AbstractID: 13253 Title: Combined use of Megavoltage Cone-Beam CT and Monte Carlo for Accurate Dose Calculation in Presence of High-Z Material

Purpose: High atomic number (Z) materials complicate the use of kilo-voltage CT in dose calculation. This work investigates the use of Megavoltage Cone-Beam CT (MVCBCT) and a Monte Carlo (MC) dose calculation engine to obtain a more realistic dose distribution for these clinical cases. **Method and Materials:** MVCBCT images of phantoms of different sizes (head and pelvis) were acquired. The phantoms were implanted with a combination of high-Z materials (aluminum, titanium, lead, gold). A cone-beam reconstruction software developed in-house was used to obtain the voxel intensities represented as “float data” on 32 bits. Matlab programs were used to convert float values to integers (CT#) and to obtain CT#-to-electron density calibrations. The theoretical attenuation coefficient for each material was calculated using the published data in National Institute of Standards and Technology. MC simulations with EGSnrc/BEAMnrc code were compared to measurements and calculation in a commercial treatment planning system. Phantom and patient images were simulated with MCRTP. **Results:** A good linear fit (R-squared value = 0.97) is found between the “float data” and theoretical attenuation coefficients for available high-Z materials. With this fit function, the “float data” can be converted to the attenuation coefficient maps for generating the CT numbers. Obtained CT numbers show no intensity truncation. For a clinical hip prosthesis case, the maximal CBCT CT# is10857 instead of 3071 in the commercial CT. Simulations on phantom demonstrated a better dosimetric accuracy using MVCBCT and MC (2-5%) than CT and a commercial TPS (~14%).
Conclusion: A more accurate method was developed to obtain dose distributions in presence of high Z materials. MVCBCT was able to accurately represent the material electron densities. Monte Carlo clearly outperformed a conventional planning system at simulating the dose distributions in presence of metallic objects.

Conflict of Interest (only if applicable): Research supported by Siemens.