

Evaluation of Plastic Scintillator Detector for Small Field Stereotactic Patient-Specific Quality Assurance

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Presentations

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Purpose:

To evaluate the performance of a commercial plastic scintillator detector (PSD) for small-field stereotactic patient-specific quality assurance using flattening-filter-free (FFF) beams.

Methods:

A total of ten spherical targets (volume range:[0.03cc-2cc]) were planned using Dynamic Conformal Arc(DCA-10 plans) and Volumetric Modulated Arc Therapy(VMAT-10 plans) techniques in Eclipse(AAA v.11, 1mm dose calculation grid size). Additionally, 15 previously-treated cranial and spine SRS plans were evaluated (6 DCA, 9 VMAT, volume range:[0.04cc-119.02cc]). All measurements were acquired using Varian Edge equipped with HDMLC. Three detectors were used: PinPoint ion chamber (PTW;active volume 0.015cc), Exradin W1 PSD (Standard Imaging;active volume 0.002cc), and Gafchromic EBT3 film (Ashland). PinPoint and PSD were positioned perpendicular to beam axis in a Lucy phantom (Standard Imaging). Films were placed at isocenter in solid water. Calibration films were delivered for absolute dose analysis.

Results:

For large spherical targets(>1.5cc) with DCA, all detectors agreed within 1% of AAA calculations. As target volume decreased, PSD measured higher doses than AAA (maximum difference: 3.3% at 0.03cc target), while PinPoint chamber measured lower doses (maximum difference:-3.8% at 0.03cc target). Inter-detector differences between pinpoint and PSD increased with decreasing target size; differences>5% were observed for targets<0.09cc. Similar trends for inter-detector behavior were observed for clinical plans. For target sizes<0.08cc, PSD measured>5% higher dose than PinPoint chamber (maximum difference: 9.25% at 0.04cc target). Film demonstrated agreement of $-0.19 \pm 1.47\%$ with PSD for all spherical targets, and agreement within $-0.98 \pm 2.25\%$ for all 15 clinical targets. Unlike DCA, VMAT plans did not show improved AAA-to-detector agreements for large targets.

Conclusion:

For all targets, the PSD measurements agreed with film within 1.0%, on average. For small volume targets (<0.10cc), PSD agreed with film but measured significantly higher doses (>5%) compared with the pin point ion chamber. The plastic scintillator detector appears to be suitable for accurate measurements of small SRS targets.