AbstractID: 5677 Title: Analysis of Photon Beam Data from Multiple Institutions:

Purpose: Beam data requirements to support sophisticated treatment planning and delivery techniques are increasingly rigorous. Small field photon measurements are particularly challenging for many centers and practitioners. The purpose of this work is to compare measured beam data characteristics from identical linear accelerators contributed by multiple institutions.

Methods and Materials: Measured beam data from 43 "identical" 6 MV linear accelerators were collected from 43 different institutions. A common treatment planning system was used by all participating institutions, standardizing the data collected and simplifying the analysis. Beam data consisted of percent depth dose (PDD), cross-beam profiles and relative scatter factors (SF) as a function of field size. Beam data for field sizes less than 1 x 1 cm^2 were contributed by the majority of institutions. A dose-to-monitor unit conversion factor was also obtained. All data were normalized in a consistent manner for direct comparison.

Data were analyzed using a commercial analysis package. Mean, standard deviation, minimum and maximum deviation were calculated for the PDD data. A one-population t-test was applied to PDD, scatter factors and dose-to-MU factors to identify statistically significant differences.

Results: PDD data for a 10x10 cm^2 field size were remarkably consistent among institutions, with 1σ variation of less than 1% at all depths beyond d_{max}. In contrast, significant variation was observed in small field PDD data; at 0.6x0.6 cm^2, the PDD at 10 cm fell outside the 95% confidence level at 63.2% of institutions. Measurement of small field output factors proved to be equally variable. Several significant outliers were noted in dose-to-monitor unit conversion factors.

Conclusions: Significant differences exist in beam data collected by multiple institutions for identical linear accelerators. Uniform procedures are needed to increase the quality and consistency of measured beam data. Use of a reference set of beam data may help to eliminate fundamental errors.