

Purpose: Age-related macular degeneration (AMD) is the leading cause of vision loss and blindness among those over age 65. In its wet form, blood vessels grow from the choroid, causing macular tension and sometimes retinal displacement. As an alternative to monthly direct-injection methods, Oraya Therapeutics has developed the IRay™ stereotactic radiosurgery device. This table-top system has been validated in Monte Carlo simulations, human cadaver eye studies, pre-clinical animal studies, and a phase 1 clinical trial. A plastic scintillation dosimetry (PSD) system was developed to monitor dose delivery in real-time and provide measurement of total dose delivered.

Methods: The IRay™ uses 100 keV x-rays to deliver 24 Gy of macular dose, divided into three positions along the inferior pars plana. The PSD's small volume (0.5 mm diameter and 2 mm height), allows placement within the machine head. The PSD is fiber-optically coupled to a photomultiplier tube via a plastic waveguide. Before direct characterization of the IRay™, the preliminary PSD performance was tested using a portable x-ray unit, mobile c-arm fluoroscopy unit, and an ion chamber.

Results: In order to avoid buffering issues, real-time measurements used 250 ms bins, but can be adjustable to 10 ms. A calibration factor (CF) from PSD percent-depth-dose to ion chamber percent-depth-dose was 1.06 at a depth of 1.5 cm in solid water, the typical macular target depth. Counts-to-exposure CF varied less than 1% from 0.862 to 15.26R. Counts-to-exposure CF remained linear with R² of 0.999 up to 16R even with varying dose rate (.002 R/s to 1.0 R/s).

Conclusions: The PSD demonstrated linear dose measurements even at high dose and high dose rates. This study demonstrates the feasibility, accuracy, and precision of a PSD for clinical implantation in the IRay™, a device for treatment of AMD.

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