AbstractID: 8433 Title: Characteristics and dosimetric parameters of small radiosurgery photon beams

Purpose:
The accuracy of dosimetric parameters, such as water-to-air stopping power ratios, directly affects the accuracy of a beam calibration. This study investigates the variation of dosimetric parameters, such as energy spectrum, water-to-air stopping power ratios, energy absorption coefficient, etc., as a function of field size and depth in water for small radiosurgery photon beams.

Method and Materials:
The Monte Carlo simulation techniques were used in this study. The accelerator head geometries of a Varian Trilogy were simulated in detail including two designs of flattening filters: one for a conventional dose rate (100-600 MU/min) and the other for a high-dose rate (1000 MU/min) 6 MV beam. The design of the flattening filter to produce a high-dose rate beam limits its maximum field size to 10x10 cm^2. The investigated field sizes range from 0.5 cm in diameter to 10x10 cm^2 and depths range from 0-50 cm in water.

Results:
Although there are noticeable differences in the spectrum distributions for beams with different flattening filters, the variations in calculated water-to-air stopping power ratios (SPR) are within 0.2%. The values of calculated water-to-air SPR as a function of field size and depth in a water phantom show a maximum variation of 0.4% and 1% respectively. The mean energy of photons increases as depth increases at a rate of 22 keV/cm for small fields.

Conclusion:
There is an insignificant variation (<0.4%) in water-to-air stopping power ratios between a small narrow field and a reference 10x10 cm^2 field. There is negligible difference (0.2%) in water-to-air SPR between beams with two very different beam flattening filters. Variations of water-to-air SPR are not significant between small and large field. Hence correction of water-to-air SPR between a reference field and a small field is negligible in the dose measurement for the small field.