AbstractID: 6727 Title: Evaluation of Different Simulation and Dosimetry Techniques in Small Field Relative Measurements

Purpose: The purpose of this study is to compare and evaluate several dosimetry and simulation techniques that can be used to quantify the beam profiles in small radiation fields, especially in the penumbral regions.

Method & Materials: Several different radiation dosimetry techniques, including ion chamber dosimetry (RK & PinPoint chamber), diode dosimetry (Scanditronix stereotactic diode), and radiographic (EDR) and Gafchromic (HS) film dosimetry were utilized to measure the beam profiles of 5 mm and 45 mm radiosurgery fields at 95 SSD and depth of 5 cm. The profiles from the ion chambers were further analyzed using a detector response function previously determined by Monte Carlo simulations using deconvolution methods to reduce the beam broadening effect produced by the finite detector size. The same radiosurgery fields were also modeled using Monte Carlo (MCNP5) simulation, including modeling chambers and their respective responses. The beam penumbras from the various dosimetry and simulation techniques were then compared.

Results: For the 5 mm cone, the Monte Carlo and diode measurements were in agreement with a 20%-80% penumbra at 1.1 mm. Gafchromic film and the deconvolved RK measurements were larger at 1.8 mm. EDR film and the raw RK chamber penumbras were 2.7 mm. For the 45 mm cone the penumbra results were as follows: Monte Carlo-2.7 mm; diode-2.0 mm; Gafchromic-3.2 mm; deconvolved RK-3.6 mm; EDR-3.7 mm; and raw RK-4.1 mm.

Conclusions: Monte Carlo simulations, stereotactic diode measurements and Gafchromic film have a range of penumbras that are within ~ 1 mm for stereotactic cones. For ion chambers, such as the RK chamber (radius 2 mm), deconvolution of previously determined detector response functions can reduce penumbral broadening due to the larger detector size.