Iterative decomposition of water and fat with echo asymmetry and least-squares estimation (IDEAL) of the wrist and finger at 3TMRI: comparison with chemical shift selective fat suppression images

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PURPOSE

Iterative decomposition of water and fat with echo asymmetry and least-squares estimation (IDEAL) imaging is a new method that can steadily separate fat and water by using three asymmetric echo times and the three-point Dixon method. Robust fat suppression (FS) facilitates more accurate and more confident interpretations in areas of B_0 inhomogeneity such as hand and finger. The purpose of our study was to compare IDEAL with chemical shift selective fat-suppressed T1-weighted spin-echo (FS-CHESS-T1-SE) images for MR imaging of the hand and finger at 3.0T MR system.

MATERIALS AND METHODS

MR imaging was performed in 8 healthy volunteers and 8 rheumatoid arthritis (RA) patients with a 3.0T MR system (Signa HDxt GE healthcare) by using an eight-channel knee coil. In the RA patients, FS-CHESS-T1-SE images and IDEAL images were obtained after gadolinium administration. Both imaging were acquired in the coronal planes covering entire structure of the bilateral hands with the slice thickness of 2 mm. Imaging time was 6 minutes 12 seconds for IDEAL and 6 minutes 56 seconds for CHESS-T1-SE sequences. Synovitis and bone edema on MR images were reviewed by two musculoskeletal radiologists using the Rheumatoid Arthritis MRI Scoring System (RAMRIS) of the OMERACT (Outcome Measures in Rheumatoid Arthritis Clinical Trials) group. Image quality was evaluated on a five-point scale (1=excellent to 5=very poor).

RESULTS

Image quality was significantly better at IDEAL than at CHESS-T1-SE images ($P < .01$). The rating was one point better in the five-point scale used. Although IDEAL showed uniform FS unaffected by magnetic field inhomogeneity and challenging geometry of hand and fingers, CHESS-T1-SE often showed FS failure within first metacarpal joint, tip of the finger, and ulnar aspect of the wrist joint. Interobserver agreement (κ value) for synovitis and bone edema was good to excellent at IDEAL (0.74-0.91, 0.62-0.89, respectively).

CONCLUSION

IDEAL compensates for the effects of field inhomogeneities, providing uniform FS of the hand and finger than did CHESS-T1-SE sequence.
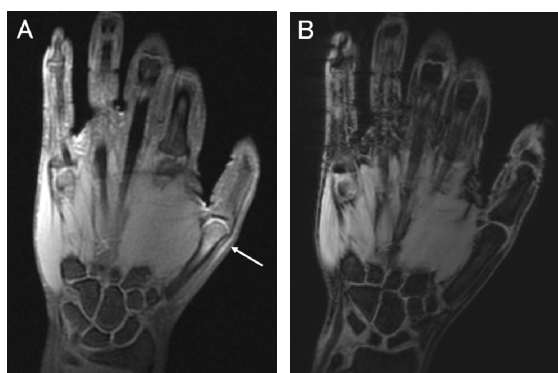

Fig. 1: Asymptomatic 32-year-old woman. Coronal CHESS-T1-SE image of hand (A) shows fat suppression failure within first metacarpal (arrow) because of field inhomogeneity created by challenging geometry of hand. Corresponding coronal IDEAL image (B) shows uniform fat suppression unaffected by magnetic field inhomogeneity.
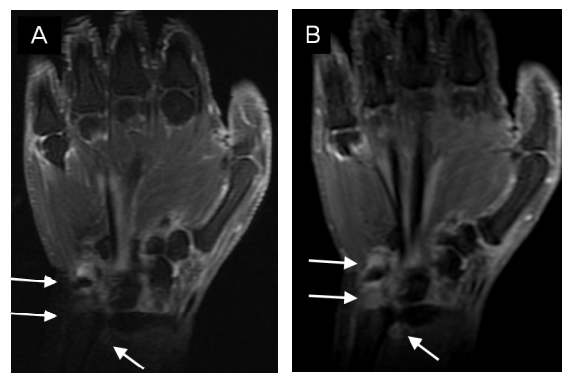

Fig. 2: Rheumatoid arthritis in a 57 -year-old woman. Periarticular enhancement in the ulnar aspect of the wrist (arrows), indicating synovitis, is more clearly depicted on the IDEAL image (B) than on the CHESS-T1-SE image (A).

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