Cureus

Open Access
Abstract

Dosimetric Characterization and Correction of a High Spatial Resolution Diode Array for Small Field Dosimetry

Mareike Held [1] , Atchar Sudhyadhom [2]

1. Radiation Oncology, University of California San Francisco 2. University of California San Francisco

Corresponding author: Mareike Held, mareike.held@ucsf.edu

Categories: Medical Physics, Quality Improvement, Radiation Oncology
Keywords: sbrt, stereotactic body radiotherapy, diode array

How to cite this abstract
Held M, Sudhyadhom A (November 02, 2017) Dosimetric Characterization and Correction of a High Spatial Resolution Diode Array for Small Field Dosimetry. Cureus 9(11): a261

Abstract

Objectives: Diode, and diode array, measurements are known to exhibit dependencies on field size, beam energy, dose rate (repetition rate), and incident beam angle, thus reducing dose measurement accuracy. The purpose of this study was to quantify the dose response effects in a high spatial resolution diode array for small field dosimetry using Sun Nuclear Corporation's (SNC) Stereotactic Radiosurgery MapCHECK (SRS MC).

Methods: A SRS MC prototype was used to evaluate and quantify its dependencies on field size (5mm to 80mm), beam energy (6MV WFF, 6MV FFF, and 10MV FFF), dose rate (repetition rates 100MU/min to 2400MU/min), and incident beam angle (0° to 90°). All measurements were performed on a robotic radiosurgery system and a stereotactic body radiotherapy linac. The SRS MC was placed inside SNC's StereoPHAN phantom and stereotactically positioned using the respective treatment delivery devices' on-board imaging system and SRS MC's fiducial markers. SRS MC measurement results were evaluated against several standalone detectors (micro ionization chamber, plastic scintillator, microdiamond). The StereoPHAN design allows locating either the SRS MC's central diode or a standalone detector at the same position.

Results: The smallest field output factors (OFs) were measured on a robotic radiosurgery system with cone collimators. OFs for the SRS MC were within 1.5% of those measured with a plastic scintillator or a micro diamond for field sizes between 7.5 and 60 mm. Measurements to quantify beam energy, dose rate, and incident beam angle dependencies were acquired on a stereotactic body radiotherapy linac. For high dose rate flattening filter free beams, the diode had a dose rate dependence that varied by <2% for dose rates between 100 MU/min to 2400 MU/min. The angular dependence of the SRS MC varied by up to 10% across all co-planar angles. Angularly dependent attenuation effects were found to vary by up to 7% (for the central diode) due to the high density of diodes when beaming laterally across the SRS MC. The diodes of the SRS MC also had a differential response of primary versus scattered beam of up to 3%.

Conclusions: A high-resolution diode array was characterized to determine dose responses in small field conditions. Correction factors depend on field size, energy, dose rate, and beam angle. These well-quantified dependencies can be accounted for through software corrections provided by the vendor. When corrected, composite SRS MC small field measurements are able to achieve a high degree of dose accuracy while providing high spatial resolution, offering an alternative to film for small field dosimetry.

Open Access
Abstract
Published 11/02/2017