AbstractID: 10535 Title: In vivo Detection of the Anterior Rectal Wall using a Scintillation Fluid-filled Rectal Balloon for Prostate Cancer Radiotherapy

Purpose: The prostate and the anterior rectum interface is perhaps the most important landmark but the most difficult soft tissue region for localization in image-guided procedures. The goal of this study is to utilize the detection of rectal dose as a surrogate for anterior rectal wall (ARW) localization for daily prostate patient set-up without using an imaging method.
Methods: In this study, we designed a sweeping MLC beam to scan the anterior-posterior (AP) prostate-rectum interface from the lateral directions. The dose response from the inside of rectum will be measured using liquid scintillator and associated fiber optics. To validate our design, a 3mm wide lateral MLC segment was designed to move across the prostate-rectum interface, and the mean rectal dose was calculated for each position in 8 prostate cancer patients with endorectal balloon immobilization and daily CT image sets. Then the dose-position response curve was measured daily and fitted to the reference relationship to determine the shift which best reproduces the reference dose-position relationship relative to the isocenter. To validate this method, the predicted alignments using the dose-position relationship were compared with the manual AP alignment of the ARW using our in-house CT registration software. Feasibility of the sliding segment technique was tested in an IMRT phantom fitted with a cylindrical liquid scintillator filled tube, optic fibers, and photodiode for current generation and detection.
Results: The mean agreement of the dose-calculated alignments and the manual image registration was 0.76 millimeters. The primary source of uncertainty was the variation in the insertion of the endorectal balloon. Measured signal increased monotonically with beam position within the rectum and rectal dose.
Conclusion: *In vivo* detection of the ARW is feasible without an on-board x-ray imaging technique to achieve better alignment to anatomically important soft tissue structures.