Case Study | MSK IMAGING

High-resolution Knee MRI

By Richard Kijowski, MD, Associate Professor of Radiology, University of Wisconsin School of Medicine and Public Health

The conventional approach for a knee MRI exam is to run 2D fast spin echo (FSE) proton density FatSat series in each of the three orthogonal planes, plus the additional T1 series without fat suppression. Replacing these three orthogonal series with one single 3D data set has not yet been adopted in clinical routine, as the commercially available 3D sequences were generally based on gradient echo instead of spin echo, thus not providing the expected tissue contrast due to undesired magnetic susceptibility. Furthermore, the 3D acquisition approach often did not match the high resolution requirements expected in MSK, especially the voxel size along the slice encoding direction.

Cube is a 3D FSE sequence using a modulated refocusing RF pulse pattern to optimize image contrast and decrease blurring. Recent improvements to Cube in data acquisition limit image blurring due to shorter T2 relaxation times in MSK applications. The clinical case below illustrates the added value of Cube versus conventional 2D FSE in the knee.

Patient history

The patient is a 45 year-old male with knee pain and swelling following a twisting injury sustained while playing soccer.

Figure 1. Sagittal fat-suppressed T2-weighted fast spin-echo image (1A) and sagittal fat-suppressed Cube FSE image (1B) show complete tear of the anterior cruciate ligament (arrow) and a partial thickness cartilage lesion on the femoral trochlea (arrowhead).

<table>
<thead>
<tr>
<th>MR parameters</th>
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<tbody>
<tr>
<td>Repetition time:</td>
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<tr>
<td>Echo time:</td>
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<td>FOV:</td>
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<td>Slice thickness:</td>
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<td>Echo train length:</td>
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<td>Total scan time:</td>
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Case Studies

Figure 2. Coronal fat-suppressed intermediate-weighted fast spin-echo image (2A) and coronal fat-suppressed Cube FSE reformat image (2B) show a complex tear of the posterior horn of the medial meniscus (large arrow) and subchondral bone marrow edema within the lateral femoral condyle (arrowhead). Also note the tiny cartilage fissure in the medial femoral condyle (small arrow) which is better visualized on the Cube FSE image due to decreased partial volume averaging.

MR technique

A 30-minute routine knee MR protocol was performed on our Signa HDxt 3.0T scanner, consisting of two-dimensional intermediate-weighted (IW) and T2-weighted fast spin echo sequences acquired in multiple planes. A five minute 3D Cube sequence was also performed. Multi-planar 3D Cube reformat images with 1.0 mm slice thickness were created from the volumetric source data immediately following the MR examination.

MR findings

Sagittal FatSat T2 FSE image (1A) and FatSat 3D Cube image (1B) show complete tear of the anterior cruciate ligament (arrow) and a cartilage lesion on the femoral trochlea (arrowhead).

Coronal FatSat IW FSE image (2A) and FatSat 3D Cube reformat image (2B) show a complex tear of the posterior horn of the medial meniscus (arrow) and subchondral bone marrow edema within the lateral tibial plateau (arrowhead).

Discussion

My colleagues and I have published two large clinical studies^1^2 on patients with surgical correlation that show a five-minute 3D Cube sequence can provide similar information regarding the ligaments, menisci, and osseous structures of the knee joint as a 30-minute routine MR protocol. This case demonstrates the clinical value of Cube with significant time savings.

References


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Richard Kijowski, MD, is an Associate Professor, Department of Radiology, University of Wisconsin School of Medicine and Public Health and a radiologist for the University of Wisconsin Hospital & Clinics. Dr. Kijowski earned his medical degree from the Loyola University Chicago Stritch School of Medicine (Maywood, Ill.) and completed his residency at Oakwood Hospital and Medical Center (Dearborn, Mich.) and the Detroit Medical Center. He has a special interest in musculoskeletal MR imaging with emphasis on the knee and elbow. Dr. Kijowski has collaborated with members of the Medical Physics Department at University of Wisconsin to develop and validate rapid three-dimensional MR techniques for joint imaging. His primary research interest is the use of morphologic and quantitative MR methods to investigate osteoarthritis and acute cartilage injury. His research efforts have lead to 49 scientific abstracts presented at national and international meetings and 30 articles published in peer reviewed journals.

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