

AbstractID: 4875 Title: IMRT delivery to a moving target by dynamic MLC tracking: delivery for targets moving in two dimensions in the beam's-eye view

Purpose: To outline a new modification of the dMLC delivery technique enabling the tracking of a target moving through rigid-body translations in a 2D loop in the beam's eye view and the accuracy of the delivery versus that of deliveries with no tracking and of 1D tracking techniques with patient intensity-modulated beams (IMB) is quantified.

Method and Materials: Leaf trajectories calculated in the target reference frame were iteratively synchronized assuming regular target motion. This allowed the leaves defined in the lab reference frame to simultaneously follow the target motion and to deliver the required IMB without violation of the leaf maximum-velocity constraint. The leaves are synchronized until the gradient of the leaf position at every instant is less than a calculated maximum. The delivered fluence in the target reference frame was calculated with a simple primary-fluence model. The new 2D tracking technique was compared with the delivered fluence produced by no-tracking deliveries and by 1D tracking deliveries for 33 clinical IMBs.

Results: The RMS difference between the desired and the delivered IMB was 15.4 ± 3.3 MU for the case of a no-tracking delivery; 10.9 ± 2.3 MU for the case where one component of motion was corrected and 6.8 ± 1.6 MU for the 2D tracking delivery. The residual error is due to interpolation and sampling effects. The 2D tracking delivery technique requires an increase in the delivery time evaluated as between 0 and 50% of the unsynchronized delivery time for each beam with a mean increase of 13% for the IMBs tested.

Conclusion: The 2D tracking dMLC delivery technique allows optimized IMBs to be delivered to moving targets with increased accuracy and with acceptable increases in delivery time. When combined with real-time knowledge of the target motion at delivery time this technique facilitates improved target conformity relative to no-tracking deliveries and allows margin reduction.