AbstractID: 4876 Title: A comprehensive dosimetric protocol for the Cyberknife radiosurgery system

Purpose: To propose dosimetric guidelines specifically designed for the Cyberknife radiosurgery system. Non-availability of $10x10cm^2$ field and use of small circular collimators (5mm to 60mm) pose serious problems, that have been faced in this study by means of 8 different detectors and Monte Carlo simulation. This work is oriented to measurement of total scatter factors ($S_{c,p}$) and to reference dosimetry, though indications will also be given in view of a comprehensive guideline.

Method and Materials: PTW PinPoint 31014, Exradin A16 and T14P microchambers, TN 502RDM micromosfet, PTW 30008 diode and TM60003 diamond, MD55 and EBT radiochromic films were used to measure $S_{c,p}$. Monte Carlo simulations (BEAMnrc) were used to produce phase space descriptions at the exit plane of each collimator, to calculate: 1) theoretical $S_{c,p}$ values in water, and 2) correction factors to be applied to $S_{c,p}$ as measured by 5 detectors (PinPoint, A16, T14P, diode, diamond), obtained by simulating shape and chemical composition of each detector. BEAMnrc was also used to calculate stopping power ratios and chamber correction factors for the Cyberknife linac, to decide whether values of k_Q from the IAEA398 protocol could be applied without using a $10x10cm^2$ field.

Results: $S_{c,p}$ of the 5mm collimator as measured by simulated detectors averaged 0.653 -9%+14%. Variation for larger collimators was smaller. After Monte Carlo correction, $S_{c,p}$ of the 5mm collimator became 0.686 -2%+1%. Pure Monte Carlo calculation gave $S_{c,p}$=0.715 +/-1%. Calculation of correction factors showed that k_Q values for the investigated chambers could be chosen when using IAEA398, introducing +/-0.2% uncertainty.

Conclusion: Pure Monte Carlo calculation gave higher values of $S_{c,p}$ compared to Monte Carlo-corrected measurement. The latter is to be preferred because correction factors are less sensitive to beam parameters than pure calculation of $S_{c,p}$. For determination of $S_{c,p}$ use of microchambers and Monte Carlo correction is recommended.