AbstractID: 14049 Title: A comparative study for daily localization with 3D ultrasound, cone beam CT, implanted prostate fiducial markers and Calypso 4D localization system for patients undergoing IGRT for prostate cancer

Purpose: To assess the accuracy and dosimetric implications of multi-modality, online image-guided localization methods, including intra-modality 3D prostate ultrasound, cone beam CT (CBCT), implanted prostate markers and Calypso 4D localization for patients undergoing external beam radiation treatment with IMRT for prostate carcinoma.
Materials and methods: Fifteen prostate cancer patients were imaged using IGRT techniques using the following daily imaging sequence: CBCT, kV orthogonal x-rays of implanted fiducial markers using the On Board Imager (OBI) on a Varian Trilogy TX linac (Varian Medical Systems, Palo Alto CA), perform patient shifts based on ClarityTM intramodality 3D U/S-IGRT system (Resonant Medical Inc., Montreal, Canada) per an IRB-approved protocol, kV x-rays (post patient-shift), and Calypso 4D Localization System (Calypso Medical, Seattle, Washington) for intrafraction motion monitoring, finally treat patient. Residual motion was assessed from differences between kV images of marker positions performed prior to and after U/S-based shifts. Dosimetric differences were evaluated by computing treatment plans using the average shift values generated by the image-guided localization methods.
Results: The anterior – posterior direction had the largest recorded average shifts, overall being less than 7 mm. Most (65%) of the average shifts calculated between the various IGRT modalities were within 3 mm of each other, and the rest within 3 - 7 mm. Changes in inter-fiducial distances between simulation and treatment were found to be on average 1.5 mm (maximum of 5.8 mm). Possible causes are rotations, migration and/or prostate size/shape changes. DVHs for the rectum, and bladder show in some instances significant increases in dose received when measured setup shifts were included.
Conclusion: The comparison of multi-modality IGRT techniques is subject to many uncertainties, including prostate intrafraction motion (89% within 3 mm range), changes in the prostate position due to bladder/rectal filling during the time between image acquisitions, and migration of fiducial markers.