AbstractID: 10800 Title: A practical method of composition ratio QA for 103Pd and 125I hybrid seeds: derivation and Monte Carlo verification

Purpose: In prostate cancer treatment, Brachytherapy using radioactive seeds of ^{125}I or ^{103}Pd is a common practice. Studies using the concept of BED have shown that it would be beneficial to treat prostate cancer with mixture of radioactive seeds of isotopes with different half-lives. Commercially, the technology to manufacture multi-isotope seeds has been developed by IsoAid LLC (IsoAid, Port Richey, FL). To be used clinically, a method of QA regarding the composition ratios of the hybrid sources must be developed in addition to other physical quantities QA. **Method and Materials:** The difference in energy spectra between ^{125}I and ^{103}Pd determines that the attenuation of the two isotope components is different when the γ-rays passing through the same material. Thus for hybrid sources, the attenuation magnitude through a certain thickness of a certain material depends on the composition ratio. Simple methods were derived based on attenuation measurements using a cylindrical chamber or well chamber. Monte Carlo simulations were performed to verify the methods. Doses at 1 cm depth in water were calculated with and without attenuation materials for pure ^{125}I and ^{103}Pd sources and hybrid sources of different composition ratios. Different measurement settings using a well chamber or cylindrical chamber were simulated. The energy spectra of the radioisotopes that were used in TG-43 were used in the Monte Carlo calculations. **Results:** Monte Carlo simulations verified that the method based on attenuation measurement is accurate and practical. Corrections for measurement depth variation and measurement time are discussed. If the measurement depth is 0.5 mm off, the error of the composition ratio can be up to 1.6%. The advantages/disadvantages of different measurement techniques using a cylindrical chamber or well chamber are presented. **Conclusions:** composition ratios of hybrid seeds can be determined by attenuation measurement method presented in this work.