

Clinical evaluation of a novel method, linear radial k-trajectory THRIVE (Liner-THRIVE) for pelvis image: compared among THRIVE, e-THRIVE and Liner-THRIVE

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Purpose

Three-Dimensional (3D) gradient echo (GRE) sequence has been commonly used for a post contrast enhanced abdominal imaging, because it has several advantages such as less partial volume effects, short scan time, and good image contrast (1). Therefore, we have usually used these 3D-GRE sequences (THRIVE (T1-weighted High Resolution Isotropic Volume Examination) or e-THRIVE (Enhanced-THRIVE)) for contrast enhanced- MRI (CE-MRI) in the pelvis. As THRIVE uses centric-radial k-space trajectory, it enables to obtain good fat suppression with spectral presaturation with inversion recovery (SPIR) and reduce motion artifact by averaging low frequency subset (2). Instead, it suffered from blurring and eddy current because data sampling was sampled during steady state transit time. The e-THRIVE technique overcame this limitation by using of combination of linear k-space trajectory and partial Fourier transformation (p-FT) (3). However, p-FT with zero-filling theoretically causes truncation artifact (4). In this study, we hypothesize that the combination of linear k-space trajectory without p-FT and radial k-space trajectory (Liner-THRIVE) reduces motion artifact and improves image quality in pelvic CE-MRI. For that, we compared Liner-THRIVE, THRIVE and e-THRIVE.

Methods

This study was approved by the local-IRB, and written informed consent was obtained from all subjects. Total of 40 patients with diagnosis of uterine fibroids were conducted post CE by THRIVE, e-THRIVE, and Liner-THRIVE using a 3.0T system (Intera Achieva, Philips Healthcare) with 32 elements phased-array coils.

Experiment 1: Examination of an optimum fat suppression effect for Liner-THRIVE

Optimum SPAIR inversion delay time (SPAIR TI) and echo train length (ETL) has been determined by phantom models (muscle, oil, diluted Gd).

Experiment 2: Compare among Liner-THRIVE, THRIVE and e-THRIVE for clinical pelvis image with CE-MRI

Common parameters in THRIVE, e-THRIVE, and Liner-THRIVE are as follows:TR/TE;2.5/1.25msec, flip angle;12 degree, field of view;300mm, slice thickness;1.5mm, intersection gap;0 mm, acquisition matrix;240*204, number of slices;100, parallel imaging acceleration factor;2. SPAIR and SPIR were used in only THRIVE. SPIAR IDT and ETL had set to the suitable value obtained from examination 1. We estimated contrast noise ratio (CNR) and the image quality of blurring and truncation, among THRIVE, e-THRIVE, and Liner-THRIVE. CNR was calculated by measurement of signal intensity signal intensity for the subcutaneous fat, the uterus and the internal obturator muscle. The image quality were estimated independently by two radiologists using score system (score 1;small, 2;moderate, 3;large) and reached in consensus afterwards, then calculated the incidence (%=score/total score × 100) of blurring and truncation. Statistical analysis was done by Wilcoxon-t test.

Results

Experiment 1: Setting in short SPAIR TI (<60msec) result in good contrast ratio (CR) cause of better fat suppression. But to set in long SPAIR TI result in worse CR (Fig.1). And there was limited of ETL to do setting in short SPAIR TI.

Experiment 2: The contrast noise ratio was significantly higher in Liner-THRIVE compared with THRIVE ($p=0.04$) and e-THRIVE ($p=0.0017$) (Fig.2). The incidence of blurring and truncation showed stepwise smaller among e-THRIVE, THRIVE, and Liner-THRIVE in order (Fig 3).

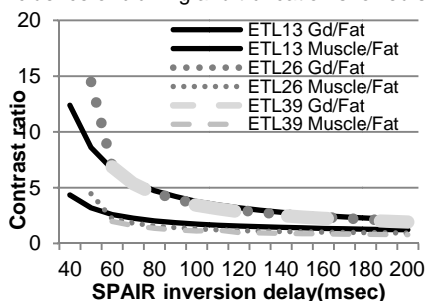


Fig.1: Results from basic study to effect for Liner-THRIVE of SPAIR inversion delay

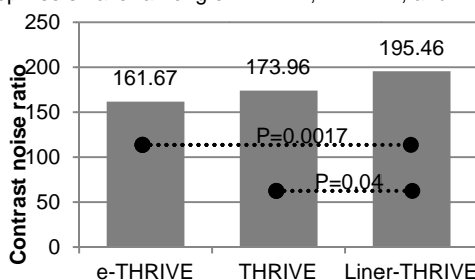


Fig.2: Results from clinical patient study for CNR

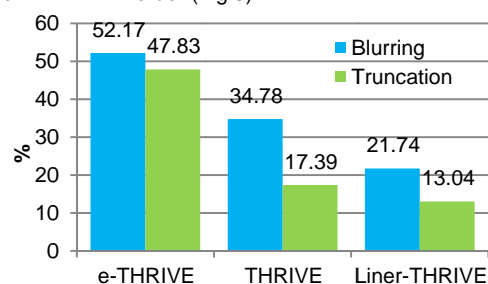


Fig.3: Results from clinical patient study to motion artifact and truncation

Conclusion

We obtained better pelvic CE-MRI using Liner-THRIVE compared with THRIVE and e-THRIVE, because we could determine the optimal SPAIR IDT and ETL using a phantom model before examination (Fig.4). However, Liner-THRIVE is more difficult than other THRIVE for fat suppression by control of SPAIR TI

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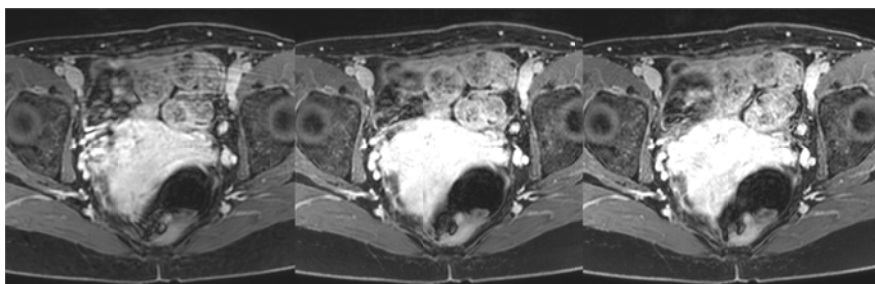


Fig4: Clinical patient image of e-THRIVE (left), THRIVE (middle), Liner-THRIVE (right) WWW/WL were same values