AbstractID: 3425 Title: Error analysis in Monte Carlo simulation of low energy brachytherapy sources

Purpose: The AAPM recommends two independent investigators to determine the dosimetric characteristics of any new brachytherapy sources before their clinical applications. In this recommendation, it is suggested that one of the two investigators must include Monte Carlo simulation technique. The accuracy of Monte Carlo simulation technique is highly dependent on accuracy of the source geometry and material information that is provided by the manufacturers, and the approximations taken during the simulations. In the present work, the effects of various parameters like configuration of active pellets, outer wall thickness and end cap thickness on the accuracy of the dosimetric characteristics of the brachytherapy sources have been investigated. Also, studies were performed to determine the effect of embedded radioactive elements within the source, and effect of number of histories used for calculating the dosimetric parameters.

Method and Materials: Monte Carlo simulation code PTRAN version 7.43 was used to simulate the source designs in water medium. The photon cross section used for these simulations was DLC-146, distributed by the Radiation Sciences Information Computing Center at Oak Ridge National Laboratory. The variations of dosimetric characteristics of different brachytherapy source design with a fixed radionuclide were obtained following the AAPM TG-43U1 recommendations.

Results: The results of these investigations showed that the anisotropy function and anisotropy factors of the source were considerably affected by the thickness of the outer wall and end caps. Whereas, the radial dose function and the dose rate constant were not significantly affected by these parameters. Moreover larger histories are required to obtain dosimetric characteristics at larger distances with acceptable ($< \pm 2\%$) statistical uncertainty range.

Conclusion: This study suggests that the Monte Carlo simulated 2D anisotropy functions for low energy brachytherapy sources are very sensitive to the geometric parameters of the source and number of histories used in simulation.