

AbstractID: 8982 Title: An analytical approach to account for shielding, anatomical heterogeneities and patient dimensions for ¹⁹²Ir high dose rate brachytherapy applications

Purpose: Based on a separate primary and scatter dose calculation technique and pre-computed Monte Carlo (MC) data, we have developed an analytical approach to account for shielding, anatomical heterogeneities and patient dimensions for ¹⁹²Ir high dose rate (HDR) brachytherapy.

Method and Materials: Using the PTRAN_CT MC code, primary and scatter dose kernels of an HDR source in water were generated. Separate 3D kernels for rectal treatment with a tungsten-shielded applicator were also created. Photon attenuation and scatter in tissue heterogeneities were corrected for via ray tracing. To quantify the reduced backscatter close to the skin, MC simulations were performed with an isotropic ¹⁹²Ir point source placed at various distances from the center of a 30 cm diameter water sphere. Scatter correction factors were derived, which vary as a function of distances between (1) the source and the surface, (2) the point of interest and the source, and (3) the point of interest and the surface. We applied this analytical method for three clinical cases and compared the results with PTRAN_CT calculations.

Results: Our technique accurately accounted for the effects of tungsten shielding and anatomical heterogeneities for a rectal patient plan. The reduced backscatter close to the skin was also calculated correctly for a base of tongue and a breast case. Around bony structures several centimeters away from the active dwell positions, there was a minor discrepancy due to softening of the ¹⁹²Ir spectrum. Differences in the lung due to reduced scattering in this low density region were also observed.

Conclusion: Making use of pre-computed 3D scatter dose data, our analytical technique is capable of calculating dose around metal shielding and the patient skin with high accuracy. Its validity and limitations have been studied for ¹⁹²Ir HDR applications.

Conflict of Interest (only if applicable): Research sponsored by Nucletron BV.