



A Comparison of Rectal Spacer vs Fiducial Marker-Based Image Guidance for Prostate Stereotactic Body Radiation Therapy

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Objectives: Cone beam CT (CBCT) matching to implanted fiducial markers (FM) is a standard method of image-guided radiation therapy (IGRT) for prostate stereotactic body radiation therapy (SBRT). Rectal spacers (RS) are often concurrently placed with FM and may allow for significant rectal dose reductions. Recently, the introduction of radiopaque iodinated hydrogels has improved the CBCT visibility of RS. Limited data evaluate the utility of radiopaque RS for prostate IGRT. We sought to compare CBCT registrations based on FM or RS in patients undergoing prostate SBRT. We hypothesized that these IGRT strategies would result in comparable patient registrations.

Methods: Ten eligible patients were retrospectively identified and received prostate SBRT at an academic center from 2021-2022. All patients underwent transperineal placement of 3-4 FM and a radiopaque RS. Patients were treated with standard CBCT matching to FM without intrafraction monitoring and were instructed to have a comfortably full bladder and empty rectum prior to simulation and treatment. Two hypothetical pre-treatment CBCT registrations were then compared for each SBRT fraction, one matching to FM, and another matching to the RS. Differences between translational and rotational shifts were calculated. Rotational corrections for pitch, yaw, and roll were separately limited to $\leq 2.9^\circ$. All registrations were evaluated by a radiation therapist, dosimetrist, and the treating radiation oncologist (RO). Descriptive analyses and a paired t-test were performed to compare the two registration methods.

Results: All patients were diagnosed with intermediate-risk prostate cancer and received curative-intent prostate SBRT prescribed to 40 Gy (CTV) and 36.25 Gy (PTV) in 5 fractions. Adequate visualization of the FM and RS by CBCT was achieved for all 50 SBRT fractions. The mean absolute differences of vertical, longitudinal, and lateral translational shifts for the two registration methods were 0.83 mm (range: 0-2.7 mm), 0.69 mm (range: 0-1.9 mm), and 1.7 mm (range: 0.1-4.6 mm), respectively. All vertical and longitudinal shifts and 88% (44/50) of lateral shifts were within ± 3 mm. The mean absolute differences of pitch, yaw, and roll for the two registration methods were 1.97° (range: 0-5.7 $^\circ$), 1.45° (range: 0.1-3.5 $^\circ$) and 1.53° (range: 0-4.0 $^\circ$), respectively. The mean of the absolute sum for all rotational corrections was greater for RS- vs FM-based registrations (5.4° vs 2.9° ; $P < 0.0001$). All FM-based registrations compared to 98% (49/50) of RS-based registrations were deemed clinically appropriate by the treating RO.



Conclusion(s): CBCT matching to FM or a radiopaque RS appear to be comparable IGRT strategies for prostate SBRT; however, total rotational corrections were significantly greater with RS-based registrations. The presence of a radiopaque RS may improve CBCT visualization of the prostate/rectum interface and supplement standard FM-based IGRT strategies for prostate SBRT.

