

AbstractID: 10655 Title: Comparison of Calculated RBE between Actively Scanned and Passively Scattered Carbon Beams Based on GEANT4 Monte Carlo Simulations

Purpose: To compare calculations of the relative biological effectiveness (RBE) for a passively scattered carbon beam to that for a scanned beam with the same physical dose distribution in the spread out Bragg peak (SOBP). It is possible that differences in the spectrum of the fragments between the two beams could significantly affect the RBE, making it difficult to compare clinical doses from scattered and scanned carbon beams. **Method and Materials:** A simulation program based on the GEANT4 toolkit was developed to mimic measurements and other simulations from a passively scattering carbon beam at the NIRS in Japan. Closely spaced pristine Bragg peaks in water were simulated for both a scanned beam -- where depth was adjusted by adjusting energy directly -- and for a passively scattered beam -- where depth was adjusted by changing the thickness of an aluminum degrader. Pristine peaks were then weighted to fit a pre-defined SOBP dose distribution. RBEs for both beams were calculated using the linear-quadratic survival model in use at NIRS. The depth dose, calculated RBE, and effective doses were then compared between the scanned beam simulation and the passive beam simulation. **Results:** No significant difference was found in the calculated RBE between the scanned carbon beam and the scattered carbon beam. After fitting to the SOBP region of previously published data, no significant difference was found in the dose, RBE, or effective dose between the scanned beams and the scattered beam. **Conclusion:** This work indicates that it should be possible to equate the biological effective doses between scattered and scanned carbon beams in so much as the LQ RBE model used can predict differences in the beams.