A fat saturated proton density-weighted 3D-TSE-sequence for MRI of the knee at 3T – first clinical results

M. Notohamiprodjo[1], A. Horng[1], M. Pietschmann[2], W. Horger[3], K. A. Herrmann[1], J. Park[3], J. G. Raya[1], M. F. Reiser[1], and C. Glaser[1]

[1]Institute for Clinical Radiology, University Hospitals Munich, Munich, Bavaria, Germany, [2]Department of Orthopedics, University Hospitals Munich, Munich, Bavaria, Germany, [3]Siemens Medical Solutions, Erlangen, Bavaria, Germany

Introduction:

3D-TSE-sequences allow covering a whole organ of interest with an isotropic slab, facilitating interactive 3D-visualization[1]. The high isotropic resolution reduces partial volume effects and enables free 3D-multiplanar-reformatting (MPR) without loss of image quality in the three major anatomical planes and along structures of interest. The purpose of this study was to technically and clinically evaluate knee-MRI at 3T with an isotropic fat-saturated(FS) proton-density-weighted(PDw) 3D-TSE-sequence.

Materials and Methods:

For technical evaluation the dominant knee of 10 healthy volunteers was examined with the sagittally orientated PD-FS 3D-TSE-sequence SPACE (TR 1200ms/TE 30ms/voxel-size 0.5^3mm^3/acquisition-time 10:35min) on a 3T-scanner (Magnetom TRIO). 0.5, 1 and 2mm thick multiplanar-reconstructions (MPRs) were performed in the three major anatomic planes. SNR, CNR, SNR-efficiency and anatomical-detail-visualization (5-point-scale) were compared to high-resolution state-of-the-art 2D-TSE-sequences in 3 orthogonal planes (TR 3200ms/TE 30ms/voxel-size 0.36x0.36x3mm/total acquisition-time 12:34min). Sixty patients with cartilage and meniscus pathologies were examined with the same techniques. Patient 3D-datasets were assessed using 1mm-thick MPRs. Detection of abnormalities and diagnostic confidence were assessed by 2 radiologists independently. Arthroscopy correlation was available for 18 patients. Statistical analysis was performed using 95%-confidence intervals, Wilcoxon-signed-rank-tests and Weighted-κ.

Results:

SNR-efficiency of SPACE was four to five times higher than for 2D-TSE-sequences. SNR and CNR of 1mm-thick SPACE-reconstructions were comparable to 2D-TSE-sequences (**Figure 1**) and provided superior visualization of small structures such as meniscal root ligaments.

Correlation with arthroscopy did not show significant differences between 2D- and 3D- sequences. One reader detected significantly more cartilage abnormalities (**Figure 2**) with the 2D-TSE-sequence (131 vs. 151, p=0.04). Diagnostic confidence was significantly higher for meniscus abnormalities (**Figure 3**) for SPACE for one reader. Intersequence-correlation was excellent (κ=0.82 to 0.92). Interreader-correlation was good to excellent (κ=0.71 to 0.80), intrareader-correlation was excellent (κ=0.90 to 0.92)

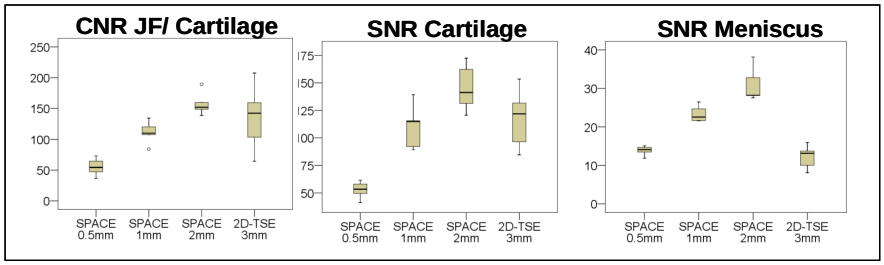

Figure 1: Exemplary SNR and CNR of meniscus and joint fluid (JF)

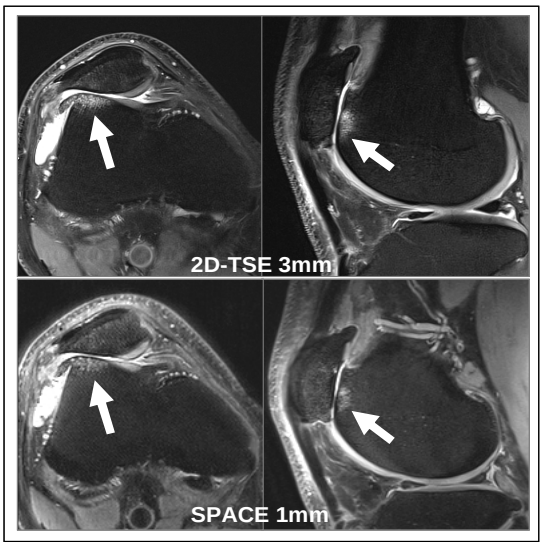

Figure 2: Femoropatellar cartilage erosion with subchondral edema is similarly depicted in SPACE and 2D-TSE

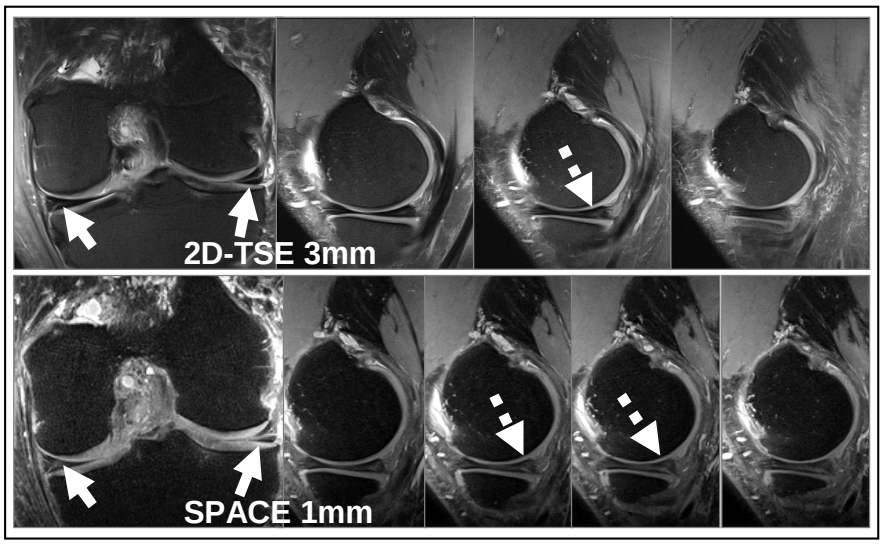

Figure 3: III°-tears of both menisci (arrows), surfacing (dotted arrow) in the posterior horn of the medial meniscus is clearly visible in SPACE but not obvious in 2D-TSE.

Conclusions:

3T enables time-efficient 3D-TSE-imaging of the knee at adequate SNR and CNR. Detection and visualization of meniscus- and cartilage-pathologies is at least comparable to state-of-the-art 2D-TSE-sequences. 3D-TSE-sequences with consecutive MPR may become a valuable component of future knee-MRI protocols.

References:

1. Lichy et al.; MRI of the body trunk using a single-slab, 3D-T2w TSE- sequence with high sampling efficiency (SPACE) for high spatial resolution imaging: initial clinical experiences. Invest Radiol,2005. 40(12): p.754-60.1