AbstractID: 9268 Title: Impact of Prolonged Dose-Delivery Time on Tumor Control: A Note of Caution for IMRT

Intensity modulated radiation therapy (IMRT) allows greater dose conformity to tumor target. However, IMRT, especially static delivery, usually requires more time to deliver a dose fraction than conventional external-beam radiotherapy (EBRT). The purpose of this work is to explore the potential impact of such prolonged dose-delivery times on treatment outcome. The generalized linear-quadratic (LQ) model was used to calculate the cell-killing efficiency of various simplified and clinical IMRT plans. LQ parameters derived from clinical data for prostate cancer (α =0.15Gy^{-1}, α/β = 3.1 Gy, and a 16-minute repair half-time) were used to compute the changes of the equivalent uniform dose (EUD) and tumor control probability (TCP) due to prolonged delivery time. EUD and TCP calculations were also evaluated for a wide range of radiosensitivity parameters. Our calculations indicate that dose-fraction delivery times in the range of 15- 45 minutes may significantly decrease cell killing. For a prescription dose of 81 Gy in 1.8 Gy fractions, the EUD for prostate cancer decreases from 78 Gy for a conventional EBRT to 69 Gy for an IMRT with a dose-fraction delivery time of 30 minutes. The values of EUD are sensitive to the α/β ratio, the repair half-time, and the dose-fraction delivery time. The total time to deliver a single dose fraction may have a significant impact on IMRT treatment outcome for tumors with a low α/β ratio and a short repair half-time, such as prostate cancer. These effects, if confirmed by clinical studies, should be considered in designing IMRT treatments.