AbstractID: 8558 Title: Development of Monte Carlo-aided ray tracing technique for verification of Cesium intracavitary brachytherapy seed

The purpose of this study is to develop Monte Carlo-aided ray tracing technique (MART) for treatment planning system that utilizes an intracavitary brachytherapy seed such as a (^{137}Cs) 3M Model 6500. Conventional ray-trace algorithms use the linear relationship of energy flux with dose-rate distribution introducing an energy absorption factor. For more accuracy, however, considering nonlinear effects such as photoelectric effect, Compton scattering, and multiple-scattering lead us to development of a nonlinear relationship by using accurate analysis tool as Monte Carlo (MC) simulation. This study includes comparison of Williamson's and Waggener's tables for 2-D dose-rate distribution in tissue to verify the accuracy of MC calculation with MCNP 4C code and that of MART. Because of asymmetry seed configuration, Waggener and Williamson defined different coordinates, which bring 0.8-mm, longitudinal offset in comparison of their dose rate tables. To resolve the conflict between two tables, we developed MC simulation with 1-mm interval. The result shows that 0.8-mm offset causes ~10% dose-rate difference at 2 cm from the center of coordinate in longitudinal direction. Furthermore, we performed additional MC simulation for water phantom with 0.662-MeV point source to develop relationship between results from ray-tracing technique and MC calculation. The nonlinear relationship of energy flux from ray-tracing technique with dose-rate from MC simulation in this study is expressed as $ln(D_{dose}) = 0.96*ln(E_{flux}) - 1.811$. The MART provides 2-D/3-D dose-rate distribution that matches to the MC result within 5% difference. This study shows that the MART is fast and accurate in multi-dimensional dose-rate calculation in brachytherapy.