AbstractID: 10445 Title: Biological effect of different IMRT delivery techniques: SMLC, DMLC and Helical TomoTherapy®

Purpose: Intensity-Modulated Radiotherapy is delivered using a variety of techniques with differing temporal dose characteristics. Spatial dose metrics are generally used to evaluate treatment plan quality, however, use of this information alone neglects effects of the significant differences in dose delivery duration and dose accumulation patterns, both of which can impact cell survival. This study uses the Linear-Quadratic model with dose protraction corrections to evaluate the biological effectiveness of different IMRT delivery techniques: SMLC (step-and-shoot), DMLC (sliding window), and helical tomotherapy (HT) for the treatment of prostate and head/neck sites. **Method and Materials:** The temporal dose pattern was measured to calculate the protraction factor and Biologically Equivalent Dose (BED) was calculated for a range of repair half-times and α/β ratios. The treatment BED is compared against the target prescription to evaluate loss in biological effectiveness. In the case of a conventional prescription, the loss in biological effectiveness was evaluated using Tumor Control Probability (TCP) data. **Results:** Our analysis finds HT to be biologically superior to SMLC and DMLC because of reduced dose accumulation times for *individual target-volume elements*. With SMLC or DMLC delivery, the expected loss in BED for a conventional prostate prescription can be as high as 3%, leading to a maximum predicted 10% reduction in TCP. Furthermore, use of hypo-fractionation can lead to BED losses up to 5%, raising even greater concerns about clinical consequences. For HT and conventional fractionation, the predicted BED and TCP losses are less than 1% and 2.5%, respectively. For head/neck tumors the larger α/β ratio results in smaller losses in biological effectiveness (~1%) which are clinically less significant. The possible range of losses can be larger if smaller repair half-times and small α/β ratios are considered. **Conclusion:** Temporal dose delivery patterns are an important component in determining the biological effects of IMRT treatment.