AbstractID: 5145 Title: Effect of measured cone-beam CT-density calibration on dose calculations

Purpose: To characterize the CT-density conversion for a cone-beam CT (CBCT) system, and to evaluate the accuracy of dose calculation using CBCT images in head & neck (H&N) and abdominal sites.

Method and Materials: A small (16 cm) and a large (32 cm) acrylic phantom with inserts of known electron densities were scanned on conventional CT and CBCT scanners. CBCT images were acquired using full and half fan (small phantom only), with and without bow-tie filter. CT-density conversion tables were measured for each combination. Head and pelvis phantoms, and H&N and prostate patients were imaged. IMRT treatment plans were designed based on conventional CT and transferred to CBCT after image registration (deformable registration for H&N patient). The CBCT dose distributions were then recalculated using the measured CT-density curves.

Results: For the small phantom, minimal differences were found between CT and CBCT numbers. Different conditions (half/full fan, with/without bow-tie) resulted in maximum differences of approximately 100 HU. For the large phantom, differences between the CT numbers and CBCT numbers were greater than 350 HU at both low and high densities. For the H&N patient and the head phantom, dose distributions calculated on CT and CBCT differed by less than 2%. For the pelvis phantom and prostate patient, there were substantial differences in the dose distributions. In the worst case, using CBCT images and the measured CBCT-density conversion curve, the mean prostate dose was 14% higher than that calculated using the conventional CT. Due to artifacts in the CBCT, the differences in dose were larger using the CBCT-density curves than using the default CT-density curves. Using unit density for CBCT is a good approximation for pelvis dose calculation.

Conclusion: Artifacts in CBCT images and CT-density conversion may lead to considerable errors in dose calculation using the large pelvis CBCT images.