AbstractID: 13295 Title: Clinical implementation of Monte Carlo simulation for RapidArc dosimetry verification

Purpose:
The RapidArc technique, which increases the treatment efficiency with reduced monitor units (MU), has been increasingly applied clinically. However, the small isolated fields and the highly irregular field shapes are challenging for conventional dose calculation algorithms employed in commercial treatment planning systems (TPS). Owing to the ability to handle heterogeneity and small fields, Monte Carlo simulation has been recognized as the benchmark method for radiotherapy dose calculation. This study aims to demonstrate the performance of TPS calculation on head and neck, abdomen, and pelvis RapidArc treatments using Monte Carlo simulations.

Method and Materials:
To simplify the simulation process, Monte Carlo dose computation was based on the reconstructed fluence distributions between control points. The dosimetric features of the MLC including rounded leaf ends, intra-leaf transmission and the tongue and groove effect were included in our simulation. Ten RapidArc patients with different treatment sites were recruited for this retrospective study. The dose distributions and the dose volume histograms (DVH) calculated by the Monte Carlo simulations were compared with TPS calculations.

Results:
The isodose comparisons between TPS and Monte Carlo simulation showed good agreement except for the highly heterogeneous region and extremely complex treatment geometry. For the DVH comparison, overall, the mean dose of the PTV calculated by the Monte Carlo agreed with the TPS calculation to within 2%. The dose to the critical organs calculated by the TPS was higher than that by Monte Carlo simulations.

Conclusion:
This study evaluated ten patients treated by the RapidArc technique to demonstrate the performance of the TPS dose calculation for different treatment sites. It is suggested that for the treatment sites with severe heterogeneity, Monte Carlo simulations are necessary.