Evaluation of Accelerated Single Shot Fast Spin Echo (SSFSE) for Imaging of the Appendix

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INTRODUCTION: The most common imaging techniques for evaluating the appendix are CT and ultrasonography, which involve exposure to ionizing radiation and high operator dependence, respectively. MRI provides an alternative in instances when avoidance of ionizing radiation is preferred, as in the younger population, those exposed to repeated CT exams, and pregnancy.

To rule out appendicitis by imaging criteria, a normal appendix must be identified without enlargement and associated abnormal findings. Identifying the normal appendix with MRI in the pregnant population has been somewhat successful (>65%) [1,2], largely attributed to the use of single-shot fast spin echo (SSFSE) sequences that can acquire rapid T2-weighted images with good contrast between the appendix and surrounding fat and minimal motion artifact. The difficulty in localizing the appendix arises in part due to its small size (typically less than 6mm in diameter) and highly variable orientation and location. However, the spatial resolution and anatomic coverage of conventional SSFSE is limited by breath-hold duration. The purpose of this work was to ascertain if autocalibrating parallel imaging could be applied to SSFSE to improve conspicuity and detection of a normal appendix compared with conventional, non-accelerated SSFSE imaging.

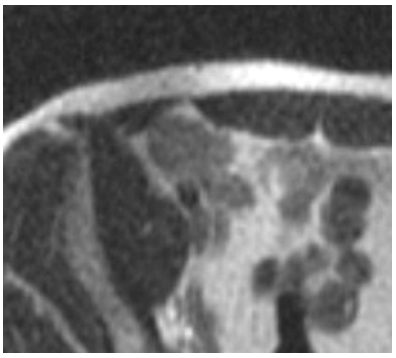

Fig. 1: Conventional SSFSE 6mm axial image. Cecum, terminal ileum and appendix poorly defined.

METHODS:
After informed consent, five volunteers and patients were imaged at 1.5T (Signa ® HD, GE Healthcare, Waukesha, WI). Conventional half-Fourier SSFSE and 1D-accelerated half-Fourier SSFSE images were acquired in the axial plane. Imaging parameters were adjusted on a per-patient basis to span an imaging volume 10 cm above and below the iliac crest [2] with spatial resolution as high as possible within a 30-s breathhold. Typical scan parameters for conventional SSFSE were: TE/TR = 33/798ms, 384x192, 33-43 slices, BW = ±83kHz, 4.6-6mm with 0mm spacing. Typical parameters for accelerated SSFSE were: TE/TR = 43/544 ms, 384x192, 50-66 slices, BW = ±83kHz, 3-4mm with 0mm spacing. The shorter TR of the accelerated SSFSE sequence permitted more, thinner slices covering the same volume to be acquired within the same breath-hold time. Images were reconstructed online using an efficient autocalibrated parallel imaging algorithm [3] followed by homodyne reconstruction.

Images were evaluated by 3 blinded radiologists for SNR, perceived spatial resolution and edge definition, conspicuity of three segments of the appendix (base, body, tip), and overall appendix conspicuity. Evaluators were asked if loss of SNR and edge definition would impact appendix identification and evaluation.

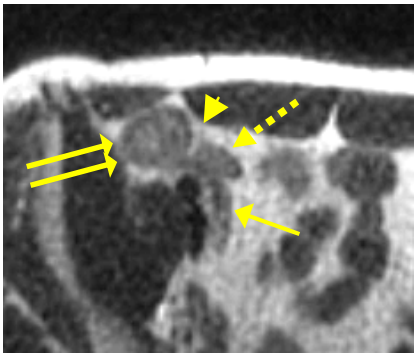

Fig. 2: Accelerated SSFSE 4 mm axial image at the same level as Fig. 1. Less volume averaging and blurring allows detection of a thin fat plane (arrow head) separating terminal ileum (dotted arrow) and cecum (double arrow). Appendix (solid arrow) clearly visualized extending posterior and medial to terminal ileum .

RESULTS:
In one patient, two evaluators were unable to definitively identify the appendix. Of 39 appendiceal segment evaluations, 56% demonstrated better conspicuity on the accelerated SSFSE images while 36% demonstrated no difference with conventional SSFE images. Of 13 overall appendix evaluations, 69% demonstrated better conspicuity with accelerated SSFSE. Using parallel imaging, SNR was perceived to be lower in 93% of cases, however, there were no cases (0/15) where this was felt to compromise detection of the appendix. Edge definition was better with parallel imaging in 93% of cases. No parallel imaging artifacts were observed.

DISCUSSION: The shorter ETL and thinner slices afforded by the accelerated SSFSE enabled overall better conspicuity of the appendiceal segments due to reduction in blurring and partial volume effects. These results suggest that the application of autocalibrated parallel imaging improves the diagnostic utility of SSFSE images for the purpose of identifying the normal appendix.

References: [1] Pedrosa et al. Radiology 2006, 238(3):891-899.
[2] Oto et al. AJR 2006; 186:883-887.
[3] Brau et al. ISMRM 2006, 2462.