PROPELLER FSE T2-weighted imaging in Pediatric Brain Imaging: Can we replace standard FSE T2-weighted imaging?

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Introduction: The T2w-FSE sequence which is critical for identifying pathology is frequently degraded by motion artifacts in pediatric patients. Imaging strategies to reduce motion artifact decrease the need for sedation and anesthesia, which are often required to generate diagnostic quality images. Typically such techniques focus on reducing scan time (e.g. SSFSE), but often suffer from blurring and other artifacts that reduce image quality and lesion detection [1]. MR imaging with periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) instead reduces in plane rotation and translational head motion by alternate sampling of k-space [2]. PROPELLER suppresses motion artifacts by over-sampling the centre of k-space through acquisition of multiple rotating concentric blades of data and then by transposing those blades to an estimated stationary position before final image reconstruction. PROPELLER achieves similar motion reduction to SS FSE in pediatric brain imaging [3], but has not yet been compared with conventional Cartesian T2w-FSE to assess for diagnostic reliability. Our goal was to compare image quality of T2w-PROPELLER FSE with conventional T2w-FSE, assessing (1) general image quality; (2) presence of artifacts; (3) ability to detect lesions, and (4)impact on clinical decision making.

Materials and Methods: 95 consecutive pediatric patients who were undergoing brain MR at our institution were evaluated. These patients ranged in age from 0 days to 17 years and presented for a variety of indications, including prematurity, congenital malformations, ischemia, infection and pre and post-operative tumor evaluation. MR studies were performed on a GE 1.5T magnet and an eight-channel head coil was used as a receiver. Images were obtained in the axial plane with 4mm slice thickness, 1mm gap, FOV 22cm and approximately 25 sections. T2w-fast-recovery (FR)FSE scans (TR/TE=2.5sec/102msec, ETL=17, DW=20.83kHz, matrix=192x288, reconned=512^2) were obtained first followed by T2w-PROPELLER FSE (TR/TE=5sec/117.7msec, ETL=28, DW=31.25kHz, matrix=256^2, reconned=512^2), in addition to other sequences determined by the patient clinical presentation. Three independent radiologists (ER, MK, TV) evaluated T2w-FRFSE images and PROPELLER images separately and then later directly compared the two sequences. They rated the two sequences on a five point Likert scale for image quality, presence of artifacts, and diagnostic confidence. Lesions detected on each scan were noted by location with comments on the type of lesion (e.g. hypointense blood product vs T2 hyperintense lesion). Each radiologist commented on the perceived time to read out each of the sequences (as compared with a typical FRFSE T2 sequence) and in comparing the two sequences noted whether they thought PROPELLER would change the clinical treatment for the patient. Chi Square analysis and Wilcoxon signed-rank test were used to assess the radiologists' responses. Interobserver variability was rated using pairwise weighted kappa statistic.

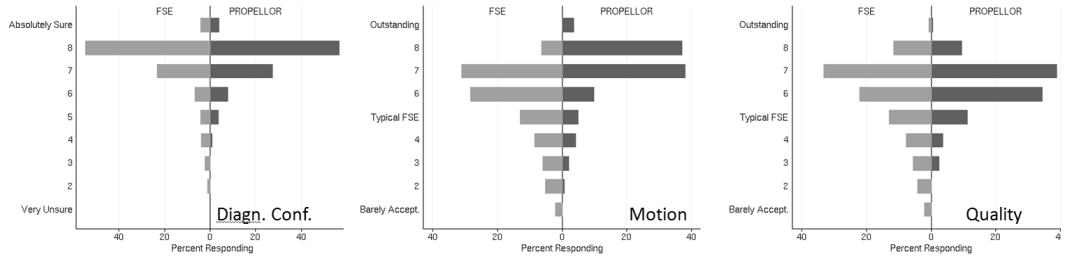

***Fig. 1** – T2w-FSE vs. T2w-PROPELLER FSE. Average scoring distribution amongst raters for diagnostic confidence (left), motion artifacts (middle), and overall image quality Despite the improved image quality and reduced motion artifacts it is quite surprising that diagnostic confidence was rated only marginally better.*

Results: Compared with T2w-FRFSE, T2w-PROPELLER FSE demonstrated significantly better image quality and reduced motion artifacts, with greater high-quality and fewer-low quality ratings in each category (Fig 1). There was no tendency to higher detection rates with one sequence over the other. However, blood products showing increased susceptibility were reported to be more easily identified on the T2w-FSE sequence than on PROPELLER (Fig 2). Despite the better image quality it was surprising that diagnostic confidence was only marginally better for PROPELLER than for conventional T2w-FRFSE (Fig 1). In our patient population (all comers) the use of PROPELLER was considered unlikely to alter management in any of the patients imaged and was not considered to have an effect on image read-out time. On average interrater agreement was 87% and never fell below 75% for any of the subtests administered.

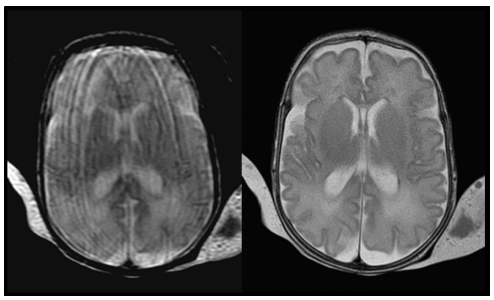

***Fig. 2** – Conventional T2w-FSE image (left) shows significantly greater motion artifact than T2w-PROPELLER FSE image (right) in ex-premature infant imaged at full term corrected gestational age. Although anatomic detail including gray-white differentiation is better delineated with PROPELLER, susceptibility from focal blood is less well seen.*

Conclusion: A comparative evaluation of T2w-FRFSE and T2w-PROPELLER on image quality and diagnostic yield was performed on a consecutive series of pediatric patients. Although no substantial benefit in diagnostic confidence was observed, T2w-PROPELLER FSE offers sufficient diagnostic information that it may be substituted for conventional FRFSE T2 in pediatric exams in order to reduce motion and improve image quality. However, caution is required in using PROPELLER to identify blood products and further studies. One difference is that Cartesian FSE used a driven-equilibrium approach, which might alter the contrast slightly relative to regular FSE. At our institution FRFSE is preferred over regular FSE mostly because of better image quality. However, further studies are warranted to investigate the nature of this difference in sensitivity to blood products.

References: [1]Mittal TK, Halpin SFS, *et al*. A prospective comparison of brain contrast characteristics and lesion detection using single-shot fast spin-echo and fast spin-echo. Diagnostic Neuroradiology 1999; 41: 480-6; [2]Pipe JG. Motion correction with PROPELLER MRI: Application to head motion and free-breathing cardiac imaging. Magnetic Resonance in Medicine 1999; 42: 963-9; [3]Forbes KP, Pipe JG, *et al*. Brain imaging in the unsedated pediatric patient: comparison of periodically rotated overlapping parallel lines with enhanced reconstruction and single-shot fast spin-echo sequences. Am J Neuroradiol 2003; 24: 794-8.

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