

**Purpose:** To determine dose errors inherent in assuming that dose is fixed in the accelerator coordinate system for image guided planning of prostate cancer.

**Methods:** A 17 prostate patient cohort with 8-13 isocentrically aligned CTs/patient are used. For each patient, a 79.2 Gy, 18 MV, 7 beam IMRT plan is developed on the first/primary image reliant on RT0G 0126 objectives. Dose on the remaining images is evaluated in two ways: (A1) Dose is recalculated on each image. (A2) The planned/primary dose distribution is copied to each image. A2 assumes dose is invariant in the accelerator coordinate system. Effects of patient miss-alignment are simulated by evaluating dose with 27 patient shifts per image; 0 and  $\pm 5$ mm in left-right, anterior-posterior and superior-inferior directions. Per-image dose differences and dose-volume metrics (prostate-D90, bladder- and rectum-D25) are used to compare A1 and A2. With no shifts, 4D dose accumulated over all images is compared.

**Results:** The per-image root-mean-square-error percentage error (RMSPE) between A1 and A2 over all shifts and all patients is 1% for prostate-D90, 1.5% for rectum-D25, and 4.6% for bladder-D25. For accumulated dose, the RMSPE values are prostate-D90=0.7%, rectum-D25=12.0% and bladder-D25=0.7%. 4 out of 17 patients had large variations. Excluding those patients RMPSE reduced from 12.0% to 3.0%.

**Conclusions:** For the patient cohort studied, assumption of shift- and deformation-invariant dose distributions on average introduces <2% error in evaluated dose-volume metrics in case of prostate and rectum. Further study is required for the bladder. Use of invariant dose distributions has a potential to reduce online re-planning time and permit pre-planning based on tissue deformation models. (Supported by NIH 5P01CA116602).