AbstractID: 6739 Title: In vitro validation of temporal optimization effects on cell survival for a single fraction of radiation

Purpose: To experimentally validate how temporal modification of the applied dose pattern within a single fraction of radiation therapy affects cell survival.

Method and Materials: The linear quadratic (LQ) repair-time model predicts that, for a single fraction of dose, the degree of cell kill is dependent on the pattern of dose applied over a period of irradiation. Previously, we demonstrated that: (1) maximum cell kill is achieved using a "triangular" temporal dose pattern (delivering the highest doses during the middle of a fraction and the lowest at the beginning and end), and (2) minimum cell kill is achieved with a "V-shaped" pattern (delivering the lowest doses at the middle of a fraction and the highest at the beginning and end). Furthermore, the model also predicted that cells with low α/β values will have a larger difference in survival based on the applied pattern of dose. Two cells lines with low α/β values (PC-3, WiDr) and one with a high α/β value (SQ-20b) were chosen for this study. For each cell line, one group of cells in a six-well plate received 9 Gy in a triangular dose pattern, and the same dose was delivered to a second plate using a V-shaped pattern. The delivery time for each dose pattern was 20 min. Cell survival was assessed using a clonogenic assay.

Results: For the SQ-20b cells, irradiation with both dose patterns resulted in only a 4.5% relative difference in cell survival ($p>0.25$). However, the triangle and V-shaped patterns resulted in relative cell survival differences of 15.2% and 18.6% for both the PC-3 ($p<0.025$) and WiDr ($p<0.01$) cell lines, respectively.

Conclusion: These results verify the assertions of the modeling study *in vitro*, and imply that the temporal pattern of applied dose is another variable to be considered in treatment planning and delivery.