

Characterization of an I-125 seed using the AAPM TG-43 dosimetry protocol

Introduction:

I-125 seeds are often used in temporary or permanent radiotherapy implants. The American Association of Physicists in Medicine (AAPM) formed Task Group (TG) 43 to propose a dosimetry protocol for such cylindrically symmetric seeds. The protocol calculates the dose rate at a particular point by taking into account the air kerma strength, dose rate constant, geometry function, radial dose function, and anisotropy function.

Methods and Materials:

OncoSeed 6711 I-125 seed dimensions of 20 seeds were confirmed with a Vernier caliper. These dimensions were then used to obtain the geometry function, which provides an inverse square correction based on the activity distribution in the source. Air kerma strength was confirmed using a calibrated PTW Sourcecheck 4π chamber. The anisotropy and radial dose functions were measured in specially designed solid water phantoms using thermoluminescent dosimeters (TLDs). Gafchromic film was also used for these measurements. The dose rate constant was determined using the ratio of the measured dose rate at 1 cm and the air kerma strength. Spectral measurements were made with a Silicon Drift Detector. These results were used to determine the average seed energy, as well as the dose rate constant by taking into account each peak's individual contribution.

Results:

The active length of the seeds was measured to be $2.85 \text{ mm} \pm 0.99 \%$, while the nominal seed length was given as 3.0 mm. The difference in the geometry function was less than 1 % at 0.5 cm, and less than 0.06 % at distances of 2 cm and larger. The average ratio of stated and measured air kerma strengths was 0.999 ± 0.031 for 175 seeds measured from 7 different batches of seeds. The anisotropy and radial dose function matched published data to within one standard deviation. The measured dose rate constant using TLDs was $\Lambda = 0.96 \pm 0.2 \text{ cGy h}^{-1} \text{ U}^{-1}$, while the calculated one using the spectrum was $\Lambda = 0.978 \text{ cGy h}^{-1} \text{ U}^{-1}$. The average energy of the I-125 seed excluding the titanium characteristic X-rays of the seed housing was 27.44 keV, in good agreement with published data.

Conclusion:

All seed parameters matched published data very well, allowing accurate and precise dose calculations for radiotherapy treatment planning.

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