Experimental Comparison of Six Commercial Dosimetry Diodes for Measurement of Stereotactic Radiosurgery Cone Factors

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Purpose
The purpose of this work is to measure SRS cone factors with commercially available diodes to determine the “best” instrumentation for beam data acquisition in small field dosimetry.

Innovation/Impact
While there have been Monte-Carlo studies of detector response measuring output factors in small field dosimetry (1), we have performed the first measurement using all commercially available diode models. Our data will provide guidance for clinical physicists who are commissioning an SRS machine as to which detector and measurement setup will provide the most accurate results.

Materials & Methods
Measurements were made in 6 MV photon beams with fixed SRS cones for two accelerator-based SRS systems: a Varian Clinac 2300iX (Varian/ZMed cones) at 600 MU/min and a CyberKnife G4 at 800 MU/min. Measurements were made at 1.5 cm depth in water using the IBA Dosimetry “blue phantom” 3D scanning system, controlled by OmnisPro-Acute software.

The same author performed set-ups on both machines for consistency. The detector position on the beam central axis was verified by performing a cross-profile scan (Figure 2). Source-to-detector distance was 100 cm for the Clinac, 80 cm for the CyberKnife. Two curves were calculated for the Clinac, one directly from 10x10 diode measurements and the other indirectly by “daisy-chaining” diode measurements to a 10x10 reference ion chamber measurement within a certain tolerance (~1 mm) of the beam central axis. To achieve an accurate detector setup for reproducible results and accurate cone factor measurements, a cross-profile scan of the field should determine the detector position.

Conclusions
The inter-detector variation is small and appears to be systematic with detector packaging, more inherent filtration producing flatter curves for both the relatively hard Clinac beam and the softer CyberKnife beam. The daisy-chaining strategy reduces the variance between diodes by about half in the Clinac beam.

References