

Initial Clinical Experience with FRFSE Triple Echo Dixon (FRFTED) for Breath-Hold Fast Dixon Abdominal MR Imaging

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Purpose: To evaluate a prototype FRFSE Triple-Echo Dixon (FRFTED) sequence for breath-hold, fat suppressed T2-weighted imaging of the abdomen.

Background: Fat suppressed FSE T2W imaging is an integral part the abdominal MR examination. Techniques for fat suppression, including CHESS, and spectral inversion at lipid (SPECIAL) are highly dependent on the uniformity of magnetic field. A technique that is insensitive to field inhomogeneity and providing rapid breath-hold T2-W imaging with consistent fat suppression would be practically desirable.

This study evaluates a prototype FSE based Dixon pulse sequence [1]. The sequence replaces each FSE readout gradient with three readout gradient pulses of alternating polarity. The length of these gradients is adjusted such that their respective echoes occur when fat and water are -180° , 0° , and $+180^\circ$ relative to each other. After data acquisition, a host computer based image reconstruction program known as FLEX uses the three echoes as input and automatically generates separate water-only and fat-only images for each slice. Since the pulse sequence acquires multiple echoes within a single pass, rapid fat-suppressed T2-weighted imaging is possible even without parallel imaging.

Materials and Methods: Sixty-two patients referred for abdominal MRI were imaged with axial FRFTED (TR 2000, TE 90, ETL 20, matrix 320 x 192, Nex 1, rFOV 0.8, slice thickness 7-8mm, 24 slices, bandwidth 64 kHz, scan time 3 x 23 sec breath holds) and axial T2-weighted FRFSE (TR 2050, TE 90, ETL 12, matrix 320x192, NEX 2, rFOV 0.8, slice thickness 7-8mm, 24 slices, bandwidth 32 kHz, ASSET x2, and scan time 2 x 21 sec breath holds). The FRFSE and FRFTED images were compared for overall image quality, homogeneity of fat suppression, image sharpness, anatomic detail, phase and other artifacts. We recorded depiction of disease of the liver, spleen, kidneys, bile ducts, pancreas, nodes, adrenal glands, GI tract, & peritoneum.

Results: FRFTED sequence successfully reconstructed water-only and fat-only images in all 62 cases. Water and fat separation was perfect in 48 (.77) patients. In 14 (.23) patients small focal areas of fat and water swapping were noted near the lung bases. Compared to FRFSE, FRFTED produced superior homogeneity of fat suppression in 61 cases (.99). The FRFTED images showed better anatomic detail in 38 (.61), and less susceptibility artifact in 31 (.50). The FRFSE images showed less vascular pulsation artifact in 22 (.35) cases, and less phase artifact in 40 (.65) patients. Overall the FRFTED images were preferred for image quality in 37 (.60) compared to the FRFSE images 15 (.24). Among the patients imaged, both FRFSE and FRFTED sequences depicted the following lesions: liver lesions in 19 patients, biliary findings in 14 patients, lymphadenopathy in 5 patients, splenic abnormalities in 2 patients, adrenal lesions in 5 patients, and peritoneal tumors in 5 patients. In addition, FRFSE depicted 14/15 and FRFTED 15/15 renal lesions and FRFSE depicted 6/7 and FRFTED 7/7 pancreatic abnormalities.

Conclusions: FRFTED is capable of breath-hold T2-weighted imaging with superior fat suppression, excellent image quality, and at least equal depiction of disease when compared to conventional FRFSE.

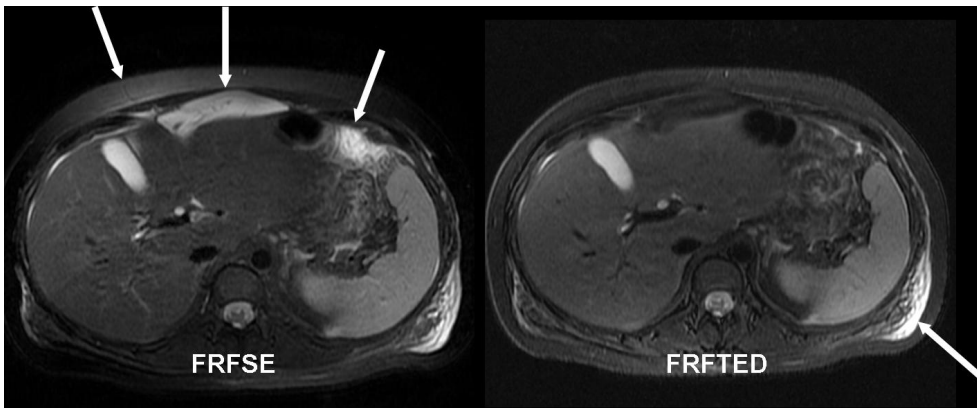


Figure 1: The FRFSE T2-weighted image (left) is degraded by inhomogeneous fat suppression (arrows). The FRFTED water image (right) much more homogeneous suppression of fat and confirms subcutaneous edema (arrow) in the left poster lateral abdominal wall. The FRFTED image shows superior fat suppression, better anatomic detail, and overall similar image contrast compared the FRFSE image.

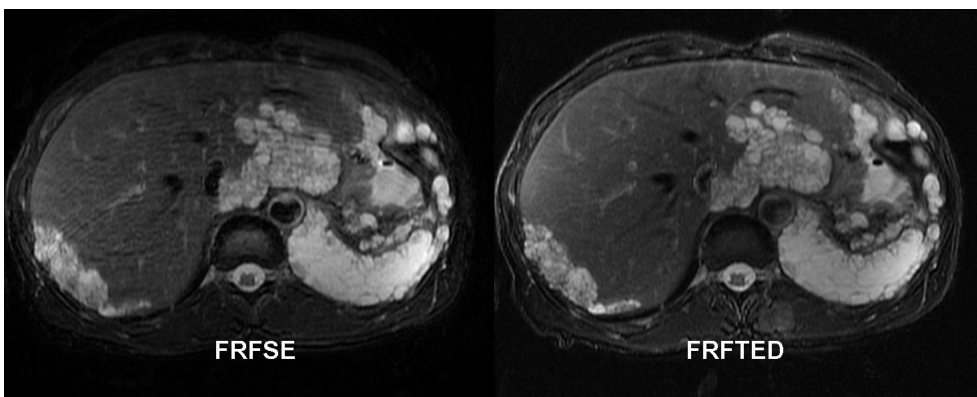


Figure 2: Patient with pseudomyxoma peritonei. The FRFTED water image (right) shows better image quality with sharper anatomic detail and less motion artifact compared to the FRFSE image (left). The bulky peritoneal tumor around the liver, stomach, and spleen are well visualized on the FRFTED and FRFSE images with similar lesion contrast.

References [1]. Ma J, Son JB, Zhou Y, Le-Petross H, Choi H. Magn Reson Med 58:103, 2007. [2] Ma J. Magn Reson Med 52:415, 2004.