AbstractID: 10988 Title: Impact of CT Number and Electron Density in Proton Dose Distribution

Purpose: The dosimetric impact of different CT number to electron density calibrations used in proton beam treatment planning with emphasis on the dose coverage to targets and organs at risk (OAR) is evaluated.
Method: A body CT phantom containing multiple plugs of varying density was scanned to measure CT numbers under different imaging protocols using various tube voltages: 80, 100, 120 and 140kVp on a GE CT simulator. The CT number versus electron density tables were generated for each image at various kVp used clinically. The calibration tables were imported into a CMS proton treatment planning system and used to investigate their impact on real patient dose calculations. Dose volume histograms (DVHs) were calculated using different CT number to electron density calibration tables for various patients (prostate, H&N, lung).
Results: The CT number is shown to be a factor of kilovoltage, field of view and reconstruction algorithm. However, its effect on PTV and OAR dose distribution is very small for most clinical situations. The CT values with 80kVp led to the largest deviation with small volume structures like cochlea and optic nerve. The low kVp has higher CT number for most cases compared to higher kVp. The dosimetric differences between the most commonly used cases (140 kVp and 120 kVp) were negligible (less than 1%).
Conclusion: Even though CT number differs with tube voltage appreciably, its impact on dosimetry is relatively small (< 2%). The differences are minimal in low density tissue (lung) and largest for high density material like a prosthesis where the accuracy of CT number and dose calculation is uncertain. It is concluded that small changes in CT number due to scanning technique have little dosimetric impact in proton beam planning.