High-resolution 3D-TrueFISP with integrated parallel imaging technique for MR-enteroclysis in patients with small bowel disease

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Purpose:

Integrated parallel imaging techniques (iPAT) are designed to increase spatial resolution while reducing acquisition time[1]. With the introduction of 32-channel-whole body MR-scanners, iPAT with high acceleration factors and in two dimensions has become applicable also to abdominal imaging. For small bowel imaging and MR enteroclysis (MRE) in particular, a steady state free precession sequence (TrueFISP) is preferentially used and highly recommended [2, 3]. 2D iPAT at a total nominal acceleration factor of six enables the acquisition of a 3D-TrueFISP data set with isotropic voxel size of 1.8x1.8x1.8mm³ in one breath hold of 18 seconds. The present study is designed to evaluate the advantages and additional diagnostic impact of high-resolution 3D-TrueFISP and 3D-post-processing with multi-planar (MPR) and curved reformats (CR) in small bowel imaging with MRE.

Patients and Methods:

Twenty-two patients addressed for suspected or proven Crohn's disease underwent MRE after trans-duodenal intubation and instillation of 2.5 l of aqueous methylcellulose-suspension. All images were acquired on a 32-channel whole-body MR-scanner (Magnetom Avanto [76x32], Siemens Medical Solutions, Erlangen, Germany) using a total of 24 array coil elements arranged in four rings, each comprising 3 anterior array and 3 posterior spine array elements. Half-Fourier single shot turbo spin echo (HASTE) and T1w post-contrast gradient echo (GRE) sequences were used as standard of reference for confirmation of pathologic findings. 3D-TrueFISP imaging was acquired with 2D-iPAT applying a total acceleration factor 6 (iPAT factor of 3 in left-right phase-encoding direction and iPAT factor of 2 in anterior-posterior partition direction, **Figure 1**) resulting in an isotropic voxel size and a spatial resolution of 1.8x1.8x1.8mm³. The other sequence parameters were: TR 4.3ms / TE 1.9ms / Flipangle 70° / FOV 450x450mm² / Matrix 256x256 / Bandwidth 528 Hz/Pixel. Image reconstruction in phase-encoding direction was based on the GRAPPA-algorithm[1, 4]. For image reconstruction in the partition direction a SENSE-like algorithm was used[1]. To assess the supplementary diagnostic information from 3D TrueFISP data, MPR and CR reformats (**Figure 2**) were generated and evaluated by two board certified radiologists in consensus grading the additional diagnostic impact in none, minor and major.

Results:

MPR and CR from high-resolution 3D-True FISP imaging added valuable information in 17/20 patients (77.3%): better assessment of length and degree of stenosis (**Figure 2**) as well as skip lesions (10/22), mucosal changes (3/22) and bowel involvement in complex fistulae (2/22) in patients with CD and better assessment of tumor margin and infiltration in 2 patients with small bowel malignancy. Additional diagnostic Information was rated "major impact" in 54.6% of cases (95% Confidence interval (CI): 32.2%–75.6%) and "minor impact" in 22.7% (95% CI: 7.8% – 45.4%). In 22.7% of the cases reformats confirmed the findings in the standard of reference.

Conclusion:

MPR and CR from isotropic 3D-TrueFISP imaging can improve and refine the diagnosis based on MRE in the assessment of Crohn's disease and other small bowel pathologies. Higher iPAT factors are a prerequisite for the successful application of this technique.

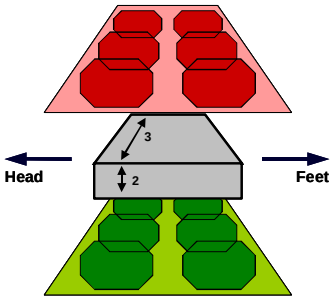

Figure 1: Graph of 2D iPAT with acceleration factor of 6

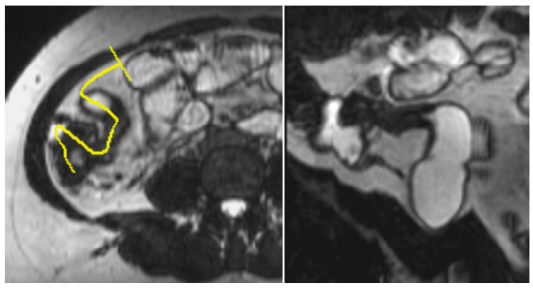

Figure 2: Curved reformat in a patient with terminal ileitis: better assessment of length of stenosis and prestenotic dilatation

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