ABSTRACT

PROSTATE INTRAFRACTION MOTION ASSESSED BY SIMULTANEOUS KV FLUOROSCOPY AT MV DELIVERY

by

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August 2009

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Major: Medical Physics

Degree: Doctor of Philosophy

Purpose: To investigate the use of a gantry mounted kV imager for prostate intrafraction motion measurement during simultaneous dose delivery. **Materials & Methods:** We developed an algorithm to register fluoroscopy images with reference images of implanted fiducials derived from daily CBCT. We investigated the relationship between imaging dose and 2D registration accuracy for fiducial localization with and without the presence of MV contamination. Prostate motion during radiotherapy was simulated using existing cine-MRI measurements, and was used to evaluate various techniques to estimate a 3D prostate trajectory from 2D localizations. Motion was measured for each fraction of 22 patients receiving hypofractionated IMRT, and was used to: (1) investigate the ability of pre- and post-treatment CBCT to predict intrafraction motion, (2) describe motion characteristics and their dosimetric effects, (3) evaluate adaptive strategies for intrafraction motion management after online correction for interfraction motion. **Results:** With fractional imaging

dose being 2mGy (~10% of a CBCT acquisition), fiducials were localized at each beam with error <1mm for 95% of registrations. Images acquired during MV dose delivery require increased mAs to obtain equal accuracy, with mAs/registration increasing roughly linearly with field size and dose rate. 3D error was <1.5mm for 95% of localizations when the 3D trajectory was assumed to be the shortest path satisfying all 2D localizations. Rectal filling status from volumetric imaging was a significant predictor of prostate intrafraction motion, and probability of motion increased with treatment duration. After online correction of interfraction motion, the overall probability of a 3mm and 5mm prostate displacement during treatment delivery was 30% and 10%, but ranged from 1%-94% and 0%-59% for individual patients. With 3mm margins, reduction in CTV D_{99} was ≤5% for ~95% of patients (21/22), but was 15.3% for the one exception and was apparent after 5 fractions. Adaptive strategies including prediction and correction of patient specific systematic error and patient specific geometric margin calculation are feasible. **Conclusions:** Prostate intrafraction motion evaluation using kV fluoroscopy during dose delivery can be performed accurately with low dose, and is useful for adaptive management of intrafraction motion after online correction.