Purpose: Patient-specific Quality Assurance (QA) of dose delivery for intracranial linac-based Stereotactic Radiosurgery (SRS) is not a common practice. This study describes an efficient patient-specific measurement using an ion chamber array system to validate the dose at the isocenter plane when High-Definition Multileaf Collimators (HDMLC) are used for planning dynamic arcs in small fields.

Methods: Measurement of dose in typical SRS treatments is a challenge due to the small sizes of the fields. This study focuses in the measurement of dose at one isocenter plane by using the ion chamber array system MatriXX® embedded into the MultiCube® phantom (IBA Dosimetry Inc.) for patients treated with SRS delivered by HDMLC (2.5-mm leaf thickness) using the Novalis-TX linear accelerator. The patient plan is mapped into the phantom placing the isocenter of the lesion in the center of the array, and converting the non-coplanar arcs into coplanar ones. The total dose distribution in the ion-chamber array plane is calculated using the same Treatment Planning Algorithm (TPA) used for the patient plan. The phantom-mapped plan is fully delivered on the phantom such that the combined dose distribution at the isocenter plane of the array is measured directly. A statistical analysis using both the gamma-factor criteria (3% dose difference and 3 mm distance-to-agreement) and the absolute dose difference is then performed between the measured and the calculated dose distributions.

Results: This patient-specific QA was applied to 14 lesions (greater than 1.8 cm in the longest extension) in 7 patients. The percent of pixels with gamma factor greater than one were below 3%, and the percent of pixels with absolute dose difference greater than 5% were less than 5% in all cases.

Conclusions: This patient-specific QA for HDMLC is feasible and effective to ensure the accuracy of calculations by the TPA.