

Purpose: To develop calibration procedures for a novel 4D diode array for IMRT as well as arc therapy quality assurance (QA).

Method and Materials: A novel 4D diode array (ArcCHECK) was designed for rotational therapy QA. Its cylindrical and isotropic design presents a consistent detector image in beam's eye view for all gantry angles. Signals were acquired every 50 ms, allowing for real-time per-beam QA as well as measuring composite dose distributions. An efficient calibration procedure was developed to obtain diode sensitivity and directional response dependence with one full gantry rotation. In this process, each diode was in turn irradiated under the same beam condition on beam central axis. The directional response was obtained using TPS-calculated beam profiles, which were validated in rectangular geometry. A real time algorithm to derive beam angle based on beam edge back projections was developed to apply the corresponding directional response factors. Its clinical application for IMRT QA was demonstrated with 17 IMRT head and neck beams delivered with planned beam angles. Measured dose distribution was compared to TPS calculation in three dimensions with %diff and distance-to-agreement analysis. Its feasibility for VMAT QA was investigated with a prostate conformal arc plan.

Results: For the IMRT beams, average passing rate was $94.3\% \pm 2.1\%$ and $99.6\% \pm 0.8\%$ with 1%/2mm and 1%/3mm, respectively. For the conformal arc plan, the passing rate was 97.7% with 1%/2mm and 100% with 1%/3mm.

Conclusion: An efficient calibration procedure was developed to obtain both the diode sensitivity and directional response dependence. Real-time gantry angles were derived accurately based on beam edge back projections, which were used to apply directional response factors. Excellent agreement with TPS calculation was achieved for both IMRT and VMAT plans. ArcCHECK is an efficient and valuable tool for both IMRT and VMAT QA.

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