

Purpose: To estimate total scatter factors ($s_{c,p}$) of small 6 MV photon beams from a Siemens Primus linear accelerator.

Method and Materials: A method of estimation of $s_{c,p}$ of small beams previously applied to circular fields of the Cyberknife radiosurgery system has now been applied to square fields of 0.3 cm and 0.5 cm field size (reference field 10 cm). Experimental measurements were made with a PTW31014 PinPoint chamber and with 3 diodes (PTW60012, PTW60008 and SunNuclear EdgeDetectorTM). The method consists of Monte Carlo simulation (BEAMnrc) of the active volume of the detectors and of the treatment head in the hypothesis of 6 different values of FWHM of the electron beam incident on the target (1.0 to 2.5 mm). Possible outcomes are then checked for consistency with experimental results to determine correction factors to be applied to experimental $s_{c,p}$.

Results: Corrected $s_{c,p}$ values of the 2 fields were 0.085 and 0.243 with the PinPoint chamber compared to 0.049 and 0.234 resulting from uncorrected measurement. Corrected $s_{c,p}$ values of the 2 fields were on average 0.075 and 0.256 with the diodes compared to 0.082 and 0.272. The FWHM of the electron beam was consistently estimated between 1.8 and 2.0 mm for all the detectors.

Conclusion: This strategy has the advantage of avoiding any "a priori" beam tuning of the electron beam width in the Monte Carlo model because it takes into account the whole range of possible values and uses the actual shape and chemical composition of the detectors in the simulation. Results are consistent with underestimation of $s_{c,p}$ from the ion chamber, partly due to volume effect, and overestimation from the diodes due to non-water equivalence of the silicon substrate (all) and of the metal shield (PTW60008 and SunNuclear). The method will be extended to include more field sizes.