AbstractID: 10483 Title: Dependency of proton dose on tissue composition investigated using Monte Carlo models of Hounsfield number conversion and cadaver-based anatomical data

Purpose: In this study, we performed dependency study of proton dose on tissue composition using Monte Carlo models of Hounsfield number conversion and cadaver-based anatomical data

Method and Materials: Monte Carlo methods provide the most accurate radiation dose calculation technology as it take into account detailed materials properties, such as materials composition, mass density and interaction cross section. Monte Carlo simulation calculates the energy deposit per mass of each small volume (voxel) after a patient is presented by a large number of voxels. Two methods of building patient-specified Monte Carlo models have been used in this study: one is to convert patient's CT Hounsfield numbers to materials; the other way is assign anatomical detailed materials using cadavers' segments. Dose distribution and dose volume histogram were compared based on the Monte Carlo models.

Results: The dose distribution at the iso-center slice, the 95% did not cover conformally to the ROI for Hounsfield MC model with shifting 2~3 mm superior to the ROI. Dose volume history for planning tumor volume (PTV), Brain, Pituitary and Chiasm were used for evaluating the effect of tissue composition. The mean doses difference for PTV was 2.1% for the cadaver-based MC and Hounsfield conversion MC model. The mean dose difference for Brain, Pituitary and Chiasm was less than 1.0%.

Conclusion: Proton radiation dose was calculated and closely compared using two Monte Carlo models: one from CT Hounsfield number conversion and the other from human anatomically detailed Cadaver segments. It is found that the effect of different tissue composition on proton radiation dose calculation is complex involving organs at risk. Our method using cadaver-based Monte Carlo model for proton dose calculation was shown to be suitable for benchmarking other Monte Carlo dose calculation methods and for providing tissue heterogeneity correction due to the effect of tissue composition.