AbstractID: 3046 Title: Effects of CT calibration on tissue inhomogeneity correction in radiotherapy

Purpose: To quantify the effect of CT calibration on tissue inhomogeneity correction in radiotherapy.

Method and Materials: Materials with known electron densities relative to water ranging from 0 to 2.34 were scanned with two GE Light Speed CTs at the four available KVs of 80, 100, 120 and 140 KV and a GE 9800 CT. The effect of using mismatched calibration curves on calculation of tissue inhomogeneity corrections were evaluated using the effective TMR method.

Results: All CT calibration curves agree with each other between air and water region. Above the density of water, the calibration curves for lower kV were significantly higher than those for higher kV, by up to 560 HU for cortical bone (ρ_e= 1.69). Thus, using a generic calibration curves would lead to an error in the determination of electron density and hence the tissue inhomogeneity correction. The effect of CT number error (ΔHU) on dose calculation is approximated as

$$\Delta D/t\ [\%/cm] = TMR' * \Delta HU/2000, \text{ for } HU > 1000,$$

where t is the physical thickness of the dense material layer and TMR′ is the TMR gradient. For example if a cortical bone is scanned with GE Light Speed at 80 KV but the CT calibration curve of 140 KV is used in dose calculation and the treatment radiation beam is the 6 MV at field size of 1x1 cm^2, the dose calculation error down stream of the bone layer will be about 1.2% per cm of bone. The effect is smaller for the 18 MV beam due to the smaller TMR gradient.

Conclusion: For best accuracy of tissue inhomogeneity correction, the KV specific, instead of a generic, CT calibration curve should be used.

Conflict of Interest (only if applicable): None.