Purpose: Volumetric modulated arc therapy (VMAT) enables stereotactic radiosurgery (SRS) treatment for multiple lesions with a single isocenter setup. Dosimetry verification is highly challenging however, and the purpose of this study is to validate this new treatment using novel 3D dosimetry techniques, with potential for dramatically more comprehensive verification than possible with conventional approaches.

Methods: A cylindrical PRESAGE dosimeter was inserted into an RPC type head phantom for treatment validation. The phantom was immobilized with an SRS U-frame system and a set of simulation CT images was acquired with a SRS localizer. A 5-arc VMAT multi-focal SRS plan was created to treat 5 intracranial lesions simultaneously. A set of cone-beam CT (CBCT) images was then acquired to localize the isocenter, and the VMAT plan delivered to the combined phantom. The PRESAGE dosimeter was then removed and scanned by optical-computed-tomography (optical-CT). The 3D PRESAGE dose measurement was reconstructed with 1 mm resolution. Another PRESAGE insert with a pre-drilled ion chamber channel was placed in the phantom and an SRS ion chamber was mounted for an absolute dose measurement. The phantom was again localized with CBCT and the VMAT plan was delivered. The dose measured with the ion chamber was compared with calculated dose.

Results: The mean planned and PRESAGE measured doses to target 1 were 12.1Gy and 12.2 Gy, 18.7 Gy and 18.5 Gy for target 2, 18.6 Gy and 18.4 Gy for target 3, 15.5 Gy and 15.4 Gy for target 4, 18.7 Gy and 19.0 Gy for target 5. The 3D gamma passing rate was 95.6% for 3% and 1mm. The ion chamber measured dose was within 1% of the planned dose.

Conclusions: Our 3D PRESAGE dose measurement shows that multi-focal VMAT is a valid technique for single isocenter SRS treatment of multiple lesions.

This research is partially supported by NCI R01CA100835.

Funding Support, Disclosures, and Conflict of Interest:

This research is partially supported by NCI R01CA100835.