

Purpose: To study how important it is to consider organ deformation under volumetric image guidance. Two questions were answered: 1) how much residual misalignment exists after rigid-body image registration; and 2) what is the dosimetric impact if deformations are ignored by simply shifting the patient.

Methods: 10 CTs were acquired on non-consecutive treatment days for 20 patients receiving radiation therapy of their prostate cancer under an IRB approved protocol. One physician contoured the prostate, rectum and bladder for all scans. To answer the first question, after rigid body registration of each image set acquired during the course of treatment with the planning CT, we measured the distance between the prostate boundaries along the three axes. For the second question, we copied the original plan with the shifts determined by rigid-body registration and compared with re-optimized plans based on the images of the day. Plan optimization was performed using the same dose and dose-volume constraints in the initial planning.

Results: 10 patients were analyzed so far. Because these mismatches were measured after rigid-body registration, they were indicative of the prostate deformations during therapy. The mismatches varied widely among patients. The results were similar to that reported by Deurloo et al [1]. The largest deformation was seen in the A/P direction of patient 3, with a mean of 5.2mm and a standard deviation of 2.3 mm.

For most cases with small target deformation, shifting the patient produces similar plans as re-optimization. In cases where there were substantial organ deformations, the plans resulting from translation were much worse than the re-optimized plan.

Conclusion: Simply shifting the patient can be far from optimal. An IGRT scheme that can handle both translations and deformations is desired.

[1] Deurloo KE, et. al. Int J Radiat Oncol Biol Phys. 2005;61(1):228-38.