AbstractID: 7432 Title: Dependence of total scatter factors of small beams on the radial distribution of the electron beam incident on the target: a multi-detector and Monte Carlo study

Purpose: To investigate dependence of total scatter factors ($s_{c,p}$) of small beams used in radiosurgery on the radial distribution of the electron beam incident on the target. The study was performed in order to clarify discrepancies observed in $s_{c,p}$ measurements performed by means of different detectors at the Cyberknife radiosurgery system and was aimed at obtaining a means to infer the electron radial distribution of a specific Cyberknife unit.

Method and Materials: PTW PinPoint31014 and Exradin A16 microchambers, PTW30012 diode and TM60003 diamond were used to measure $s_{c,p}$. The same detectors were simulated by means of the Monte Carlo code BEAMnrc to calculate correction factors for $s_{c,p}$. BEAMnrc was also used to calculate theoretical values of $s_{c,p}$. Accuracy of Monte Carlo simulation depends on the choice of energy, divergence and radial distribution of the electron beam incident on the target. The energy was determined by comparison to experimental TMRs. Radial distribution of the electron beam (expressed as FWHM, gaussian shape) was chosen to be optimal when correction factors of the 4 detectors were such that corrected $s_{c,p}$ converged to the same value within +/-1%.

Results: measured $s_{c,p}$ of the 5mm collimator averaged 0.638 -4%+11% with the 4 detectors. E=7.2MeV best matched calculated to experimental TMRs. Optimal FWHM=2.3mm gave $s_{c,p}$=0.673 -0.7%+0.3%. Correction factors decreased with increasing FWHM, while Monte Carlo-calculated $s_{c,p}$ increased. Measured (corrected) and calculated $s_{c,p}$ matched at 0.673 only for FWHM=2.3mm.

Conclusion: Variations of electron beam focussing can explain significant variations of $s_{c,p}$. If one of the investigated detectors is used, it is possible to infer actual FWHM values and thus appropriate correction factors by comparison to pure Monte Carlo-calculated $s_{c,p}$ values as a function of FWHM. This fact could be exploited by centres who do not have access to Monte Carlo codes to simulate their own system.