to improve the therapeutic ratio for stereotactic body radiotherapy (SBRT) of lung cancer.

Method and Materials: Treatment plans of ten patients (13 tumors) were retrospectively studied, with average GTV and PTV of 13.2cc and 72.3cc. All plans used IMRT with 3-5 6MV coplanar fields per target, generated on an in-house planning system using PB dose calculation with radiological pathlength correction. Initial plans (TPS1) were recalculated with an in-house MC algorithm (MC1), yielding lower PTV and GTV dose indices D05 and D95 relative to TPS1. A second IMRT plan (TPS2) used an objective function that increased the GTV and PTV doses to compensate for the deficit observed in MC1 but using the same normal tissue constraints as TPS1. The new plan was recalculated with MC (MC2).

Results: Although the target dose observed in TPS1 plans is the clinical goal, it is overestimated by the PB algorithm. Average PTV D95 and GTV D95 in MC1 plans are (85±6)% and (92±4)% of those in TPS1 for 13 sites. MC calculation following the second optimization showed target dose indices to be closer to clinical goals: average PTV D95 and GTV D95 in MC2 plans are (98 ±4)% and (102±2)% of those in TPS1. However, target inhomogeneity is higher, with average PTV D05 and GTV D05 of (109±4)% and (104±3)% respectively. Critical normal tissue doses in MC2 were approximately the same as the acceptable values predicted by TPS1.

Conclusion: MC-guided second optimization of PB-based IMRT plans substantially improves target coverage for small lung tumors while maintaining normal tissue constraints. However increased hot spots in tumor require careful clinical consideration.