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On an auto-commissioning for an electron beam model applicable to MLC collimated electron beams

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Purpose: Using the photon multileaf collimator (MLC) instead of the electron applicator is a promising solution to improve clinical workflow and enable intensity modulation for electron radiotherapy. Currently, an inefficient manual process is performed to commission beam models for MLC shaped electron beams. The aim of this work is to develop an auto-commissioning procedure for a Monte Carlo (MC) electron beam model of TrueBeam systems.
Methods: The beam model includes two sources each consisting of an electron and a photon part: a main source representing the primary beam and a jaw source representing the head scatter contribution. For the particle transport through the MLC, MC simulation is performed. The commissioning procedure uses predetermined information from BEAMnrc and electron MC (eMC) simulations and in total seven measurement scans in air and water to automatically determine the fluence distributions, weights, energy spectra and focal spot position and lateral intensity distribution of the beam model sources. For validation purposes, calculated and measured dose distributions in water were compared for different field sizes (2x2-10x10 cm2), source to surface distances (SSDs) (70-100 cm) and beam energies (6-22 MeV) for eight TrueBeam systems of six different institutions, either equipped with a Millennium 120 MLC or with a high-definition MLC. Furthermore, calculated and film measured dose distributions of a single electron field plan for a sternum case in an anthropomorphic phantom were compared at different SSDs.
Results: The auto-commissioning procedure was successfully applied to eight TrueBeam systems in minutes instead of several days that were necessary for the manual commissioning. Measured and calculated dose distributions agree generally within 3% of maximum dose or 2 mm. Gamma passing rates for the sternum case using 3% (global) / 2 mm criteria with a threshold of 10% ranged from 96% to 99% for different SSDs.
Conclusions: The developed auto-commissioning procedure enables an efficient commissioning of an MC electron beam model and simplifies the usage of MLC shaped electron beams.
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