Purpose: The dose distributions of static and dynamically delivered IMRT fields for real-time target tracking were evaluated to determine which methods work best for the compensation of breathing-induced organ motion.

Methods: A single IMRT beam of a clinical plan was applied with the step-and-shoot delivery technique and the sliding-window technique with the research Siemens 160MLC in order to account for a two-dimensional, sinusoidal target motion and for a real patient breathing-curve. For the sliding-window dose delivery, two different maximum leaf speeds, as well as synchronized and non-synchronized leaf trajectories were employed. All fields were delivered without and with tracking of the target using three electromagnetic transponders of the Calypso-System. The dose distributions were measured with radio-chromic films in a water equivalent phantom in 5cm depth and were compared to the step-and-shoot delivery for a non-moving phantom. For the dose comparison a gamma criterion of 2%/2mm was utilized.

Results: For both motions tracking improved the gamma-index by 13%-32%. For the dynamic delivery no significant advantage was observed between unsynchronized and synchronized leaf trajectories. Moreover no remarkable differences were found by comparing results obtained with different maximum leaf speeds. For both target motions the step-and-shoot delivery shows a better dose distribution using the tracking approach: For the 2D-motion a gamma-passing rate of 86.3% can be achieved using step-and-shoot compared to 78.2% on average for the dynamic dose delivery. For the patient breathing-motion 83.3% compared to an average of 77.1% were obtained. When comparing the results of both motion patterns, slightly higher passing rates were found with the periodic 2D-sinusoidal motion.

Conclusions: Only small differences were observed for different IMRT dose delivery modes with organ motion tracking, except for the tracked step-and-shoot delivery. However, more experiments have to be performed to investigate other IMRT plans and explicit dependencies on the field modulation.

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