Monte Carlo simulated peripheral doses in SRS of the brain

Purpose: In arc based brain Stereotactic Radiation Surgery (SRS), a major concern is the accuracy of the peripheral doses to organs close to the treated lesions. This concern is more pronounced when planning software utilizes Pencil Beam algorithm. To evaluate the out-of-target radiation doses to Organs At Risk (OAR) the predicted organ doses by BrainLab Treatment Planning System (TPS) were compared with doses acquired by a Monte Carlo simulation.
Methods and Materials: An arc based brain SRS treatment plan was developed in BrainLab® TPS to be treated on the Novalis® Varian linear accelerator, using 6 MV photon arcs with a 20 mm cone. The doses to different points of interest, representing major OAR were investigated. The photon spectrum in air for 20 mm cone at 100 SSD was designed and verified for the simulation with EGSnrc Monte Carlo particle transport code (DOSRZnrc user code). The resulting Percent Depth Dose (PDD) and dose profile at 75 mm depth were confirmed with respective measurements in a water phantom. Each arc will be approximated by summing simulated discrete angled beams following the arc path and accounting for the difference of their depths to the target. The doses of both calculations will be normalized to an ion chamber measurement at the isocenter.
Results: The greatest difference in the PDD was less than 1%. MC simulated profile at 75 mm depth appeared to be less than 1mm wider than the measured data in the penumbra region.
Conclusions: A method for simulating peripheral doses in SRS was developed. The agreement in the measured and simulated PDD and profile provide a basis for successfully utilizing this method and comparing the calculated peripheral doses by the TPS and the simulated doses by the Monte Carlo technique.