AbstractID: 8549 Title: X-ray beam model benchmarks

Purpose: Determine fluence, differential in energy and angle, of Siemens Oncor 6/18 MV x-ray beams, a necessary step towards an accurate, easily-commissionable beam model for Monte Carlo treatment planning.

Method and Materials: Dose to water is measured under various conditions, including: various field sizes including the largest; flattening filter present and removed; energy, steering tuned from nominal values to outside manufacturer acceptance criteria; target position moved along beam axis; filters. Energy is determined from depth dose curve measured with no target, flattening filter, or primary scattering foil (in electron mode, using x-ray beam parameters). Spot size is determined using an alternating layer spot size camera. Spot position, beam angle, primary collimator and flattening filter positions are determined geometrically from profile scans vs. distance. Positions of treatment head elements, density of flattener, verified by direct measurement. Monte Carlo simulations with EGSnrc, taking asymmetry into account with beam angle and position, modified BEAMnrc code allowing lateral shifts of component modules, and modified 'flatfilt' component module allowing shift of flattening filter relative to primary collimator.

Results: Comparison of electron PDD to Monte Carlo yields the beam energy to within positional accuracy and systematic uncertainty of Roos detector. Precision of geometrical measurements is sufficiently high to constrain inputs. Simulations agree to measurement within 1%/1 mm. Fluence is determined accurately over range of clinically acceptable beams.

Conclusion: We determine, with reliable uncertainty estimates, input parameters for Monte Carlo simulation of Siemens 6/18 MV x-ray beams. Close agreement is obtained to measured data over range of beam tuning. The method is applicable to other types of linacs and provides fluence benchmarks of clinical x-ray beams for development of an accurate, easily-commissioned beam model.

Support from NIH R01 CA104777-01A2.