AbstractID: 8999 Title: Desired Dose Distributions from Newly-Designed Low-Energy Needle-Based X-ray Sources

Purpose: to establish a dosimetry system in developing a low-energy (17.5 keV) needle-based miniature x-ray generator using BANG-3 Polymer Gel. **Method and Materials:** A newly-designed miniature x-ray generator (Advanced X-Ray Technology, Inc.) used an off-shelf X-ray tube with an Ag-anode to produce the primary X-rays of 22 keV K_α that were optically collimated and focused at a cone- or wedge-shaped Mo target in a detachable needle. The Mo-target absorbed most of the primary X-rays and emitted the pure K_α X-rays of 17.5 keV to be used for brachytherapy. The dose distribution at the vicinity of the needle was measured with custom BANG-3 polymer gel (MGS Research Inc.) cylindrical phantoms according to the calibrated relationship between the dose and R2 (=1/T2) in 3 Tesla MR images with 1.5 mm slice thickness + 0.5 mm gap or 2 mm slice thickness + 1 mm gap. The calibration phantoms had filled with the same gel and scanned under the same conditions but irradiated by the primary beams with doses determined with a parallel-plate ionization chamber. **Results:** The gel dosimeter calibration curve was closely approximated by Dose (Gy) = -5.685.6136 + 1.630 x R2 (1/s) with $R^2 > 0.9$. After 60 min exposures using the cone- and wedge-shaped target needles, the expected full and half ring-type dose distributions were respectively obtained on the Gel dosimetry phantoms. High dose rate of ~12 cGy/min at the radius of 0.5 cm was achieved under high input current. **Conclusion:** Our results demonstrated that the miniature x-ray generator could be used as a new source in LDR and HDR brachytherapy with electronically controlled dose rate and dose distribution. BANG-3 Polymer gel dosimetry played an essential role in development of the low energy X-ray source.