

AbstractID: 1526 Title: An advantage of Monte Carlo over the pencil beam model based treatment planning system for electron beams

Until recently pencil beam based algorithms have been commonly used in commercial treatment planning systems for calculations of dose distributions for electron beams. Their accuracy is known to have some limitations due to various approximations present in the models applied in such algorithms. Recently, Monte-Carlo-based dose calculations for electron beams have become available in some commercial treatment planning systems. This investigation focuses on the comparison of dose distributions generated by two commercial electron beam treatment planning systems: one uses a Monte Carlo dose calculation engine and the other uses a pencil beam algorithm. The Monte-Carlo-based system can accurately predict dose in complex inhomogeneous phantoms for all beam energies, while the pencil-beam-based system shows serious limitations in predicting dose accurately for lower beam energies such as 9 MeV, which is commonly used in patient treatments. The deeper the inhomogeneity is positioned from the phantom surface, the larger is the discrepancy between pencil beam calculations and the experimental data. This is particularly true for lower beam energies due to the larger importance of scatter. The pencil-beam based system cannot be used to predict monitor units calculations for SSDs other than 100 cm. There are unacceptable errors (>20%) in the calculated absolute monitor units for an SSD of 110 cm for 6 and 12 MeV beams due to the method of SSD normalization although the pencil beam system predicts the relative cutout factors with an acceptable uncertainty (2%) for SSDs other than 100 cm.