AbstractID: 11760 Title: Evaluation of 4DCT and Soft-Tissue Registration in the Clinical Process for SBRT Patient Treatment

Purpose: Soft-tissue-based registrations are routinely performed for 3D alignment in SBRT. One approach often reported is to perform registration of the ITV (reconstructed over multiple phases of a 4D-CT) with the daily, free-breathing CBCT, using first bony-landmark alignment followed by soft-tissue matching. As the ITV and free-breathing CBCT target volumes are both spatially and temporally different, alignment of them to determine daily shifts is questionable. We performed a study to compare the 4D-ITV with the free-breathing CBCT target volume to assess the extent of differences in these volumes, ultimately to determine whether soft-tissue matching is beneficial or desirable.

Method and Materials: Free-breathing helical and 4D-CT scans (4 phases sorted retrospectively) were acquired on a Philips, 16-slice 4D-CT scanner. KV-CBCT scans were then acquired on the treatment unit using the on-board-imager. 3D/3D auto matches (between the CBCT and ITV) were performed analogously to daily setup for SBRT patients. Multiple 4D-CT scans were then acquired to sample the interplay between breathing phase and starting point of the helical scan and to determine the influence of this interplay on the reconstructed ITV.

Results: The calculated shift from registration of 5 CBCT scans using a structure VOI showed a variation of up to 3mm. CBCT volumes were significantly smaller than the ITV but were always enveloped within the ITV; the center-of-mass location of the CBCT volume within the ITV varied between CBCT scans up to 3mm. Target volume differences were also noted between the free-breathing CT and CBCT scans, due to increased volume averaging with CBCT.

Conclusions: Daily shifts determined using soft-tissue alignment of 4D-ITV and CBCT and may introduce a source of systematic error in the delivery process, which may not be properly accounted for in the ITV-to-PTV margin design. Based on these, albeit preliminary findings, we are considering modifying our clinical procedures.