A Comparative Analysis of the use of Electronic Portal Image Device and Diode Array-Based Patient Specific Quality Assurance for Multi-Met Intracranial Stereotactic Radiotherapy Patients

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Introduction

SRS and SRT treatments continue to grow in complexity. The necessity to verify patient specific quality assurance for these complex plans is an area of concern and of utmost importance.

Objective

To compare the performance of two commonly used Quality Assurance (QA) devices in the application of Multi-Met Intracranial Stereotactic Radiotherapy (SRS) or Stereotactic Radiotherapy (SRT):

- Electronic Portal Image Device (EPID)
- Diode Array

Specifically, the study aimed to identify factors that may impact the choice of QA method. These factors include:

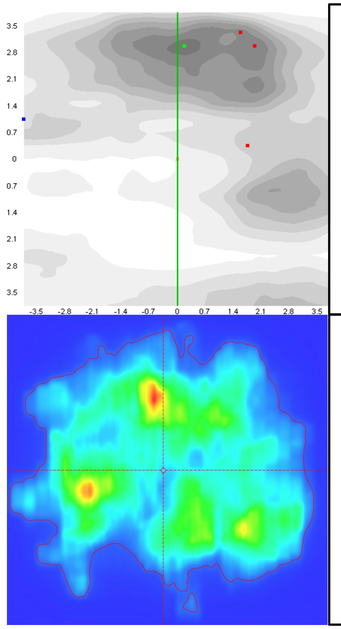
- Mean Distance from Isocenter
- Total Tumor Volume
- Number of Lesions Treated
- Conformity Index

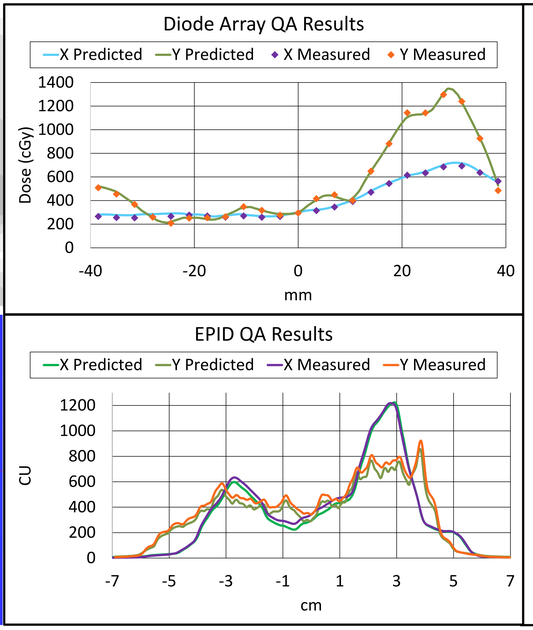
Methodology

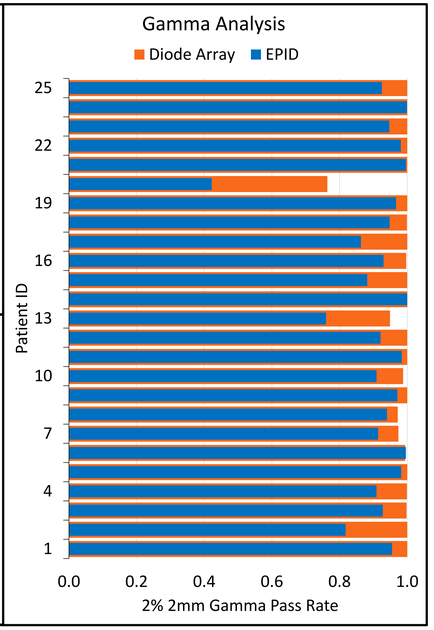
25 previously treated patients who underwent multi-met SRS/SRT treatments were retrospectively analyzed. A composite image was generated by combining the individual field images for EPID based measurements. EPID images were acquired at a source-to-imager distance of 100 cm. The diode array was placed in a phantom and the beams were delivered to generate a true composite image. Gamma pass rates were evaluated for both device measurements using 3%/2 mm, 2%/2 mm, and 2%/1 mm criteria. Correlation analysis was performed, and Pearson correlation coefficients were calculated to identify factors influencing gamma pass rates.

Results

Correlation analysis revealed that the total tumor volume had the largest correlation with gamma pass rates for both measurement devices. The tumor volume correlation coefficients for both methods only indicate moderate to low positive correlation. Additionally, the average gamma pass rates for the diode array were 3.7%, 5.4%, and 14.5% higher than the EPID results for the gamma criteria of 3%/2 mm, 2%/2 mm, and 2%/1 mm, respectively. This may indicate that diode array-based QA may be less sensitive to error detection in terms of passing gamma criteria compared to EPID-based QA.







Conclusion

Though no major correlation for different clinical factors on gamma analysis pass rates was found, this study demonstrates that both EPID-based and diode array-based QA methods are valuable tools for SRS/SRT treatment verification. The choice of method may depend on various factors. EPIDs offer the advantage of being readily available and integrated into the treatment workflow, making them a convenient option for daily QA. Diode array-based QA systems may be more representative of the actual dose delivered to the patient, as they are often placed in a phantom that mimics the patient's anatomy, but setting up and using a diode array phantom can be more time-consuming and complex. The choice between EPID-based and diode array-based QA should be made by first considering the specific clinical needs and available resources. In some cases, a combination of both methods may be beneficial to ensure comprehensive QA coverage.