

AbstractID: 10825 Title: Calculation of cumulative dose for daily CT-guided prostate irradiation using deformable image registration

Purpose: To calculate the cumulative dose actually delivered to prostate cancer patients treated with daily image-guided radiation therapy (IGRT) and to quantify differences between planned and delivered doses to determine the need of better adaptive strategies.

Method and Materials: Daily kV CT data, acquired for ten prostate cancer patients treated with daily IGRT repositioning based on soft-tissue registration on a CT on Rails (CTVision, Siemens), were analyzed. The dose actually delivered at each fraction was reconstructed by applying the original plan to the daily CT considering the repositioning shifts performed. Each daily CT was deformably registered to the plan CT using a newly developed deformable image registration tool. The resulting deformation field was used to map the delivered daily dose onto the planning CT. The cumulative dose over all treatment fractions was calculated and compared with the planned dose.

Results: Accumulated prostate dose is consistently lower than the planned dose. For example, prostate D100 and D95 were reduced by 0.1-6.6% and 0.3-1.2%, respectively, as compared to their planned values. The variation in cumulative dose is reduced as the treatment progresses. The rectum had the largest and most erratic volume disparity, leading to frequent overdosing (mean dose increasing up to 11%). The bladder delivered dose is more likely to be an under-dose.

Conclusion: The cumulative doses actually delivered to the prostate, rectum and bladder are different from their planned values, even with the soft-tissue-registration based daily repositioning, the most accurate IGRT, indicating a better adaptive strategy, such as re-planning, is required to account for interfraction anatomy variation observed in certain treatment fractions/patients.