AbstractID: 6946 Title: Feasability of a Treatment Nozzle without a Range Modulator Wheel using the Passive Scattering Technique

Purpose: The purpose of this work was to study the feasibility of producing a spread out Bragg peak (SOBP) without a range modulation wheel (RMW) using the passive scattering beam delivery technique.

Method and Materials: Monte Carlo simulations of a passive scattering treatment nozzle were performed using the MCNPX Monte Carlo code. The model was developed using manufacturer design data and calculations were validated against measurements. In this work, the RMW was replaced with a fixed thickness, non-rotating scatterer (RMW-free configuration). For the RMW-free method, SOBPs are produced by changing the relevant initial energy injected into the nozzle and weighting each individual energy Bragg peak by an original energy-dependent weighting factor. The depth and cross-field dose profiles in water were calculated for incident beam energies from 100-250 MeV. The RMW-free SOBP results were successfully compared to both simulated and measured data.

Results: SOBPs and cross-field dose profiles calculated with the RMW-free technique were found to be analogous to calculations and measurements from the standard treatment nozzle, with RMW-free to standard-RMW ratios of approximately unity for all calculated profiles. In addition, calculations showed that RMW-free method produced a dose rate increase in water and also a reduction in the in-air secondary neutron fluence at isocenter.

Conclusion: Our results indicate that SOBPs of various widths can be produced without an RMW using only a thin fixed scatterer in its place. Comparable depth dose curves and cross-field profiles were calculated with the RMW-free method using a newly developed energy-dependent weighting function based on the range of protons in water. Based on this preliminary evaluation, we believe that this method could result in an increase in the treatment dose rate and also a significant reduction in secondary neutron exposures to the patient.