AbstractID: 13183 Title: Impact of treatment planning optimization parameters on dose painting plans

Purpose: To develop a methodology for creating voxel-based dose painting plans that are clinically deliverable using a commercialized, structure-based treatment planning system (TPS).

Methods and Materials: Uptake data from head and neck patients who underwent [^{61}Cu]Cu-ATSM (hypoxia surrogate) PET/CT scans were retrospectively extracted for treatment planning. Non-uniform voxel-based prescriptions were converted to structure-based prescriptions for compatibility with the TomoTherapy Hi-ART II^{TM} TPS. Optimized treatment plans were generated using fixed pitch, jaw width, and modulation factor delivery parameters. The effects of structure importance, prescription point normalization, iteration number, DVH volume, Min/Max dose, and dose penalty were investigated by varying these constraints one at a time in each plan. Avoidance structures were constrained to clinical tolerances. Quality-volume histograms (QVH) as percent receiving within 5 percent of the prescription ($Q_{0.95\text{-}1.05}$) were used to evaluate treatment plan conformity.

Results: Conformity of the plans to their non-uniform dose prescription was insensitive to the optimization parameters when the prescription DVH constraint and the dose normalization point were set to the mean PTV volume and dose. Plan conformity decreased as the prescription DVH constraint ($Q_{0.95\text{-}1.05}$: 88% vs. 84%) or the normalization point ($Q_{0.95\text{-}1.05}$: 88% vs. 85%) deviated from the means. Plan conformity was also negatively impacted by increasing integral boost doses from 10 Gy to 30 Gy ($Q_{0.95\text{-}1.05}$: 97% vs 78%), decreasing iteration number from 1000 to 100 ($Q_{0.95\text{-}1.05}$: 86% vs 80%), and applying conventional planning strategies ($Q_{0.95\text{-}1.05}$: 88% vs 59%).

Conclusions: This investigation demonstrates the ability of a structure-based TPS to create voxel-based dose painting plans using a relaxed set of optimization parameters and a dose normalization point set to the mean PTV dose. Under these conditions, plan conformity is dominated by few optimization parameters. However, tightening constraints on target structures via conventional planning strategies results in decreased plan conformity.