Experimental Validation of Dose Calculation Algorithms for the GliaSite™ RTS, a Novel ^{125}I Liquid-Filled Balloon Brachytherapy Applicator

We present the experimental validation of dose calculation algorithms for a novel ^{125}I liquid-filled brachytherapy balloon applicator (the GliaSite RTS) designed for the treatment of malignant brain-tumor resection-cavity margins. A solid water phantom machined for catheter conformity (verified by Computed Tomography (CT) imaging) was used to perform absolute low dose-rate radiochromic film (RCF) measurements in coronal planes about the applicator. The results were used to validate Monte Carlo photon transport (MCPT) simulations and a point-source dose-kernel model algorithm. Densitometry of RCFs employed a validated optical densitometry system with an artifact elimination process. The absolute activity of the ^{125}I solution was determined by inter-comparing a National Institute of Standards and Technology (NIST) ^{125}I standard with a known mass of radiotherapy solution (Iotrex™) in an identical vial and geometry.

Agreement between RCF and MCPT was found to be within ± 5%. This significantly improves upon earlier reports of absolute RCF film dose measurements about ^{125}I sources. Agreement between the simple semi-empirical dose-kernel model and the MCPT and, by extension between the RCF measurements and semi-empirical model, was better than 5% except very near the applicator surface where 8-10% discrepancies were observed. Measurement also confirmed no dose-distribution deviation from equatorial isotropy as predicted.

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