AbstractID: 8468 Title: Large-field sensitivity analysis of a non-cylindrically symmetric Monte Carlo beam model of a Varian electron accelerator

Purpose: To facilitate the development and commissioning of radiotherapy electron beam models by studying the dosimetric response of a Varian Trilogy electron accelerator to variations of the geometric and electron beam parameters of the treatment head, including lateral offsets of linac components and lateral and angular offsets of the incident electron beam.

Method and Materials: We have performed a sensitivity study examining the effect of varying beam and geometric parameters of a Monte Carlo model of a Varian Trilogy accelerator. The accelerator was modeled using a modified BEAMnrc package that included asymmetric accelerator and beam models. The dose output was modeled using DOSXYZnrc. Electron beams were modeled for 40x40 cm^2 fields with applicators removed. Profiles at d_{max} and in the bremsstrahlung region were calculated for 4, 12, and 20 MeV configurations.

Results: The dose distributions were evaluated for flatness, symmetry, and OAR. Scattering foil thickness had a negligible effect on d_{max} profiles, but increased the bremsstrahlung production rate. A 3 mm shift in the interfoil distance had a 5% effect on the OAR at 12 cm, but only 2% at 5 cm radius. Profiles in the bremsstrahlung region help differentiate between similar d_{max} behavior for changes in incident electron angle and lateral secondary scattering foil position. A 4 mm variation in the electron spot size had a negligible effect on the 4 MeV dose distribution, but varied the flatness of the 12 and 20 MeV beams by 2% and 5%, respectively.

Conclusion: Lateral and angular offsets of beam and accelerator components have strong effects on dose distributions, and need to be included in any high-accuracy electron beam model. Large fields without applicators and bremsstrahlung profiles can give additional insight into how parameters should be adjusted when commissioning a Monte Carlo beam model.

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