AbstractID: 10765 Title: Decreasing CBCT dose without compromising its clinical fidelity

Purpose: The objective of this study is to evaluate the effect of KV cone-beam CT registration accuracy and image quality with reduced number of planar projections used in 3D reconstruction. The ultimate goal is to reduce patient dose while maintaining registration accuracy for different clinical disease sites.

Methods and Materials: An Elekta Synergy Linear accelerator with onboard CBCT system (XVI) is used in this study. The image quality of XVI CBCT images reconstructed with decreasing number of projections was evaluated using a CAT phantom that provides quantitative data on spatial resolution, low contrast visibility, uniformity, and geometrical accuracy. Subsequently, we acquired volumetric imaging data on an anthropomorphic phantom with different rectilinear shifts and rotations. We used standard scanning protocol for CBCT imaging. However, we reconstructed images with reduced number of projections (as low as $1/6^{th}$). We evaluated image registration accuracy between planning CT and CBCT data generated with decreased number of projections used in reconstruction. We also reconstructed imaging data for 3 real patients with limited number of projections.

Results:
The CBCT images of CAT phantom reconstructed with half as many projections satisfied all image quality criteria defined by Elekta in its acceptance test document. The images reconstructed with $1/6^{th}$ of the original number of projections failed only in low contrast resolution while satisfying all other quantitative image quality specifications. The CBCT images get noisier with reduced number of projections but their spatial resolution is hardly affected. The maximum registration error for both the phantom and real patients was found to be within 1mm and 1^{o}

Conclusions:
This study demonstrates that the image registration accuracy is not compromised even when the numbers of planar projections are reduced significantly. This means that the patient dose from CBCT study can potentially be reduced by a factor of approximately six.