

**AbstractID: 6726 Title: Investigating the temporal effects of respiratory gated IMRT treatment delivery on in vitro survival: A theoretical and experimental study**

**Purpose:** Respiratory gated radiotherapy changes radiation delivery compared to conformal radiotherapy (CRT) in two ways: the beam is periodically turned on and off and treatment time is increased. IMRT also changes radiation delivery in two ways: only part of the tumor is irradiated at any given time and the treatment time is increased. The aim of this research was to experimentally and theoretically investigate the temporal effects of respiratory gated and IMRT treatment delivery on *in vitro* survival.

**Method and Materials:** Four radiation delivery methods were investigated: CRT, IMRT, gated CRT and gated IMRT. Experiments were designed to isolate the effects of periodic irradiation (gating), partial tumor irradiation (IMRT) and extended treatment time (gating and IMRT). For the experimental studies V79 Chinese hamster cells were irradiated to 2Gy with four delivery methods and a clonogenic assay performed. The theoretical calculations used the incomplete repair model. The biological parameters of the model were taken from a previous publication studying V79 cells; the remaining parameters of the model were determined from the biological experiments.

**Results:** Treatment times ranged from 1.67 (CRT) to 15minutes (gated IMRT). Survival fraction (SF) calculations ranged from 68.2% for CRT to 68.7% for gated IMRT. For the same treatment time (5minutes), gated delivery alone and IMRT delivery alone both had calculated SF of 68.3%. The experimental values ranged from 65.7( $\pm$ 1.0)% to 67.3( $\pm$ 1.3)% indicating no significant difference between the experimental observations and theoretical calculations.

**Conclusion:** Of the three temporal effects of radiation delivery caused by gating and IMRT, extended treatment time was the dominant effect compared with periodic irradiation (gating) and partial tumor irradiation (IMRT). Care should be taken clinically to ensure that the use of gated IMRT does not significantly increase treatment times by evaluating appropriate duty cycles for respiratory gating and the complexity of IMRT delivery.