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Commissioning 6 MV photon beams of a stereotactic radiosurgery system for Monte Carlo treatment planning.

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The goal of this work is to implement a beam commissioning procedure to generate a multiple source model using a set of standard measurement data for possible Monte Carlo treatment planning in the clinic for a Cyberknife stereotactic radiosurgery system. The required measurement data include the central axis depth dose curve (PDD), the dose profile at dmax(= 1.5 cm) of 60 mm cone at 80 cm source-to-surface distance (SSD), and the cone output factors for cones of 5 mm to 60 mm at 80 cm source-to-axis distance (SAD). The employed dual source model has the same structure as the one that has been studied in our previous work while most of the parameters of each source are extracted from the measurement data rather than the beam phase space. The energy spectra will be extracted from the central axis PDD, the fluence distributions will be deconvoluted from the dose profile at dmax, and the source distributions will be determined from the measured cone output factors. Monte Carlo dose calculations in various water phantoms have been performed to verify the beam commissioning procedure. The agreement between the measurements and the commissioning results was within 2%/1 mm for the central axis PDDs and the dose profiles at various depths when an IC-3 chamber was used and within 2% for the cone output factors for various collimator sizes of 5 to 60 mm. Largest difference (9.5%) was observed for the 7.5 mm cone when an IC-10 chamber was used. The large differences can be attributed to the volumetric averaging effect of the IC-10 chamber, whose dimension is comparable to the field of the small cones. The overall agreement between the measurements and the commissioning results is clinically acceptable, which implies that our commissioning tool is adequate for clinical applications of Monte Carlo dose calculations for the Cyberknife stereotactic radiosurgery system.

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