

AbstractID: 6972 Title: Evaluation of Heterogeneity Effect in Intra-Operative HDR (IOHDR) Brachytherapy Dose Calculation using Monte Carlo Simulation and GAFCHROMIC EBT Film Measurement

Purpose: Investigate the heterogeneity effect due to air cavity and lead sheets in intro-operative High-Dose-Rate (IOHDR) brachytherapy dose calculation using Monte Carlo (MC) simulation and GAFCHROMIC EBT film measurement.

Method and Materials: The organs-at-risk (OARs) in IOHDR treatment are usually pushed away from applicators and covered by lead sheets. The dose estimations to OARs are affected by local heterogeneities like air gap and lead sheets and difficult to calculate by conventional treatment planning systems, where infinitely homogeneous water environment is assumed. This study used both MC simulation and Gafchromic film measurement to access the heterogeneity effect of dose calculations in a phantom setting. Nine 5x5cm² sloid water slabs, each 2mm thick, were put on a 30x30x20cm³ solid water phantom. Gafchromic EBT films were place at 0, 4, 8 12 mm depth between the slabs. The Ir-192HDR source was place 19 mm above the slabs in the air. 0-3 lead sheets, each 0.9mm thick, were placed directly on top of the slabs. MC Photo Transport code (PTRAN) was used to simulate doses at each film positions and compared with film measurements.

Results: The MC simulation agrees with film measurements within 5% except data points directly under lead sheets where dose enhancement by secondary electrons was not simulated in PTRAN. The heterogeneity correction factor (HCF), defined as dose ratio of with and without lead sheets at surface of the slabs is 147%, 121% and 96%, for 1-3 lead sheets respectively. At 4-12mm depth in water slabs, the HCFs are approximately 81%, 65% and 53% for 1-3 lead sheets.

Conclusion: Significant dose enhancement was found directly under lead sheets. HCF data obtained in this study can be used to estimate doses to OARs in IOHDR treatment. The MC simulation was proved to be useful to calculate doses to OARs at complex clinical settings.