AbstractID: 6636 Title: Physical Performance and Image Quality of Megavoltage Cone-Beam CT

Purpose: To evaluate the physical performance of Megavoltage Cone-Beam CT (MVCBCT) and to optimize system and reconstruction settings for image quality.

Methods and Materials: Several system parameters were varied to quantify their impact on image quality including the exposure (2.7, 4.5, 9.0, 18.0 and 54.0 MU), the cranio-caudal field-size (2, 5, 15, 27.4 cm), the voxel size (0.5, 1, 2 mm) and the slice thickness (1, 3, 5 mm). For the reconstruction algorithm, we investigated binning, averaging and diffusion of raw projections as well as four different backprojection filters. Two CT# normalization factors were compared. A head size water cylinder with different configurations of CT inserts was used to measure contrast-to-noise ratio (CNR) and uniformity. The point-spread function (PSF) was obtained using a brass wire and an iterative edge blurring technique. The current MVCBCT product settings were used as the performance baseline for comparison.

Results: Beam intensity variations per projection of up to 35.4% were observed for a 2.7 MU MVCBCT acquisition. Such variations were mostly captured in the system MU reading per frame and did not affect the CNR. The non-uniformity was reduced from 18.8% to 14.2% by closing the Y-jaws for imaging. An optimized reconstruction protocol was developed and showed an improvement of 60% in CNR with a penalty of only 8% for the PSF and an increase of 1 to 2 minutes in reconstruction time. The application of diffusion filtering for 9 MU reconstructions resulted in similar CNR improvement to using 5 times more dose with the current reconstruction protocol. Using reconstructions with smaller voxels and thicker slices can further improve the CNR.

Conclusion: The image quality stability of MVCBCT over a 4-month period was excellent. Soft-tissue visualization with MVCBCT can be substantially improved with proper system settings.

Conflict of Interest:
Research sponsored by Siemens OCS.