

AbstractID: 6741 Title: Validation of a new radiochromic film calibration protocol and a gel-based phantom for beta dosimetry applications

**Purpose:** To validate a new film calibration protocol and a gel-based phantom for use in beta dosimetry by comparing the dose rate measured from a single  $^{90}\text{Sr}$  seed to Monte Carlo simulations.

**Method and Materials:** Two acrylic boxes were constructed and a catheter hole was drilled 2 mm below the surface of one box. A single lumen catheter was placed through the hole and both boxes were filled with porcine gel (90% water and 10% gel). After the gel solidified, a single  $^{90}\text{Sr}$  seed was loaded into the catheter and a sheet of HD-810 radiochromic film was sandwiched between the two box halves. A Microtek flatbed scanner, an ophthalmic applicator, and a background subtraction technique were used to readout and calibrate the film. A validated Monte Carlo code simulated the seed, phantom, and film geometry. To verify the Monte Carlo simulation, the output was compared to previously published data. Since Monte Carlo provides the dose per starting particle, a highly accurate and precise non-destructive assay of the source seed was required to calculate the absolute dose rate. The recently updated internal pair production branching ratio for  $^{90}\text{Y}$  and a high-purity germanium detector were used to assay the  $^{90}\text{Sr}$  seed. The efficiency for detecting 511 keV photons was determined using a certified  $^{22}\text{Na}$  solution.

**Results:** The dose rate measured with film was  $2.70 \text{ Gy/min} \pm 4.7\%$  using a region of interest (ROI) of  $0.5 \text{ mm} \times 0.5 \text{ mm}$ . The Monte Carlo calculated dose rate was  $2.75 \text{ Gy/min} \pm 5.1\%$  for the same ROI using a measured seed activity of 2.64 mCi.

**Conclusion:** Overall, there was a 1.8% difference between the film dose measurement and the Monte Carlo-based calculation. Together, the HD-810 radiochromic film, the calibration protocol, and the gel phantom were shown to provide accurate beta dosimetry.