Validity of accuracy of tumor targeting using Bony Landmark Fusion or Surrogate Markers inside Prostate

Purpose

Two of the most commonly used IGRT techniques are: 1) bony landmarks, 2) implanted markers. Because neither of these methods take into account the actual positions and shape of the target at the time of treatment, they serve as a surrogate to the interfractional movements of the target. In our department, we have used in room CT in combination with linear accelerator for IGRT since year 2000. Over 400 patients and 3000 pre-treatment CT scans have been collected. We selected 10 patients with multiple intrinsic calcifications in the prostate glands for this study. The intrinsic prostate calcifications function like implanted makers, except without migrations. By retrospectively analyzing 144 CT scans, we gained insight into the accuracy and validity of the two of most commonly used methods of IGRT.

Methods and Materials

10 patients with significant calcification in their prostate were retrospectively reviewed. Each patient was imaged via CT-on-rails for 15 fractions. A total of 144 valid scans were compared against their planning CTs. The method of CT-guided IGRT has been descibied previously. Using the CT scans obtained, we correct for the daily set up errors using two methods:

1) Bony Landmark Fusion (BLF)—the Pinnacle Syntegra® system is utilized to automatically match the anatomy.
2) Intrinsic calcification (CF)—all ten of these patients had multiple intrinsic calcifications scattered at different parts of the prostate glands. As such, their properties are similar to that of implanted fiducial markers. The CT data were manually fused by matching the calcifications.

After applying both types of registrations, we examine how much the prostate gland is still varied from the planned isocenters.

Results

In the lateral directions 13% and 3% shifts measured with BLF were off more than 3 and 5 mm respectively when the actual positioning is reviewed with the CT scans. For the CF group, 21% and 4% were off more than 3 and 5 mm respectively against those measured with MPF.

In the AP direction, for the BLF group, 38% and 19% were off more than 3 and 5 mm respectively. For the CF group, 26% and 10% were off more than 3 and 5 mm

resectively. In the SI direction, for the BLF group, 19% and 10% were off more than 3 and 5 mm respectively. For the CF group, 26% and 9% were off more than 3 and 5 mm respectively.

Conclusions

Although bony landmark fusion and fiducial markers are straightforward and quick to be performed, our data indicated that both methods may miss the ‘corrected isocenter’ by 3mm or more for a substantial number of patients. Dosimetric considerations of these variations will be presented in the conference. Our data further implied that accurate and clear images of the prostate gland and normal tissue is a pre-requisite for performing IGRT.