AbstractID: 10899 Title: Interfraction dose variation resulting from anatomic deformation in CyberKnife prostate radiosurgery

Purpose: Radiosurgery dose distributions in the prostate are often characterized by tight margins and high dose gradients, increasing the negative consequences of beam misalignment. Tumor targeting based on the location of fiducial markers will not always account for deformation in the prostate and the surrounding tissue. Partial misalignments associated with these deformations may cause nearby critical structures to receive a much higher dose than intended. We have performed a pilot study evaluating the dosimetric consequences of fiducial-based tracking in CyberKnife radiosurgery of the prostate.

Method and Materials: A prostate radiotherapy patient image set containing implanted Calypso seeds was used to generate a CyberKnife radiosurgery plan using an HDR-emulating 38 Gy prescription. The dose distribution from the planning image was rigidly transformed to a series of daily CT scans based on fiducial locations. The resulting DVH for prostate, rectum, and bladder were compared.

Results: When measured with respect to the planning image, fiducial locations on the daily treatment images exhibited a range of roll, pitch, and yaw of 4.5^{o}, 9.6^{o}, and 2.1^{o}. Dose coverage of the prostate was generally degraded in the daily images, with a reduction of mean dose between 1.5 and 4.0%, and a reduction in target coverage from the prescribed 95% to as low as 88.4%. The maximum dose to the bladder and rectum varied over a 32% and 33% range, respectively. Most of the hotspots in the daily images were lower than those found in the planning image. Conversely, generating a plan on a daily image and transforming it to the planning image increased the maximum dose to the bladder and rectum by 13% and 24%, respectively.

Conclusion: Deformation near the prostate is not always well modeled by the locations of implanted fiducial markers, and this can lead to significantly higher doses received by neighboring critical structures.