

ABSTRACT SUBMISSION FORM

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PRESENTATION TITLE

MRI guided radiotherapy of centrally located thoracic tumors: effect of cardiac motion

AUTHOR(S)

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ABSTRACT

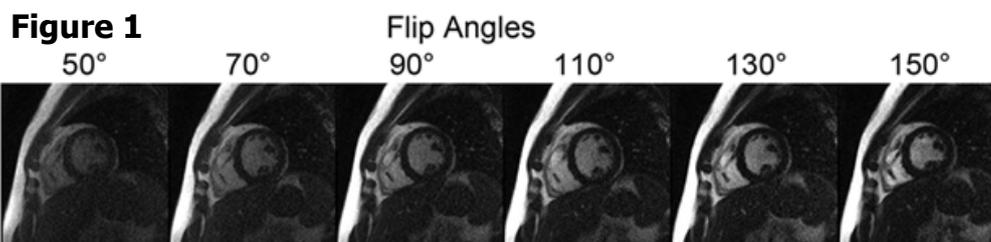
Purpose: The development of effective screening and treatment strategies for many cancers has resulted in large population of long-term cancer survivors. The impact of cancer and of cancer treatment on the long-term health of these survivors is substantial. Among all the late effects of organ damage from radiation therapy (RT), cardiac late effect is of great research interest. Recent studies also suggest that symptomatic cardiac events can happen as early as 2 years post-RT. To assure minimal toxicity to critical structures, like heart, motion compensation techniques are critical. Intra-fractional soft tissue based gated RT, offered by MR guided RT (MRgRT) with on-board CINE MRI (4 frames/second), has the potential to greatly reduce treatment uncertainty caused by respiratory motions. However, for some tumors, such as central lung and esophageal patients, additional efforts may be necessary to evaluate cardiac motion. In this study, we explored the feasibility of using cardiac CINE MRI to assess the effect of cardiac motion for treating centrally located thoracic tumors on an MRgRT system.

Materials & Methods: Cardiac cine images were acquired in 6 healthy volunteers for sequence optimization on our 0.35T MRgRT system and 7 patients with tumors adjacent to the heart. For the patient scans, cardiac CINE MRI was acquired immediately after clinical treatment simulation sequence. The cardiac gated cine imaging had the following parameters: TR/TE=4/2ms, voxel size 1.25x1.25x7mm³, FOV=320mm, readout bandwidth = 780Hz/pixel, flip angle = 50o – 150o for volunteer scans and 110o (optimized value) for patient scans, parallel imaging: GRAPPA. A SIEMENS Physiological Monitoring Unit (PMU) was used to acquire ECG signal which was used to gate the image acquisition. Each scan took approximately 200 seconds for 20 phases and 20 slices, each slice was acquired within one breath hold.

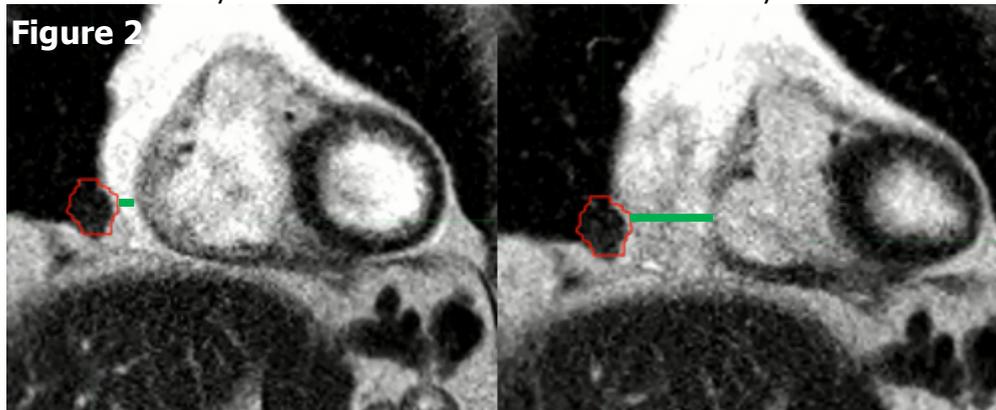
Results:

- Figure 1 shows a single phase from bSSFP cine images at multiple flip angles in a volunteer, which demonstrates great image quality of cardiac cine MRI at 0.35T field strength, especially the ones acquired with larger flip angles which are not feasible on high MR field due to SAR.

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2. Figure 2 shows an example patient cardiac cine MRI acquired at two different cardiac phases. A large variation of the distance between gross tumor volume (GTV) (red contour) and the myocardium and valves was noticed and it ranged from sub-mm to over 4cm. Across the 7 patients, the maximum variation in the myocardium-tumor distance within the cardiac cycle was 3.5 ± 1.3 cm.



Conclusions: We demonstrate that cardiac bSSFP cine MRI is feasible at the low-field strength of 0.35T on our MRgRT system. Cardiac motion caused non-trivial variation in the distance between the heart and tumor, and this could be an overlooked but non-trivial potential source of treatment error. Incorporating cardiac motion evaluation into RT treatment design may bring great value to better identifying the treatment range for the soft tissue based gated RT enabled by MRgRT. It will also provide more accurate dose estimation for sub-volumes of the heart, and help identify the true sensitive areas for various types of cardiac toxicities.