AbstractID: 7324 Title: Development and evaluation of an ultrasound-guided tracking and gating system for radiotherapy of liver metastases

Purpose: To investigate the feasibility of ultrasound imaging for tumor localization and respiratory gating for the treatment of liver metastases with radiotherapy.

Method and Materials: An ultrasound-guided tracking and gating system was developed for stereotactic body radiotherapy. We use an existing infrared marker system to track a moving ultrasound probe which is obtaining images of target motion throughout the respiratory cycle. The reconstructed ultrasound video of target motion in room coordinates is displayed with the treatment beam projection on the imaging plane to determine optimum gating levels.
To investigate the system, a phantom was constructed to model the respiratory motion of a liver tumor and also to enable imaging with ultrasound and kV x-rays for comparison purposes. Ultrasound video and orthogonal localizing x-ray images were taken of the same moving tumor model. We compared the timing to an existing clinical system.

Results: Ultrasound has a better soft tissue contrast than x-ray and is capable of producing up to 26 fps video. We measured a time delay of 22 ± 11 ms at 2.4 s period, and 30 ± 25 ms at 4.8 s period of breathing motion. The same figures for the clinical x-ray system were 81± 29 ms at 2.4 s, and 5 ± 18 ms at 4.8 s period. This was comparable to our system's delay. None of the measured delays in our system would compromise planning margins, the largest observed error extending to only 1.1 mm.

Conclusion: An ultrasound-guided tracking and gating system and a moving phantom was developed. The image quality and timing delay of the system was equivalent to that of an existing clinical solution. Further investigation needed to apply three-dimensional gating signal and to test imaging on actual patients before clinical application.

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