Purpose:
Magnetic Resonance Imaging (MRI) offers great promise in improving target delineation during radiation treatment planning. However, it is well known that MR images may be hampered by geometric distortion. One potentially large source of geometric distortion arises from gradient nonlinearities, which can result in anatomical compression along the superior-inferior direction, anatomical dilation in the anterior-posterior and right-left directions, and aliasing (arising from spins at different spatial locations being mapped to the same frequency). The purpose of this study was to determine the effectiveness of moving table acquisitions in diminishing gradient nonlinearity-induced geometric distortion.

Methods:
A custom 20x30x50 cm grid phantom was imaged on a Siemens 3T Verio scanner. Conventional 3D FLASH images were collected in the sagittal plane and reconstructed without and with vendor-provided 2D and 3D distortion correction. The prescribed volume was then broken into four segments and, immediately prior to acquisition of each segment, the scanner table was moved such that the center of each segment aligned with the scanner isocenter. Following acquisition, images from each segment were combined into a single series.

Results:
Gradient nonlinearities produced geometric distortion in all three dimensions. The magnitude of the distortion exceeded 2 cm at the periphery of the field of view in the uncorrected images. Although the vendor-provided 3D correction algorithm was effective at reducing distortion, residual distortion at the periphery of the field of view remained. The images acquired using the proposed step and shoot approach exhibited minimal distortion along the entire length of the field of view.

Conclusions:
The proposed step and shoot MRI approach is a simple and effective method to diminish gradient nonlinearity-induced geometric distortion. By breaking up the imaging volume into smaller segments, images in each segment can be acquired in the region of highest gradient linearity.

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