

Purpose: To evaluate two ultrasound (US) systems for prostate localization using fiducial markers assessed by electronic portal imaging (EPI) and to determine the size of planning target volume (PTV) margin using novel strategies of US guidance.

Methods: We evaluated SonArray (Varian Medical Systems, Palo Alto, CA) and Restitu (Resonant Medical, Montreal, QC) US systems. SonArray compares daily US images to treatment planning CT image while Restitu compares daily US images to the US simulation image acquired at the time of CT simulation. 27 patients had 3 fiducial markers implanted in the prostate for localization. Daily US using the Restitu (n=13) and SonArray (n=14) systems were acquired followed by EPI (anterior and lateral) for localization using fiducials. For each patient, twenty image pairs of 3DUS versus EPI were evaluated. Shifts in the anterior-posterior (AP), superior-inferior (SI) and lateral (ML) directions were compared using 3DUS vs. fiducial markers. We determined the PTV margins by simulating US shifts and evaluating with fiducial markers.

Results: AP direction exhibits the highest correlation ($R^2 = 0.78$) for the SonArray system. In comparison, the Restitu ultrasound shifts demonstrate a greater correlation in both the LR and SI directions and is comparable in the AP direction ($R^2 = 0.71$). Inherent systematic errors were detected in the SI direction of 3mm for both US systems. Both US systems report shifts larger than that from fiducial markers. PTV margins can be reduced from 1cm isotropic to 7.5mm isotropic margins for both SonArray and Restitu if we only shift patients in the AP direction and correct the setup error only down to 3 mm.

Conclusions: A correction shift threshold down to 3mm is recommended in the AP direction only. Daily US image guidance permits the use of smaller PTV margins.