Purpose

Using an on-board cone-beam CT (CBCT) based statistical margin model to determine whether a prostate center-of-mass (COM) based translation correction procedure can significantly reduce the CTV-to-PTV margin required for prostate patients who were first setup based on skin/alpha-cradle markers (SAM).

Methods and Materials

A total 110 CBCT scans were performed, daily in the first week of radiotherapy and once weekly afterward, for 10 prostate patients immediately after their clinical setup based on SAM. Soft tissue matching was used to estimate the required translation corrections by matching the COM of the observed prostate volumes on treatment planning CT and CBCTs. Based on the CBCT prostate volumes, a statistical model (Bayesian margin expectation model) provided patient specific optimal margins before and after a prostate COM based translation correction was added to the patient SAM based setup. We compared these margins to determine the efficacy of prostate COM based translation correction when it is added to the SAM based setup.

Results

After the 5 daily CBCTs from the first week, all 10 patient prostate uniform margins for 95% tumor geometric coverage were reduced after applying the prostate COM based translation correction to their SAM based setup. However, the percentage reduction varied from patient to patient, ranging from 1% to 60% with a median value of 22%. In 4 of 10 patients, margin reduction greater than 4mm was obtained. In general, patients with more deformable prostates benefited less from COM translation. Beyond the first 5 CBCTs, very little further margin change was obtained.

Conclusions

The addition of prostate COM based translation correction to SAM based setup did reduce the uniform margin required to achieve 95% tumor geometric coverage, but the extent of reduction was patient specific. In general, incorporating COM translation in prostate margin determination can help reduce bladder/rectal doses.