AbstractID: 10416 Title: A Simplified 4DRT Strategy Using a 3.5D Approach and 3D Planning Tools: A Dual Motion Phantom Study

Abstract:

Purpose: A major obstacle to achieve motion-tracking 4DRT for optimal therapeutic ratio is 4D planning, which requires planning in multi-phase CTs and maps dose distributions to a reference CT via deformable image registration. A simplified 3.5D approach was studied, in which a 3.5DCT is acquired using a motion-tracking platform on CT couch, providing a motion-free target for 3D planning.

Methods: A customized phantom (C-phantom) was mounted on a Quasar mobile phantom (Q-phantom)[#], which served as a motion-tracking platform. A Teflon ball (diameter=2.54cm) was used to mimic a moving target with a sinusoidal waveform (period=6.70s) and multiple motion ranges. Mobile and stable control balls were used. The dual phantom system was placed on CT and RT couches for 3.5D/4D simulation and delivery. Eclipse planning system was used for 3D planning with 8-mm margin based on the 3.5DCT. The EPID was used for IGRT setup, and two radiochromic films (in the ball and on the couch) were utilized for measuring 2D dose distribution from a lateral beam orthogonal to the motion.

Results: Both 3.5DCT and 4DCT were acquired. For fully-compensated ball, the 3.5DCT appeared similar to that of stable ball, while for under-compensated ball, the 3.5DCT contained a residual motion as the net motion. Phase-shifts (18˚&36˚) produced residual motion artifacts. 4D delivery of the 3.5DCT-based plan showed excellent dose conformality, comparing to that of stable ball. A proper margin is needed in case of residual motions. This approach simplified 4DRT as 3.5D simulation, 3D planning and 4D delivery.

Conclusion: This 3.5D approach to 4DRT is demonstrated to be feasible, provided that the 3.5DCT simulation could produce a stable target. The motion-free target allows 3D planning, reducing the 4D planning workload substantially.

[#] *The authors thank Drs. Nesrin Dogan and Mihaela Ruso at VCU Massey Cancer Center for landing the Quasar phantom.*