AbstractID: 11136 Title: Optimizing Spot Spacing and Margin for Intensity-Modualted Proton Therapy Planning

Purpose: For intensity-modulated proton therapy (IMPT), spots (high dose regions around the Bragg peaks of beamlets) for a set of energies are arranged on a grid in the target volume. The spot spacing can have a significant impact on the quality and efficiency of an IMPT plan. The purpose of this research is to optimize spot spacing and lateral margin for IMPT. **Method and Materials:** Multiple treatment plans were generated for a group of prostate patients, varying spot spacing (2.5-10mm) and margin size (0-12mm). All plans employed two opposing fields which were individually optimized for uniform target coverage. Dose Volume Histograms were compared to evaluate rectal sparing and target dose homogeneity. Spot-weight histograms were used to investigate the impact of delivery system constraints on low MUs per spot, on plan quality and robustness, and on optimization efficiency. **Results:** Dose homogeneity decreases with lateral margin size for a given spot spacing, with 5mm spacing showing comparable performance to current treatment protocols (10mm spacing and 12mm margin). Rectal dose increases with margin size and decreases with spot spacing. For small spot spacing and margin combinations, a large fraction of the spots are close to the minimum MU limit for the delivery system. Many of the spots below this limit are discarded during optimization. This effect decreases significantly above about 5mm spacing and margin. **Conclusion:** Lateral margins and spot spacing must be chosen to balance target dose homogeneity against avoidance of critical structures. While decreased spot spacing increases target dose homogeneity and lowers rectal dose, it also results in a large number of low-intensity spots, decreasing plan robustness and optimization efficiency and increasing calculation time. The optimum combination that improves rectal sparing while maintaining comparable dose homogeneity, calculation time, and plan robustness is 5mm for spot spacing with 5mm for lateral margins.