Purpose: To address important questions regarding calibration and use of the ArcCHECK (Sun Nuclear Corp) detector resulting from its hollow shape and cylindrical array geometry. The goals are to investigate how accurate different treatment planning algorithms are with the phantom containing a large air-density inhomogeneity; to establish a method of calibrating the detector against an isotropic, energy-independent dosimeter; and to develop a robust virtual inclinometer capable of providing uninterrupted beam angle information during arc deliveries.

Methods: A PMMA shell accommodating an ion chamber at the diode position was designed to replicate the dimensions of the ArcCHECK phantom. The ratio of entrance to exit dose was measured and compared to calculations by five sophisticated commercial algorithms. Field size dependence of the diode response was measured at different locations in the phantom. A novel virtual inclinometer algorithm was designed based on the coincidence of dose grid images projected with attenuation on a common plane. A formalism of reading to dose conversion accounting for the field size and detector position dependence was developed. A practical method of measuring the positional dependence factors against an ion chamber in the actual phantom geometry was designed.

Results: Philips Pinnacle CCC, CMS XiO Superposition and Monaco algorithms disagreed with the ion chamber by no more than 1.5%. XiO Convolution and Varian Eclipse AAA were off by >11%. Field size correction is position-dependent and varies between the hollow and plugged phantom configurations. Virtual inclinometer is robust and deviates no more than 0.5±0.7° from the Dynalog record. An average disagreement is 0.5% between the diode and ion chamber dose measurements in a wide field.

Conclusions: Using hollow ArcCHECK phantom configuration with Eclipse AAA is not recommended. A robust positional correction based on the novel virtual inclinometer is feasible. Diode “reading to dose” formalism must include field size dependence.

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