

AbstractID: 6640 Title: Onboard CT imaging quality and its effect on online patient positioning correction on TomoTherapy and Elekta Synergy platforms

Purpose: To evaluate online imaging quality of implanted prostate gold markers on two clinical image-guided radiation therapy (IGRT) platforms – TomoTherapy HI-ART and Elekta Synergy, and its effect on online patient registration accuracy in a typical IGRT workflow.

Methods and Materials: Currently, our institution has two IGRT platforms in clinical use – TomoTherapy HI-ART (Madison, WI) and Elekta Synergy (Elekta AB, Sweden). In external beam prostate treatment, 3 gold markers (Best Medical International, Springfield, VA) are implanted to help locate prostate on daily pre-treatment CT scans, in order to register patient with corresponding planning CT images and then perform online positional correction. However, because of very small physical dimensions of the implanted markers and their high Z material, there could be significant image reconstruction artifacts and geometrical distortions on either TomoTherapy's helical Megavoltage CT (MVCT) or Elekta's XVI kilovoltage cone-beam CT (CBCT) images. As a result, accuracy of patients' inter-fractional online position adjustment based on registering prostate markers could suffer. In this work, we systematically investigate this issue. First, we use a home-made prostate marker-solid water phantom to evaluate reconstructed image artifacts and geometrical distortion on both IGRT platforms. Then, we carefully exam the process and results of patient online position correction by registering pre-treatment MVCT/CBCT images to corresponding planning CT images, using both phantom images and patient images.

Results: On both IGRT systems, significant image reconstruction artifacts and geometrical distortions of the gold markers were found on both the phantom images, and the patient pre-treatment CT images. However, the effect of this imaging quality problem on the accuracy of patients' inter-fractional online position adjustment was found to be relatively small – both on phantom setup and patient daily online registrations. Findings are discussed in details and its meanings to general IGRT procedures are discussed in depth.