

AbstractID: 3024 Title: Clinical Impact of Seed Density and Prostate Elemental Composition on Permanent Seed Implant Dosimetry

Purpose: To evaluate the impact of inter-seed attenuation and prostate elemental composition in clinical prostate treatment plans with 6711 125I permanent seed implants using the Monte Carlo (MC) method. The effect of seed density (number of seeds per prostate unit volume) is specifically investigated.

Method and Materials: The MC toolkit Geant4 is used to perform the simulations. The study focuses on treatment plans that were generated for clinical cases. For each plan, four different dose calculation techniques are compared: TG43-based calculation, superposition MC (SMC), full MC with water prostate (MCW), and full MC with realistic prostate tissue (MCP). The SMC method is a technique for which a shifted one-source MC distribution is added to the total dose distribution for each source position. The realistic prostate composition includes the ten most abundant elements in prostate tissue based on ICRP23.

Results: Seed density has a definite influence on inter-seed attenuation. A typical low seed density (42 0.6 mCi seeds in a 26 cc prostate) corresponds to a 0.7% drop in the CTV D90 value when comparing SMC to MCW while a drop of 2.5% is calculated for a higher seed density (75 0.3 mCi seeds, same prostate). The influence of the prostate elemental composition is similar for all plans. When comparing MCW to MCP, the difference in total dose deposited in the CTV is 3.0 +/- 0.2%, while it is 3.6 +/- 0.3% for the D90 parameter. When considering all effects, the variation on the CTV D90 value is ranging from 3.8% to 9.3% when comparing TG43 to MCP, depending on the seed density.

Conclusion: The MC study establishes the dependence of inter-seed attenuation on seed density and reveals a 3% overdose for a water prostate compared to a realistic composition. Overall, the effect on the CTV dosimetry is clinically significant.