AbstractID: 8689 Title: Is dose rate variation crucial for single-arc radiation therapy delivery?

Purpose: Recent arc therapy techniques such as arc-modulated radiation therapy (AMRT) developed at the University of Maryland and Varian's RapidArc™ allow variable segment-weightings in order to expand the optimization domain. As a result, these plans may require a varying dose rate (DR) for delivery. To evaluate the necessity of DR variation in arc therapy delivery, the variable-DR plans were translated in such a way that they can be delivered with a constant DR.

Method and Materials: Four cases were selected for this study: 1 HN, 1 lung, 1 prostate and 1 brain. A single-arc AMRT plan was generated for each case. Planning of AMRT started with optimization of ideal intensity maps with 36 equi-spaced beams in Pinnacle followed by segmentation of the intensity maps into a deliverable AMRT MLC sequence. During leaf-sequencing, the segment weightings are allowed to vary. In translating variable-DR AMRT plans into constant-DR plans, the angular spacing of the original beams were changed from equi-spacing to spacing according to their weightings. Hence, apertures with more MUs occupy a greater angular range. To account for any field shifting in the process, a field shape correction was applied ensuring proper target coverage.

Results and Conclusion: DVH comparisons show that constant-DR plans were comparable to the corresponding variable-DR plans in 3 of the 4 cases. Significant degradation occurred in the constant-DR plan of the prostate case due to the large MU variations in the original variable-DR plan, causing the beams to deviate significantly from their original positions. The estimated delivery times of the constant-DR plans are 3 to 30 times longer than the variable-DR plans due to large MLC shape variation within a small beam interval. It is hereby shown that DR variation is crucial to AMRT delivery in order to maintain excellent plan quality and efficient delivery time.