T1-Weighted PROPELLER GRE using Inversion Recovery (IR)

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[Introduction]
PROPELLER has been widely used to obtain motion-corrected T2-weighted images [1]. In this technique, k-space data are collected in strip-shaped dataset (blade) consisting of parallel linear trajectories. Each blade is rotated to fill up k-space. In case of Fast spin echo (FSE) of PROPELLER, a blade is acquired in a train of echoes. When the PROPELLER FSE is applied to obtain T1-weighted image, shorter echo train length (ETL) is required in order to alleviate T2 weighted effect. However, it narrows the width of blade and affects accuracy of the motion correction due to insufficient coverage around the center of k-space. Aim of the present study is to obtain T1-weight images by using an inversion pulse (IR) and PROPELLER with gradient echo acquisition.

[Methods]
PROPELLER GRE with IR preparation is shown in Fig.1. The IR pulse was employed to establish T1 contrast and followed by fast spoiled GRE sequences to acquire a blade. This method was implemented on 1.5T EXCITE system (GE Healthcare, Milwaukee, WI) with quadrature head coil and compared to a standard T1-weighted SE sequence. Inversion time (TI) and Recovery time (RT) was set taking into account the signal-to-noise ratio (SNR) and T1 contrast between white matter and gray matter. In order to measure SNR, four ROIs over image was selected and the averaged signal intensity inside image was divided by the standard deviation of the background noise outside image. First, head axial image were obtained from a static volunteer for each sequence. In the second experiment, volunteer performed random motion of his head during entire scan. Scan parameters were as follows. PROPELLER IR-GRE: FOV 250 mm, TR / TE 10.7 ms / 5.2 ms, flip angle 30 degrees, nex3, slice thick 5 mm, TI 1000 ms, RT 1000ms, ETL 16, scan time 2 min 6 sec. T1-SE: FOV 250 mm, TR / TE 600 ms/ 14 ms, slice thick 5mm, scan time 2 min 9 sec.

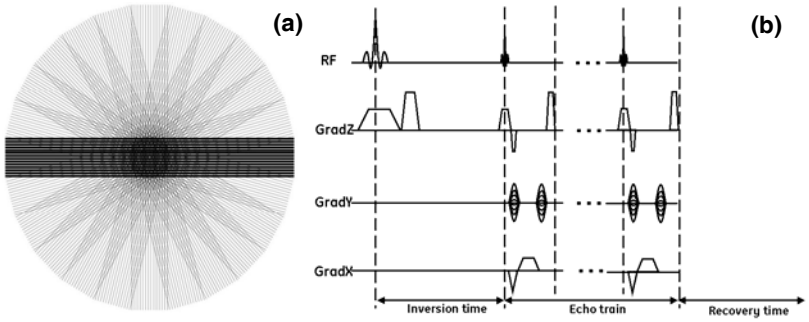

Figure 1. Illustration of (a) a single strip (bold line) in k-space in a complete data set of PROPELLER. (b) Diagram of Spoiled GRE Sequence with IR pulse in a blade. After IR pulse, rapid GRE images are acquired.

[Results and Discussion]
Image contrast between white matter and gray matter was better with the PROPELLER IR-GRE (Figure 2b) than the T1-weighted SE sequence (Figure 2a). For white matter, SNR was 82.8±1.1 with T1-weighted SE, whereas it was 135.6±3.2 with PROPELLER IR-GRE. For differentiation of gray and white matter, the contrast-to-noise ratio (CNR) was 6.1 with T1-weighted SE and 19.2 with PROPELLER IR-GRE. Motion during scan caused T1-weighted SE image to corrupt (Figure 2c). In contrast, the PROPELLER IR-GRE image reduced motion artifact using rigid motion correction (Figure 2d). It is demonstrated that the PROPELLER IR-GRE can provide higher SNR and CNR than that of conventional T1-SE and correct motion. IR pulse makes T1 contrast. Appropriate setting of TI and RT increases the SNR and CNR.

References: 1) Pipe JG, MRM 1999; 42(5): 963. 2) Pipe JG, ISMRM 13thAnnual Meeting; 2005.

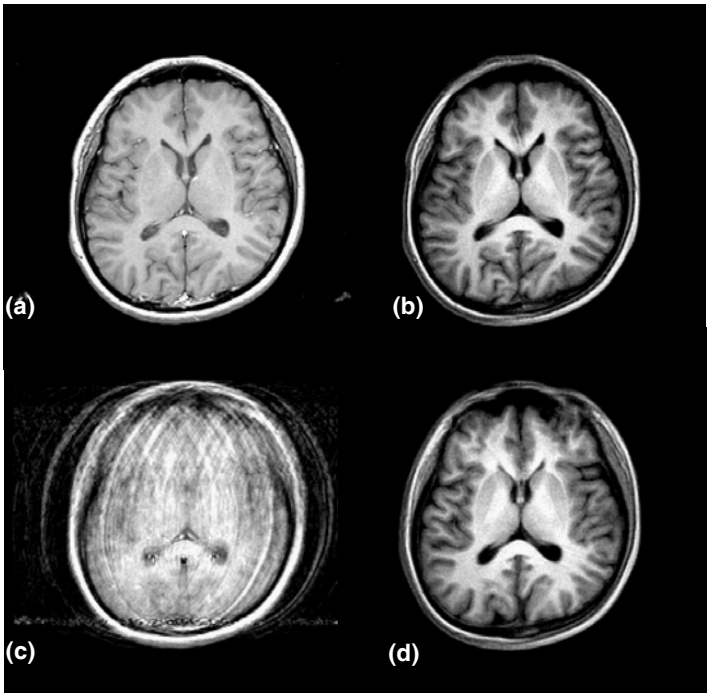

Figure 2. Comparison of PROPELLER IR-GRE axial image with T1-weighted SE axial image. (a) PROPELLER IR-GRE with no motion. (b) T1-weighted SE with no motion. (c) PROPELLER IR-GRE with motion. (d) T1-weighted SE with motion. Window Level and window range is the same in all images.