AbstractID: 3864 Title: Planning Target Volumes for Image-Guided Radiation Therapy of Prostate Cancer

Purpose: Image-guided radiation therapy has the potential to reduce the uncertainty in targeting the clinical target volume (CTV) for prostate cancer. This allows a reduction in the size of the planning target volume (PTV). Determination of an appropriate PTV is a non-trivial task. Issues that need to be considered include the magnitude of the uncertainties, the shape of the dose distribution, and the desired treatment goal. This work examines the PTV requirements for image-guided radiation therapy of prostate cancer.

Method and Materials: The effect of geometric uncertainties is modeled to determine appropriate PTV margins. Random uncertainties are modeled as a convolution of the dose distribution, and systematic uncertainties as probability weighted shifts of the dose distribution. PTV margin requirements are examined as a function of the use of image-guided positioning (no correction vs. on-line correction), treatment technique (conformal vs. intensity modulated radiation therapy), and probability of achieving 95% minimum dose to the CTV (95% vs. 99%).

Results: For a 95% probability of achieving the treatment goal, PTV margins of 6-7 mm are required if no correction is performed. The use of on-line position correction reduces the required margin to 1-2 mm. Achieving the treatment goal with 99% probability requires >10 mm margins with no corrections, while 2 mm margins are sufficient with on-line corrections. The use of conformal vs. IMRT techniques has minimal impact on the required PTV.

Conclusion: The results suggest image-guided on-line positioning correction allows substantial reduction of PTV margins. Achieving specific treatment goals with a very high level of confidence may be impossible without on-line corrections. Since patient positioning and internal organ motion may no longer be the dominant sources of uncertainty when on-line corrections are performed, these results should be interpreted cautiously until factors such as intrafraction motion are incorporated into the analysis.