

Utilizing the MapCHECK 2 Diode Array for RapidArc based SRS Patient Specific Quality Assurance

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Abstract

Objective: Stereotactic radiosurgery (SRS) treatment is being increasingly used for patients with multiple brain metastases, including treatments with single isocenters. The MapCHECK® 2 (Sun Nuclear) diode array and the accompanying MapPHAN water phantom can be used to perform patient-specific quality assurance (PSQA) on these plans; however, due to the spacing of the detectors (10mm horizontally), additional efforts are necessary to ensure the highest confidence in the accuracy of the data analysis, for PTVs smaller than 5 cc.

Methods: The following process is recommended: Aligning the MapCHECK® 2 device to position the diode array plane at the center of the lesion. If there was a multi-lesion plan with a single isocenter, this may involve raising or lowering the table depending on the isocenter in the plan relative to the lesion. Then, conduct two measurements—the first at the central axis of the device and the second with a 5mm shift (either left or right). This is followed by merging the two datasets in the SNC Patient software, which effectively doubles the detector density of the MapCHECK® and increases the resolution of the dataset. Twenty (20) plans were measured from thirteen patients that involved RapidArc based SRS treatment. The traditional method of measurements (in which just the fluence and dose at the central axis was measured) were compared to the merged data (which was the central axis data combined with the 5mm shifted measurement). The gamma analysis results for the following parameters were recorded: 3%/3mm; 3%/2mm; 3%/1mm; 2%/2mm; 2%/1mm.

Results: The results show that by merging the two datasets—the central axis and the 5mm shift—we increased the data points for analysis of these small lesions by a factor of 2.01. The gamma analyses that provided the most significant differences in passing rates were the 3%/1mm and the 2%/1mm parameters. The margin of error for the passing rates (with a confidence level of 99%) was decreased with more data points: for the 3%/1mm readings, the margin of error decreased from $\pm 8.41\%$ to $\pm 5.76\%$, and for the 2%/1mm readings, the margin of error decreased from $\pm 10.37\%$ to $\pm 6.92\%$.

Conclusion: These findings suggest that the MapCHECK® 2 device with the MapPHAN can be used to perform PSQA for RapidArc based SRS plans whether it's a single lesion or a multi-lesion plan with a single isocenter without the need for additional equipment and without sacrificing confidence in plan passing rates. This is valuable for clinics treating linac based SRS cases who already use a MapCHECK 2 device for non-SRS IMRT or RapidArc plans. While the authors recognize there are more precise devices (ie SRS MapCHECK) specific for SRS QA, smaller clinics may not have the resources to have both devices. This study demonstrates that the full MapCHECK device can achieve accurate SRS QA results.