AbstractID: 2967 Title: Dosimetry Comparison of LDR ¹³⁷Cs and LDR ²⁵²Cf Brachytherapy Sources

Purpose:
Hundreds of patients have received gynecological brachytherapy treatments in the US using applicator tube-type (AT) low dose rate (LDR) ^{252}Cf sources. However, its mixed-field radiation dose distributions have not been characterized using the AAPM Task Group 43 dosimetry formalism, nor quantitatively compared to conventional photon-emitting sources. Towards clinical implementation of LDR ^{252}Cf brachytherapy for gynecological applications, the mixed-field dosimetry for this source type has been modeled using Monte Carlo methods and compared to dose distributions produced by LDR ^{137}Cs brachytherapy sources.

Method and Materials:
Mixed-field dose distributions in the vicinity of an AT LDR ^{252}Cf brachytherapy source were calculated using MCNP5 in a 50 cm diameter spherical phantom composed of water, soft tissue, and muscle. ENDF ^{252}Cf neutron energy spectrum was used. Published ^{252}Cf photon energy spectra were employed and compared. The MCNP F4 and F6 calculation tallies were utilized for determining various dosimetric components. These include the source photon, neutron capture photon, fast neutron, and thermal neutron dose components. The LDR ^{137}Cs source used for comparison was the 3M Model 6500.

Results:
Brachytherapy dosimetry parameters for LDR ^{252}Cf neutrons were in agreement with previously published values. TG-43 dosimetry parameters for ^{252}Cf photons exhibited a maximum g(r) value at 10 cm due to induction of capture photons in the phantom and a general decrease in anisotropy with increasing radial distance. ^{252}Cf photon spectra including estimates of delayed photons exhibited –2% difference in g(r) and 5% relative variation in anisotropy at $\theta = 0°$. Dose distributions generated from dosimetry parameters for LDR AT ^{252}Cf were similar to those produced by conventional ^{137}Cs sources using the Pinnacle^3 Planning System.

Conclusion:
Using appropriate radiobiological weighting for ^{252}Cf neutrons, treatment planning for AT LDR ^{252}Cf sources may be performed and compared to conventional ^{137}Cs dosimetry for gynecological applications.