

# Single breath-hold MR Imaging of the bowel employing a 32-channel coil

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## Introduction

Chronic inflammatory bowel disease (IBD) has a prevalence of 3:10000 in the western world. In the majority of cases it is first diagnosed in the 2nd decade of life and the disease is a lifelong companion with multiple bowel-examinations. In current clinical practice, the utilization of multidetector CT for body imaging dominates that of MRI. Due to radiation exposure to the relatively young patients, MRI has become an clinically appealing alternative bowel examinations in IBD [1]. Since most of the imaging protocols need to be performed in the breath-hold regime consisting of multiple breath-holds (10-25) per sequence to avoid motion artifacts, bowel-MRI is very time consuming and bears the risk for slice misregistration and the challenge of patient discomfort. Also, the diagnostic quality can be impaired due to bowel movement between the breath-holds. The purpose of this prospective study is to investigate the benefits of merging multiple breath-hold scans into single accelerated scan that cover the entire region of interest with the ultimate goal to substantially shorten the examination time for patients with IBD by employing a 32-channel coil array together with parallel imaging techniques.

## Methods

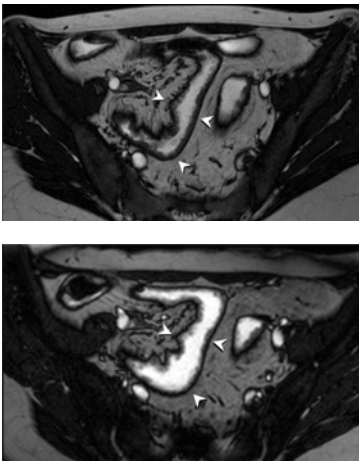
40 patients aged 4-64 years (mean=26.6 ys., median=22.5 ys.) with suspected or known IBD underwent MRI on a 1.5T-scanner (Achieva 1.5, Philips, Best, The Netherlands). The bowel was distended by oral administration of 700-1500 ml mannitol-solution and an additional enema. MR-imaging was performed with two different coil-arrays: (i) conventional 4-channel surface-coil, balanced-FFE-sequences (b-FFE) (FOV = 45 cm x 45 cm, TE = 2.9 ms, TR = 5.7 ms, flip angle = 80°) with a spatial resolution of (0.8x0.8x6) mm<sup>3</sup> in coronal and axial planes without acceleration in 10-15 breath-holds (12 sec per breath-hold) (ii) dedicated 32-channel coil array, bFFE (FOV = 45 cm x 45 cm, TE = 2.2 ms, TR = 4.3 ms, flip angle = 80°) with a spatial resolution of (0.8x0.8x6) mm<sup>3</sup> in axial and coronal planes in a single breath-hold (14-18 sec) with an acceleration factor of R=5. The number of slices (i.e. FOV in z-direction) was adapted to the body size. MR-images were correlated with endoscopy and clinical findings. The images of both coil arrays were evaluated regarding sensitivity and specificity in detecting inflammatory bowel-wall changes. In addition image-quality was assessed regarding different tissue-contrasts and susceptibility to artifacts.

## Results

The 5-fold accelerated b-FFE proved to have the same sensitivity (95%) and specificity (100%) compared to the conventional non-accelerated b-FFE. The soft-tissue contrast between bowel-wall and surrounding tissues was slightly reduced in the accelerated b-FFE, without impairing the diagnostic value (Fig. 1). For the 5-fold accelerated scans, a mild signal-to-noise-ratio loss was observed in the very periphery of the large imaging field of view due to noise amplification related with sensitivity encoding based parallel imaging (Fig. 2). The influences of different inspiration-level could be eliminated with the single breath-hold sequence.

## Conclusion

Our current data indicate that accelerated short breath-hold scans may indeed provide a viable technique for fast, simplified MRI of the entire bowel in patients with suspected IBD on the model of multi-detector CT but maintaining the advantages of MRI. Apart from the benefits of reduced scan time, this approach also offers the potential for improved patient comfort and reduced slice misregistration. This capability can simplify existing protocols by replacing multiple breath-hold scans with a single accelerated acquisition.



**Fig 1:** 24-year-old female patient with known Crohns disease and bowel wall thickening of the ileum. The contrast between the thickened bowel wall (arrowheads) and the mesenterial fat is slightly smaller in the accelerated b-FFE (bottom) than in the non-accelerated (top).



**Fig 2:** 53-year-old female patient with inflammatory stenosis of the distal ileum (arrow) and consecutive dilatation of the mor proximal small bowel (arrowheads). Coronal b-FFE with (right) and without (left) 5-fold acceleration. At the bottom of the accelerated image on the right a signal loss at the edge of the 32-channel coil can be observed.

## References

1. Hohl C, Haage P, Krombach GA, et al. *Rofo* 2005;177:856-863.