Is there a benefit from rotating K-SPACE sampling (BLADE) vs. conventional Cartesian K-SPACE sampling (TSE) for routine shoulder MRI?

A. Horng[1], M. Pietschmann[2], M. Notohamiprodjo[1], P. Müller[2], M. F. Reiser[1], and C. Glaser[1]
[1]Department of Clinical Radiology, University Hospitals LMU Munich Campus Grosshadern, Munich, Bavaria, Germany, [2]Department of Orthopedic Surgery, University Hospitals LMU Munich Campus Grosshadern, Munich, Bavaria, Germany

Purpose: In shoulder-MRI the radiologist is often confronted with involuntary patient movement which might produce artifacts and consecutively non-diagnostic images using conventional TSE sequences with common Cartesian block-wise linear readout of k-space. Recently a multishot T2-weighted sequence based on rotating rectangular read-out of k-space data after successive radiofrequency excitations (BLADE) was developed, which is supposed to reduce motion artifacts and improve image quality as evaluated for brain and abdominal imaging [1-5]. Given possible benefits for musculoskeletal imaging, this initial study was conducted for comparison of BLADE to a conventional fat-saturated TSE sequence (cTSE) for image quality, anatomical detail depiction and confidence in the detection of shoulder pathologies.

Materials and Methods: Moderately T2-w coronal and axial BLADE and cTSE sequences in identical positioning were acquired in 97 consecutive patients (TR 3000ms/TE 45ms/FOV 160/BW 260Hz) at 3T using a commercial 4-channel-shoulder coil. Datasets were rated using a 5-point-Likert-Scale for image quality, artifacts and clinically important anatomical structures (muscle and tendons of musculi supraspinatus, infraspinatus and subscapularis, long biceps tendon, labrum, glenoid and humeral cartilage, inferior and middle glenohumeral ligaments). Differences were calculated using the t-test.

Results: Average rating for image quality and artifacts was 4.55/4.70 for BLADE and 3.59/3.69 for cTSE. Image quality was rated better in BLADE for 83%, same in 12%, worse in 5%. Artifacts were observed 81% less in BLADE, 17% same as cTSE and 2% worse in BLADE as compared to cTSE. Average rating for anatomical structures/confidence of clinical diagnosis was 4.78/4.73 for BLADE and 4.44/4.58 for cTSE. BLADE demonstrated significantly better image quality ($p<0.01$), less artifacts ($p<0.01$) and better depiction of anatomical structures ($p<0.01$) as compared to cTSE. Confidence of diagnosis for pathologies tended to be higher for BLADE (4.73 vs 4.58) than for cTSE. Subanalysis of the single shoulder pathology entities revealed significantly better diagnostic confidence of anterior labral abnormalities using BLADE.

Conclusion: Rotating read-out of k-space (BLADE) enables significant reduction of motion artifacts, improvement of image quality and depiction of anatomical detail as compared to conventional Cartesian K-SPACE sampling sequences (cTSE) used in musculoskeletal radiology. It provides significantly better diagnostic confidence for anterior labral abnormalities. BLADE provides a promising alternative for examination of young, critically ill or claustrophobic patients, who express a higher probability for motion artifacts.

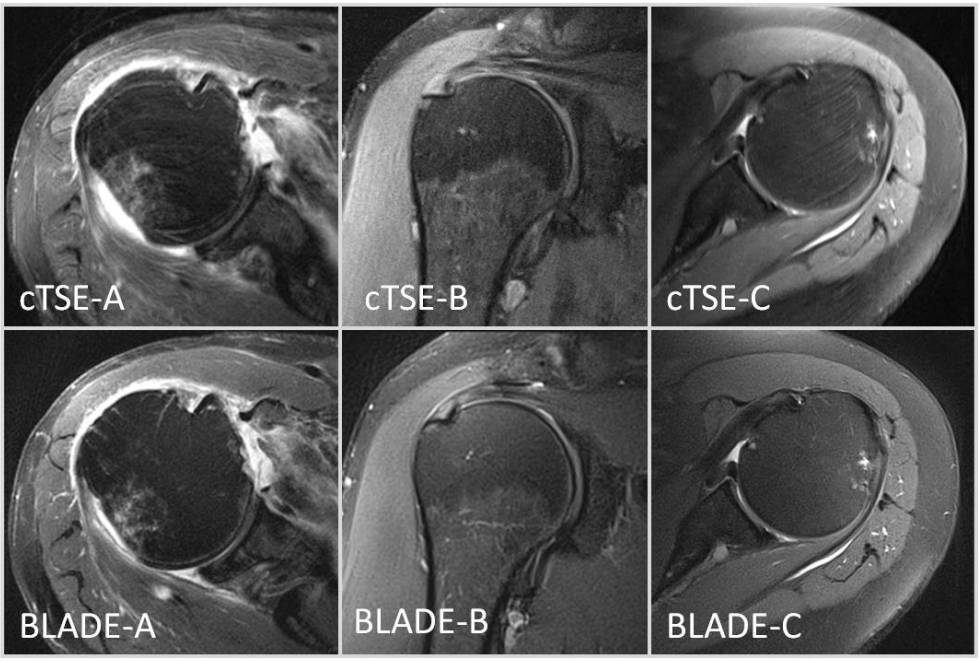

Figure
Coronal and axial image examples from 3 patients (A-C). A shows markedly less artifacts and consecutively improved image quality in BLADE as compared to cTSE. B reveals sharper and more detailed depiction of the anatomical structures, e.g. supraspinatus tendon insertion. C has less artifacts in the image and shows a sharper depiction of the anterior labrum with BLADE.

Literature:

1. Pipe. Motion correction with PROPELLER MRI: application to head motion and free-breathing cardiac imaging. Magn Reson Med 1999
2. Wintersperger et al, Brain magnetic resonance imaging at 3 Tesla using BLADE compared with standard rectilinear data sampling. Invest Radiol. 2006
3. Michaely et al, Renal T2-weighted turbo-spin-echo imaging with BLADE at 3.0 Tesla: initial experience. J Magn Reson Imaging 2008
4. Hirokawa et al, MRI artifact reduction and quality improvement in the upper abdomen with PROPELLER and prospective acquisition correction (PACE) technique. AJR Am J Roentgenol 2008
5. Hirokawa et al, Evaluation of motion correction effect and image quality with the periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) (BLADE) and parallel imaging acquisition technique in the upper abdomen. J Magn Reson Imaging 2008