

Purpose: Recent developments in two-dimensional x-ray detector technology have made volumetric Cone Beam CT (CBCT) a feasible approach for integration with conventional medical linear accelerators. The requirements of a robust image guidance system for radiation therapy include the challenging combination of soft tissue sensitivity with clinically reasonable doses. Previously, low contrast objects have generally not been perceptible with MV energies due to relatively poor signal to noise ratio (SNR) performance. We have developed an improved imaging system that is optimized for MV CBCT and acquire CBCT images containing soft tissue contrast using a 6MV x-ray beam.

Methods and Materials: Many factors, such as image noise, x-ray scatter, improper calibration and acquisitions have a profound effect on the imaging performance of CBCT. In this study attempts were made to optimize these factors in order to maximize the SNR. A QC-3V and contrast/resolution phantoms were used to determine the contrast to noise ratio (CNR) and f_{50} of a single 2-D projection and the contrast and spatial resolution of the reconstructed images.

Results: The computed f_{50} was 0.43 lp/mm and the CNR for a radiation dose of 0.02cGy was 43. Relative electron density as low as 1% can be resolved with clinically reasonable radiation doses. Clinical Megavoltage CBCT images acquired with this system demonstrate that anatomical structures such as the prostate and optic nerves are visible using radiation doses in range of 4 to 8cGy.

Conclusion: We have developed an imaging system that is optimized for MV and acquire Megavoltage CBCT images containing soft tissue contrast using a 6MV x-ray beam and irradiation doses in range of 4 to 8cGy. This system can also be used for routine portal imaging applications without risk of saturation for high dose/high energy treatment/verification imaging, or dosimetry applications.

Conflict of Interest (only if applicable): Sponsored by Siemens