AbstractID: 3963 Title: An accurate method for determining prostate shift and rotation using portal images with implanted fiducial seeds

Purpose: Portal imaging of implanted fiducial seeds is widely used for setup verification of conformal radiotherapy for prostate cancer. Isocenter shift is usually determined by the shifts of two imaging fields required to align the fiducials to their planned positions. Due to prostate rotation, deformation and seed migration, it might not be possible to satisfactorily align the fiducials. We describe here an accurate image-processing method to determine the isocenter shift and prostate rotation using three fiducial seeds.

Method and Materials: Two portal images were obtained using anterior-oblique beam angles for clear seed imaging. The center of a portal image was determined by field edges. The images were enhanced for seed identification by filtering operations. The 3-D coordinates of the seeds were determined considering their physical dimensions and the signal strength of processed images. The three seed-to-seed distances were checked to avoid using a migrated seed for setup verification. The Triad algorithm was used to find the rotation of the plane of the three seeds to make it exactly parallel to the reference seed plane. The seeds were then shifted and rotated about the common normal vector to the seed plane by iterations for a least-square fit of imaged and planned seeds.

Results: The method was tested on 10 cases with daily portal images. The largest isocenter shift and seed plane rotation were 2 cm and 13 degrees, respectively. The isocenter shifts determined by aligning the seeds on individual images with split differences led to larger than 2 mm errors. The seed-to-seed distance was reduced on average by 3-4 mm, indicating the prostate was shrinking during the treatment.

Conclusion: An accurate method was developed for determining the shift and rotation of the prostate using portal images, in order to minimize the errors due to lacking the 3-D correlation of fiducial seeds.