AbstractID: 9122 Title: Evaluation of Dosimetric Margins in Prostate IMRT Treatment Plans Generated with Pinnacle DMPO

Purpose: To quantify 'dosimetric margins' existing in prostate IMRT plans generated with Pinnacle Direct Machine Parameter Optimization (DMPO), due to imperfect conformance of the planned dose distribution to delineated targets. To demonstrate that when these margins are accounted for, the van Herk margin framework provides accurate target coverage estimates.

Method and Materials: DMPO was performed on 27 prostate plans with 5mm PTV margins. Setup errors were simulated via fluence convolution and sampling from a systematic error distribution, and resulting dose volume histograms (DVHs) were used to generate van Herk style Dose Population Histograms (DPHs). The dosimetric margin distribution (DMD) is the 3D margin distribution between the clinical target volume (CTV) and the treated volume (TV). Consistent with ICRU guidelines, the TV was the volume enclosed by the planning target volume (PTV) minimum dose isodose surface. Due to imperfect conformance of the planned dose distribution, the DMD can extend beyond the PTV. This creates an additional 'buffer zone' around targets, which can absorb setup and other geometric errors. The DMD was measured by exporting CTV and TVs from Pinnacle as meshes, and measuring collision distances.

Results: DPH analysis showed the DMPO plans could tolerate random plus systematic setup errors having standard deviations (SDs) up to 3mm. Naive application of the van Herk margin formula suggests that 5mm PTV margins should absorb errors with SDs up to only 1.6mm. Coverage calculations based on measured DMDs were in agreement with the DPH analysis: the presence of dosimetric margins allows the prostate plans to absorb larger errors than one would naively expect.

Conclusion: These DMPO results agree with those previously obtained using an in-house optimizer. Both optimizers create similarly large dosimetric margins. Accounting for these margins enables accurate coverage estimates, without the need for simulations. (Supported by NIH R01CA98524 and NIH P01CA116602).