Heterogeneity Effect of Small Fields for Intensity Modulation with 6MV Photons

Narrow, elongated or very small beams are typically required for intensity modulated radiation therapy (IMRT) with devices such as the NOMOS Mimic and dynamic multileaf collimation. Inhomogeneity corrections (IC) for small 6MV photon beams were investigated for several geometries including: (1) field size, (2) lung thicknesses (2, 4, 6cm), and (3) lung and bone location. Capintec PR-05P (0.07cm^3) and Exradin A14 (0.009cm^3) ionization chambers were used for measurements. The measurement point was at 2cm beyond the distal interface of media relative to the source. The ionization readings for various field sizes were compared to those measured in a homogenous water phantom including additional measurements of small-field TARs at 6 and 10cm depths. A maximum IC of 1.235 was found for a 1cm x 1cm field size. The RTAR method underpredicted the IC by 7% for 1cm x 1cm and 1cm x 10cm fields. The ETAR method for this geometry generated the same IC factor as the RTAR method. Without IC, a 9% error resulted with 2cm air gap or 2cm bone for a 1cm x 1cm field size. The differences of IC depending on lung and bone location were within 3%. We conclude that IC for small fields can be significant. Benchmark data such as these are needed for IMRT dose calculation algorithm verification.