

AbstractID: 5129 Title: Effects of IMRT Treatment Time Prolongation on Tumor Cell Survival 1

Purpose: To quantify the loss in effective dose resulting from prolongation of treatment fraction delivery times associated with IMRT, and investigate the corresponding effects for neutron IMRT.

Method and Materials: The effect of treatment fraction delivery time prolongation was investigated *in vitro* using human PC3 prostate and HGL21 and U373 glioblastoma tumor cell lines. Cells were maintained at 37 degrees Celsius and irradiated with photons from a conventional linac and with d(48.5)+Be fast neutrons. The delivery time for simulated, multiple-port fractions was varied from acute to 60 minutes for photon irradiation, and acute to 120 minutes for neutron irradiation. Physical dose ranges for cell survival analysis were 0.5-6 Gy and 0.16-2 Gy for photons and neutrons, respectively.

Results: Prolonging photon delivery time (from initiation to completion of irradiation) from 5 to 45 minutes resulted in a loss in effective dose of 6% and 11% in the PC3 and HGL21 cell lines, respectively. A loss of <1% in effective dose was observed for similar prolongation of neutron irradiation of PC3 and HGL21, and photon irradiation of U373 cells. More clinically common prolongations of 5 to 30 and 5 to 15 minutes resulted in effective dose reductions of 4% and 1.5% for PC3, and 6% and 2.5% for HGL21. Application of typical dose response gradients would result in even larger percentage reductions in calculated TCP.

Conclusions: This work indicates that prolonged fraction delivery times may have a significant impact on treatment outcome for tumors with a low α/β ratio and short repair half-time. These effects are significant at delivery times commonly associated with IMRT and are highly variable with cell type. Fraction delivery time should therefore be minimized to achieve the most predictable radiobiological effect. This work also demonstrates that the biological effect of neutron radiotherapy is independent of fraction delivery time.