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Validation of Geant4 Monte Carlo Model of ^{60}Co High Dose Rate BEBIG Brachytherapy Source

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The ^{60}Co sources are widely used for high dose rate (HDR) brachytherapy treatments. The purpose of this study is to validate a Geant4 (version10.7.1) computational model of the BEBIG ^{60}Co HDR source. The Geant4 Monte Carlo (MC) model has been used in compliance with the standard TG-43 formalism. The air-kerma strength per unit source activity (Sk/A) was estimated by keeping the source at the center of the xyz coordinate system. The air-kerma was scored at 100 cm on the transverse axis in a spherical air volume of 1 cm radius. Histories of 1×10^9 were used with an uncertainty below 0.4%. A cubic water phantom with dimensions 1 m x 1 m x 1 m was modeled to obtain the dose rate distribution. The radial dose distribution of the source was scored by placing the source at the center of a 40 cm radius water phantom. Histories of 2 x 10^8 were simulated and the density and temperature were taken as recommended in TG-43. The calculated Sk/A in this work was 2.944 x 10^{-7} UBq^{-1}. Dose rate constant (Λ) was measured at 1cm on the transverse axis in water medium using 0.1 mm^3 cubic volume and the measured Λ was 1.155 c Gyh^{-1} U^{-1}. The values Sk/A and Λ show good agreement with the previous simulation studies and has the ability to produce dose profiles. The dose rate per unit air kerma strength and the radial dose functions calculated in this study are consistent with the previous study data.

Keywords: High dose rate brachytherapy, Monte Carlo simulation, Coboalt-60

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