

AbstractID: 3803 Title: Monte Carlo based retrospective dose calculations for outcomes modeling

Purpose: To improve the dosimetric accuracy of archived lung treatment plans, we use a novel Monte Carlo recalculation method based on pencil beam optimization methods. The impact of the dose corrections on outcome modeling of pneumonitis was assessed.

Methods and Materials: For 189 archived non-small cell lung cancer plans, dose distributions were re-calculated using the VMC++ Monte Carlo code (I.Kawrakow). Nominal input spectra for 6 or 18 MV photons were used; only radiation transport through the patient was modeled, using each patient's pre-treatment CT scan. We derived approximate beam weights and wedge effects with a novel method based on optimization of MC-derived pencil beams: MC and treatment planning results were matched for the water-based (non-heterogeneity corrected) results. Heterogeneity-corrected plans were then produced using Monte Carlo with the derived beam profiles and weights.

Results: The method showed good agreement when compared against a small series of treatment plans using a convolution-superposition dose calculation. For the lung plans, the average absolute differences in metrics of interest (V20, maximum lung dose, and mean GTV dose) between water-based TPS and water-based MC data were 0.5%, 0.9 Gy, and 0.8 Gy; for water-based TPS versus heterogeneity-corrected MC data the absolute differences were greater: 2.0%, 1.8 Gy, and 2.5 Gy (typically heterogeneity corrected dose distributions produced higher dose values). The correlations between V20 and occurrence of pneumonitis for water-based TPS, water-based MC, and heterogeneity corrected MC data were (using Spearman's rank correlation coefficient) 0.13, 0.13, and 0.14 (respectively). For maximum lung dose, the correlations were 0.15, 0.14, and 0.09.

Conclusions: The differences in some metrics (e.g., maximum lung dose) between water-based and heterogeneity corrected data may have a significant impact on modeling treatment outcome. This method could be applied to any multi-institutional data sets for which RTOG format plan archives are available.