Isotropic Imaging of the Wrist at 1.5T using 3D-FSE-Cube

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INTRODUCTION: MRI with two-dimensional fast spin-echo (2D-FSE) requires multiple acquisition planes because of slice gaps and partial-volume artifacts. Volumetric acquisitions with isotropic resolution overcome these limitations, allowing reformations in arbitrary imaging planes from a single acquisition [1-3]. A 3D isotropic fast spin-echo sequence (3D-FSE-Cube) was compared with conventional 2D-FSE in the wrist at 1.5T.

METHODS: The wrists of 10 healthy volunteers (mean age 31 yrs) were imaged in the coronal plane using a GE Signa 1.5T MRI scanner (GE Healthcare, Milwaukee, WI) and an 8-channel wrist coil. 3D-FSE-CUBE images were acquired both with and without fat saturation using TR/TE 3000/35ms, 256 x 256 matrix, 12cm FOV, 0.5mm sections, ETL 60 and receiver bandwidth ±83kHz. 132 slices were acquired using auto-calibrated parallel imaging and an acceleration factor of 2.8 in 4mins 28s. 2D-FSE images were acquired with and without fat saturation in the coronal and axial planes for comparison using TR/TE 3000/35ms, 256 x 256 matrix, 12cm FOV, 2mm slices and 0.5mm gap, ETL 8, receiver bandwidth ±83kHz, acquisition time 3mins 18s. Both 2D-FSE and 3D-FSE-Cube were also acquired with the RF pulse off to allow measurement of noise. For each method, a region of interest was placed in cartilage, muscle, and fluid. The standard deviation of the noise was calculated from a ROI placed in an identical noise image obtained with the RF turned off. The SNR was calculated using a correction factor to correct for Rayleigh noise distribution [4]. A paired t-test was then used to compare both SNR and CNR (Microsoft Excel 2008).

RESULTS: Cartilage, muscle and fluid SNR (Figure 1) were all significantly higher using 3D-FSE-Cube ($p<0.001$). Fluid-cartilage CNR was also significantly higher with 3D-FSE-Cube ($p<0.001$). The 3D-FSE-Cube images had much thinner slices, allowing improved visualization of structures such as the intercarpal ligaments and triangular fibrocartilage complex (Figure 2). Axial reformations of the 3D-FSE-CUBE images were similar to the directly acquired 2D-FSE data, without significant blurring (Figure 3). Fat suppression was uniform on all sequences, and no significant blurring was seen on the 3D-FSE-CUBE images.

DISCUSSION: Isotropic data from 3D-FSE-Cube allows for reformations in arbitrary scan planes, making multiple 2D acquisitions unnecessary. The thinner slice thickness of 3D-FSE-Cube decreases partial-volume artifacts, improving visualization of small anatomic structures. 3D-FSE-CUBE is a promising high-resolution MR imaging technique which may improve depiction of complex wrist anatomy.

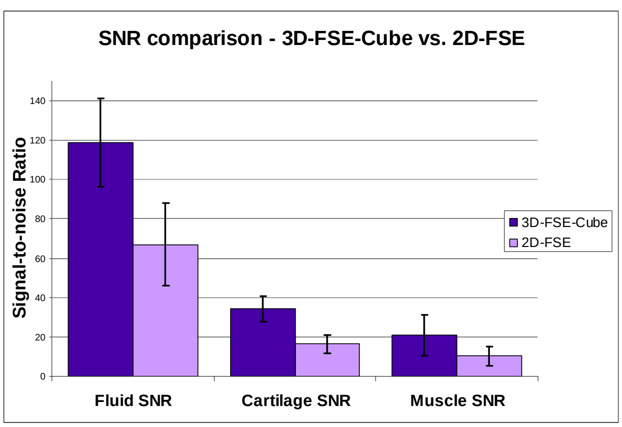

Figure 1. Comparison of corrected SNR in cartilage, muscle, and fluid for 3D-FSE-XETA and 2D-FSE. 3D-FSE-XETA had significantly higher SNR in all three tissues ($p < 0.001$) compared with 2D-FSE, despite much thinner slices.

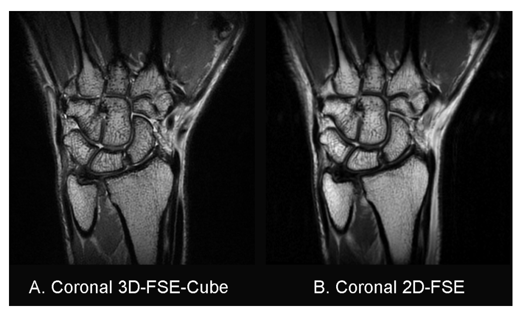

Figure 2. Coronal images of the right wrist in a normal volunteer.

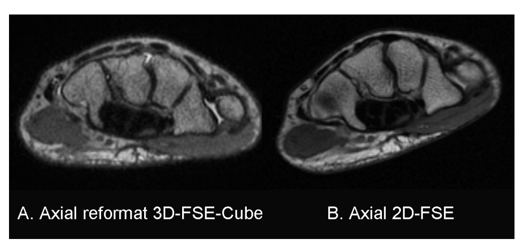

Figure 3. Axial images of the left wrist in a normal volunteer.

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