AbstractID: 5299 Title: Validation of a linear accelerator source model and commissioning process for routine clinical Monte Carlo calculations

Purpose:
Many source models for Monte Carlo treatment planning include parameters which are difficult or ambiguous to determine. We developed and tested a straightforward source model and commissioning process for clinical Monte Carlo calculations.

Method and Materials:
Our commissioning process of fitting treatment planning system data includes fitting the photon spectrum, electron contamination, penumbra fluence blurring, jaw leakage, and the flattening filter effect. The energy spectrum is fit using a modified Fatigue Life Distribution multiplied by a Fermi. Electron contamination is modeled separately an exponential function, as suggested by Fippel. Penumbral blurring is modeled using a Gaussian filter. Leakage radiation is modeled as a low-intensity wide-field monoenergetic source. The flattening filter effect is modeled by multiplying the optimized fluence by a Gaussian reduction. The penumbra and the flattening filter are applied to the fluence map. We tested our methodology on doses produced by a Varian accelerator for 6 MV and 18 MV photons and 5x5, 10x10, and 20x20 cm^2 field sizes.

Results:
We found that nine published photon spectra of Varian, Eleckta, and Siemens linear accelerators, ranging in energy from 4 MV to 25 MV could be modeled by the Fatigue Life Distribution with a Fermi cutoff. The agreement between the TPS doses and the commissioned MC doses were within 2%. Off-axis energy spectrum softening was unneeded.

Conclusion:
We have developed a straightforward, yet flexible source modeling system. The commissioning process affords a high-degree of automation with an unambiguous determination of the relevant parameters. Commissioning of clinical Monte Carlo treatment planning systems is facilitated by using a source model which is only as complicated as necessary to accurately simulates dose distributions.

Conflict of Interest:
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