AbstractID: 8608 Title: Controlling the impact of intensity modulation when treating moving targets with dynamic IMRT

Purpose: The treatment of moving targets using dynamic IMRT can result in dosimetric effects that have a predictable component (dose blurring) and an unpredictable component (interplay between organ motion and leaf motion). We investigate the impact of the intensity modulation on the unpredictable component.
Materials and Methods: Software was written to simulate MLCs moving across a moving target using dose distributions exported from Eclipse. The dose distribution delivered to a static target was blurred with the target motion to give the expected dose distribution. Dose errors were calculated by comparing the dose delivered to a moving target with the expected dose distribution. The impact of the intensity modulation (1:1 to 6:1) on the maximum dose error was investigated for a wide range of MLC sequences and target motion. MLC sequences were identified which kept dose variations within 10% of the expected dose. Results were confirmed experimentally by measuring the dose delivered to an ion chamber array in a moving phantom.
Results: The maximum dose error increases with increasing intensity modulation. Dose errors also increase with a decrease in the following parameters: target period, target amplitude, MLC separation and MLC speed. Simple rules were developed to determine whether a planned fluence / MLC sequence will give a dose error larger than 10%. If the MLC speed is restricted to 0.1cm/sec and target period ≤6sec, then the maximum daily dose error is always less than 10% for all levels of intensity modulation. For some combinations of intensity modulation and MLC sequences, faster MLC speeds are acceptable depending on details of the MLC parameters and target motion.
Conclusion: Intensity modulation as high as 6:1 can be used when treating moving targets with dynamic IMRT, but the MLC speed must be carefully restricted if unpredictable and large dose errors are to be avoided.