AbstractID: 9504 Title: Biologically Based Corrections for Interfraction Variations During Prostate Cancer Radiation Therapy

Purpose

The linear-quadratic (LQ) survival model is used to calculate the doses required to correct for interfraction deviations from the planned doses arising from patient setup errors, organ deformation and organ movement after multiple daily fractions. Corrected dose distributions derived from isosurvival (biological) and isodose (physical) methods are compared to planned dose distributions for a representative prostate cancer case.

Methods

Voxel-by-voxel interfraction deviations from a planned prostate cancer treatment delivered using image-guided intensity modulated radiation therapy (IG-IMRT) with a linac and CT-on-Rails combination (CTVision, Siemens) are determined using the XiO treatment planning system by CMS and an in-house image deformable registration tool based on the CT-of-the-day for multiple days. Dose distributions needed on the n^{th} treatment day to correct for the accumulated interfraction variations in previous fractions are determined using methods expected to produce the same surviving fraction in all regions of diseased and normal tissue as the planned treatment.

Results

After completing a series of 5 planned fractions of 1.76 Gy, dose corrections derived from the biological modeling ranged from a low of 1.391 Gy (reduced by 27%) to a high of 2.652 Gy (increased by 51%) in some regions of tissue. Dose corrections derived from isosurvival modeling always yields smaller corrected doses than isodose methods, although the differences in the two methods are nearly indistinguishable for planned doses ~ 2 Gy per day.

Conclusion

Doses required to correct for interfraction variations accumulated on multiple treatment days are smaller for isosurvival (biological) methods than for isodose (physical) methods. In the limit when the planned fraction size is small compared to α/β, interfraction corrections to dose distributions derived from the physical and biological methods are indistinguishable. For hypofractionated treatments, dose corrections derived from isosurvival modeling may be substantially smaller than the ones derived from isodose methods.