

Purpose:

To measure the dose decrement to the prostate caused by daily prostate motion and to correlate target coverage with prostate rotations to establish individualized rotational tolerances and PTV margins.

Methods:

Real-time tracking data for 26 patients were obtained during RT and used to calculate "average" prostate rotations and translations. For each patient, IMRT treatment plans meeting RTOG0126 dosimetric criteria were created with 0, 2, 3, and 5 mm PTV margins. Daily translations and rotations were used to calculate prostate delivered (dynamic) dose from the planned (static) dose. Dose volume histograms, D95, and V79 are computed from the dynamic dose to evaluate the coverage and the adequacy of PTV margins under measured target motion. The intra-fractional effective rotations of the prostate (rotations weighted by rotation lever arm and prostate geometrical shape) were obtained for each patient.

Results:

Large variations in dosimetric coverage were seen among patients. Adequate coverage to target was met in 39%, 65%, and 84% of the patients for plans with 2, 3, and 5 mm PTV margins, respectively. This dosimetric coverage could not be correlated with measured rotations for any of the PTV margins. Prostate shape and the length of rotation lever-arm were parameterized and used to obtain effective rotations from the measured rotations. Clear correlations were seen between effective rotations and the prostate delivered dose.

Conclusions:

Prostate rotations, if left unmanaged, could cause significant underdosing to the target even if daily translational tolerances applied and a 5 mm PTV margin is used. Unlike translations, effective management of prostate rotations requires individualized rotational tolerances due to variations in prostate shape and rotation lever-arm length among patients. Consequently, individualized rotational tolerances enable PTV margins to be individualized.