

**Purpose:** The goal of this study is to develop a fast and accurate GPU-based RapidArc QA package which consists of two dose calculation engines and 3D gamma index calculation code.

**Methods:** The dose calculation package includes a GPU-based Monte Carlo dose calculation algorithm, based on a dose calculation code, DPM and a GPU-based FSPB algorithm with 3D-density correction. It also includes a GPU-based gamma index calculation algorithm. To test this QA package, five treatment plans for typical tumor sites treated with RapidArc have been created and delivered to a water phantom on the RapidArc treatment unit. During the delivery, the gantry angle and leaf positions for each leaf pair were recorded at 50ms intervals in the two separate MLC Dynalog files, while the gantry angle and dose rate for each control point were recorded in the Clinac log file. With two sets of delivery log files, we generated inputs for our two GPU-based dose calculation algorithms. The dose distribution was calculated on patient's planning CT and compared with the planning dose distribution from the treatment planning system using the GPU-based 3D gamma index code. The computational time for each step was recorded to test the efficiency.

**Results:** For all cases, the calculated 3D dose distributions agreed well with the TPS calculated doses. Dose calculation part can be completed within 2.5 minutes using both algorithms and dose evaluation can be finished within a few minutes.

**Conclusions:** We have developed a fast and accurate patient-specific RapidArc QA package. The algorithms in this package are specifically optimized for the GPU architecture to achieve high computation efficiency. The results of patient tests suggest that the accuracy and running time of the package have met the clinical requirement for RapidArc QA.

**Funding Support, Disclosures, and Conflict of Interest:**

We acknowledge Varian Medical Systems, Inc. for its support.