AbstractID: 9459 Title: Experimental techniques for the determination of relative radiation output from small stereotactic radiosurgery photon beams

Purpose: Accurate determination of radiation output from photon beams <3×3 cm^2 has been hampered by the lack of an ideal dosimeter. Even with small volume ionization chamber, its relatively large aspect-radio of active volume and the attached stem and electronic cable often introduce unintended error. The aim of this work was to investigate the utility of micro thermaluminescent dosimeter (TLD) in the experimental determination of output factor (OF) for small photon beams.

Method and Materials: Output factor of 6MV high-dose-rate stereotactic photon beam with field sizes of 1×1 to 3×3 relative to 10×10 cm^2 were measured. A 0.015 cm^3 PTW PinPoint chamber with 2-mm inner diameter and about 5-mm long active volume and 1×1×1 mm^3 micro TLD cubes were used. To minimize the volume-averaging and stem effects, a new experimental setup that aligns the chamber's longitudinal axis to the beam's central axis was used. To minimize statistical uncertainties of TLD, a new approach that utilizes TLD's dose response rate measured for each field size was used for OF determination, instead of using the dose response for fixed beam-on time.

Results: Output factors measured by the TLD cubes (and PinPoint chamber) for 1×1, 2×2, and 3×3 cm^2 beams were 0.753 (0.736), 0.859 (0.864), and 0.891 (0.901), respectively. The agreements were better than 2.5%. The TLD measured OF was consistently higher than that measured by PinPoint chamber for the 1×1 cm^2 field.

Conclusions: Micro-TLD cube has the attributes of an ideal detector: tissue equivalent and free of stem and cable artifacts. The measured OF was comparable to that measured by a Pinpoint chamber. Volume-averaging across the relatively larger chamber diameter could be responsible for the smaller chamber measured OF. Monte Carlo simulations using scoring volume equivalent to each detector's active volume are being performed to quantify this effect.