ISOTROPIC MRI OF THE SHOULDER, ELBOW, AND HIP AT 3.0T WITH 3D-FSE-CUBE

1Shapiro, L; 1Jenkins, A; 1Li, C; 1Sin, J; 1Chen, W; 2Busse, R; 2Brau, A; 2Beatty, P; 2Safran, M; 2Beaulieu, C; 2Stevens, K; 2Gold, G
1Stanford University Department of Radiology, 2GE Healthcare Global ASL Laboratory, 3Stanford University Department of Orthopaedic Surgery

gold@stanford.edu

INTRODUCTION
MRI of the joints is traditionally done with multiple two-dimensional fast spin echo (2D-FSE) acquisitions1,2. Each of these acquisitions is composed of anisotropic voxels, which results in a much higher in-plane resolution than slice-direction resolution. Standard examinations require acquisition of 2D data in multiple planes and are susceptible to partial-volume artifacts in the slice direction. By contrast, acquisitions with isotropic resolution allow reformations in arbitrary planes3. Recently, 3D FSE with isotropic resolution has been evaluated in the knee and the ankle4,5. We developed a prototype isotropic resolution three-dimensional fast spin-echo acquisition using an extended echo train (3D-FSE-Cube) and compared it with conventional 2D-FSE in the hip, elbow, and shoulder.

METHODS
Ten shoulder, elbow, and hip joints of healthy volunteers were imaged using a GE MR 750 3.0T MRI scanner (GE Healthcare, Milwaukee, WI). A total of 30 joints were studied. For the hip, a cardiac array coil was used with axial acquisitions. For the shoulder, an 8-channel shoulder coil with axial acquisitions was utilized. For the elbow, an 8-channel knee coil with coronal acquisitions was performed with the patient in a prone position. 3D-FSE-Cube used variable flip angle refocusing to constrain T2-decay over a long echo train length (60 echoes)6. Images were acquired with a repetition time/echo time (TR/TE) 3000/35ms, 288x256 matrix, 16 - 20 cm field-of-view, 0.6 – 0.9 mm sections, and bandwidth +/- 42 kHz, resulting in an isotropic resolution of 0.6 – 0.9 mm. Partial Fourier acquisitions or auto calibrated parallel imaging7 reduced scan time by factors of 3 to 4, and about 200 sections were acquired in 5 - 7 minutes. Two-dimensional FSE images were acquired with TR/TE 3000/35ms, 288x256 matrix, 16-20 cm field-of-view, 3 mm slices and 1 mm gap, 2 signal averages, echo train length 8, bandwidth +/- 32 kHz, and a scan time of 4-6 minutes. 2D-FSE was acquired in a perpendicular plane for comparison with reformats of the 3D data. Two experienced musculoskeletal radiologists evaluated the images.

RESULTS
3D-FSE-Cube images were acquired for the shoulder, elbow, and hip joints with a scan times between 4 and 7 minutes. Images were reformatted into multiple planes without significant loss of quality. Image analysis by two radiologists showed that fat suppression was comparable between 2D-FSE and 3D-FSE-Cube. Compared with the 2D-FSE images, some blurring or loss of image sharpness could be seen on 3D-FSE-Cube images due to the long echo trains. Mild artifacts from parallel imaging were noted. However, 3D-FSE-Cube images could be reformatted into multiple planes, facilitating the display or curving or oblique structures. Slice averaging of the 3D-FSE-Cube images was used to improve the reformatted image signal to noise ratio.

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REFERENCES