Monte carlo calculations and experimental measurements of dosimetric parameters of the IRA-^{103}Pd source

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Abstract

The use of ^{103}Pd seed sources for permanent prostate implantation has become a popular brachytherapy application. As recommended by AAPM the dosimetric characteristics of the new source must be determined using experimental and Monte Carlo simulations, before its use in clinical applications thus The goal of this report is the experimental and theoretical determination of the dosimetric characteristics of this source following the recommendations in the AAPM TG-43U1 protocol.

Figure 1 shows the geometry of the IRA-^{103}Pd source. The source consists of a cylindrical silver core, 0.3 cm long × 0.05 cm in diameter, onto which 0.5 nm layer of ^{103}Pd has been uniformly adsorbed. The effective active length of source is 0.3 cm and the silver core encapsulated inside a hollow titanium tube with 0.45 cm long, 0.07 cm and 0.08 inner and outer diameters and two caps. The Monte Carlo N-Particle (MCNP) code, version 4C, was used to determine the relevant dosimetric parameters of the source. The geometry of the Monte Carlo simulation performed in this study consisted of a sphere with 30 cm diameter. Dose distributions around this source were measured in two Perspex phantom using enough TLD chips. For these measurements, slabs of Perspex material were machined to accommodate the source and TLD chips.

A value of 0.67±1% cGy.h^{-1}.U^{-1} for, Λ, was calculated as the ratio of $\dot{d}(r_0,\theta_0)$ and s_K, that may be compared with Λ values obtained for ^{103}Pd sources. Result of calculations and measurements values of dosimetric parameters of the source including radial dose function, g(r), and anisotropy function, F(r,θ), has been shown in separate figures. The radial dose function, $g(r)$, for the IRA-^{103}Pd source and other ^{103}Pd sources is included in Fig. 2.

Comparison between measured and Monte Carlo simulated dose function, g(r), and anisotropy function, F(r,θ), of this source demonstrated that they are in good agreement with each other and The value of Λ is comparable with the other ^{103}Pd sources. These measurements and calculations were performed following the AAPM TG-43U1 task group recommendations.

KEYWORDS: ^{103}Pd source; MCNP4C; Dosimetry; TLD chips

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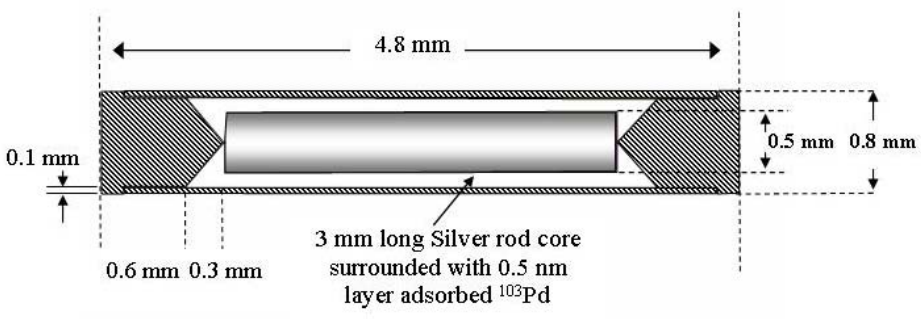

FIG.1. Schematic diagram of the IRA-^{103}Pd source.

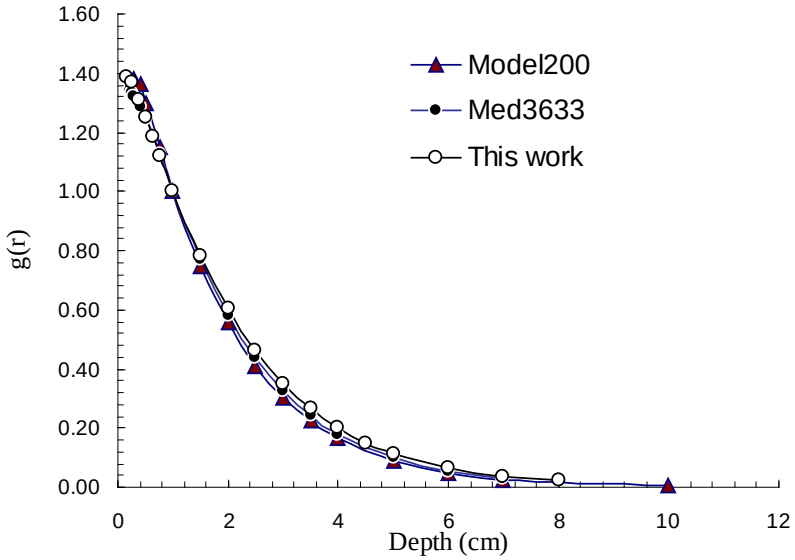

FIG.2. Comparison between Monte Carlo calculated radial dose function of this work and other ^{103}Pd sources.