Experimental Validation of a Target Tracking IMRT Delivery with Conventional MLCs

D. McQuaid, M. Partridge, J. R. N. Symonds-Taylor, P. M. Evans, S. Webb

Joint Department of Physics, Institute of Cancer Research, Sutton, Surrey, UK

Introduction: This study assessed complex, target-tracking, intensity-modulated delivery by the Elekta MLCi system. For treatment sites where intrafraction tissue motion is a significant problem, target-tracking deliveries have the potential of reducing motion margins used in radiotherapy planning.

Method: A toroidally shaped target surrounding an organ at risk (OAR), necessitating multiple field segments to irradiate the target and spare the OAR, was defined in a solid water phantom. The phantom was programmed to move in a reproducible 2D elliptical trajectory. A static and target-tracking delivery were planned for delivery on a standard Elekta Precise series linac with integrated MLCi system. Dose was delivered in 3 ways: (i) static delivery to the static phantom, (ii) static delivery to the moving phantom and (iii) tracking delivery to a moving phantom, and was assessed by film measurement. The dose delivery was quantified by measurement of the mean and standard deviation of the dose on the central plane through the target.

Results: The mean target doses measured were: 100% +/- 2.8%, 95.8% +/- 7.2% and 98.5% +/- 2.6%, respectively, for the three cases listed above, whereas the mean doses to the OAR from the three delivery scenarios were: 38.2% +/- 24.4%, 54.0% +/- 18.1% and 38.2% +/- 19.7%. All dose measurements are quoted relative to the static target dose from a static delivery.

Conclusion: Target-tracking deliveries have been shown to be realisable on the current generation of Elekta linacs. The tracking techniques have been shown to remove the negative effects of tissue motion. In this case, reducing the mean dose to the OAR by 15.8% whilst restoring the target dose homogeneity to the static case. However, many obstacles remain before the technique can be safely used in the clinic and these are the subject of further research in the field.