AbstractID: 1500 Title: Heterogeneity corrected convolution dose calculation for kV x-rays versus Monte Carlo simulation

Fast and sufficiently accurate evaluation of dose distributions from kilovoltage x-rays is required for the clinical evaluation of kilovoltage treatments especially in comparison with alternative radiation modalities such as electron beams. There have been several investigations on the suitability of convolution/superposition models implemented in commercial treatment planning systems for kilovoltage dose calculations.[1,2] While calculated dose distributions are in close agreement with measured data for homogeneous water phantoms, discrepancies up to 300% have been reported in and around bone. Such discrepancies are not surprising given that radiological parameters relevant only in the megavoltage range were used ad hoc for the heterogeneity corrections. In this work we compare Monte Carlo (MC) simulations and experimental data to a convolution model including first order heterogeneity corrections. The convolution model proceeds by dose kernel convolution in water followed by depth scaling with attenuation coefficients corresponding to the treatment beam quality and dose conversion by relevant mass-energy absorption coefficient ratios. The x-ray source spectrum is MC simulated and used for the mapping of tissue CT numbers onto attenuation coefficients and mass-energy absorption ratios. Such first order corrections are shown to decrease the discrepancies between MC and model based calculations to 25 percent, with larger discrepancies at interfaces. This method gives, therefore, much better results for kV x-rays than dose scaling by electron densities.

1. P. Alaei et al, Med.Phys. 27(12), 2821-2826, 2000
2. P. Keall et al, Med. Dosim. 24(2), 141-144, 1999