

AbstractID: 8486 Title: Radiobiologically Quantified Treatment Setup Uncertainties based on Megavoltage (MV) CT Imaging

Purpose: To evaluate and compare the expected effectiveness of the planned and delivered dose distributions in prostate cancer radiotherapy. The average setup uncertainties were determined by using the on-board megavoltage computed tomography (MVCT) capabilities of the tomotherapy HiArt unit.

Materials and Methods: Co-registrations between daily MVCT and planning CT were used. Before the delivery of each treatment an MVCT image was acquired. The therapists registered the MVCT image with the planning kilovoltage computed tomography (kVCT) images. The registration criteria were based on bony anatomy and contoured regions of interest. For a typical prostate cancer patient the dose distributions of the Helical Tomotherapy plan and that of the average shifted delivery registration were used. The dose distributions were compared based on dosimetric criteria and the biologically effective uniform dose (BEUD) together with the complication-free tumor control probability (P_+).

Results: The average shifts that were observed are 10.7 mm for the vertical, 4.0 mm for the longitudinal and 0.5 mm for the lateral directions, respectively. At the optimum dose levels of the planned and delivered dose distributions, the P_+ values are 84.7% and 84.0%, respectively. The total control probabilities, P_B are 93.0% and 92.9%, whereas the total complication probabilities, P_I are 8.3% and 8.9%. More specifically, the response probabilities of the different tissues are 95.6% and 95.5% for the GTV, 97.4% and 97.3% for the seminal vesicles, 0.8% and 0.7% for bladder and 7.6% and 8.3% for rectum.

Conclusions: It is shown that the intra-fraction movement of tumors can be reduced by using the MVCT co-registration. This appears to be a powerful tool, which can result in improved sparing of critical structures, while delivering high doses to the target. The use of P_+ – BEUD diagrams to compare similar treatment plans may show that in radiobiological terms they may be quite different.