AbstractID: 7048 Title: Angular distribution of photon energy spectra emitted by low-energy interstitial brachytherapy sources

Purpose: The cylindrical geometry associated with the current low-energy interstitial brachytherapy sources is known to produce lesser dose near the ends of each source that are 1) highly dependent on source construction and 2) potentially harmful to a successful brachytherapy treatment. The aim of this work was to establish an experimental technique for quantitative determination of the angular variation of photon energy spectra emitted by the low-energy sources.

Method and Materials: A high-purity Germanium detector designed for low-energy photon spectrometry was used to measure the energy spectra emitted by brachytherapy sources. A remote-controlled source holder was constructed to hold the source at a desired source-to-detector distance with minimum disturbance to the emitted photons and to precisely rotate the source around a radial axis in the source's bisector. Two ^{103}Pd source models, one constructed with traditional titanium encapsulation and the other with a novel polymer encapsulation were used to test the experimental setup and to study the dependence of angular spectra distribution on source construction.

Results: Larger than 40% reduction in photon fluence was observed near the ends of both source models relative to the fluence emitted along the radial direction in their bisectors. The use of polymer encapsulation resulted in minimal encapsulation-induced spectral hardening to the photons emitted by bare ^{103}Pd. It also resulted in improved spatial isotropy of the emitted photon fluence as compared to the titanium encapsulation. Additional variations in angular fluence distribution that were linked to specific source construction features were also observed.

Conclusions: The angular distribution of photon energy spectra emitted by low-energy brachytherapy sources can be measured with high accuracy (better than 4%) using a high-resolution photon spectrometer. This complete spectral information is needed for accurate determination of dose distribution around each source and for optimizing the source design to reduce fluence anisotropy.