Chondromalacia of the Knee:
Sagittal, Gd-Enhancement, Fat Suppression 3D SPGR Imaging.

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Introduction
Chondromalacia is a pathological condition of articular cartilage degeneration. The cartilage is softened, swollen, or fibrillated in the early stage, and fragmentation, fissuring and subchondral bone abnormalities are present in the advanced stage. Many factors may have influenced on the accuracy of MR imaging. Fat-suppressed 3D imaging is capable of increasing the contrast between articular cartilage and adjacent tissues such as bone marrow and subcutaneous fatty tissues and allows high spatial resolution. Our study was designed to access the accuracy of a fat-suppression 3D SPGR imaging after intravenous contrast injection in detecting chondromalacia.

Materials and Methods
Sixty-one patients were chosen who had underwent MR imaging and arthroscopy. All were suspected of having internal derangement of the knee. MR imaging were performed using 1.5T(GE, Signa) and knee coil. Sagittal Gd-enhancement, fat-suppression, 3D SPGR imaging were obtained: 60 contiguous sagittal images, TR/TE/TI = 60/12/60°, 1.2-mm thickness, 14-cm FOV, one NEX. Total imaging time was about 12 minutes after an intravenous contrast injection. Two musculoskeletal radiologists reviewed MR imaging without knowledge of the arthroscopic diagnosis. The differences were corrected by the concensus of two reviewers. The MR interpretation results were compared with arthroscopic results. The MR interpretation of the severity of chondromalacia was made based on the arthroscopic grading system (0-4): 0, normal; 1 softening or blister; 2, superficial fissure; 3, deep fissure; 4, full thickness fissure and exposed bone. If a region showed various grades at multiple areas, the region was assigned its highest grade. Medial & lateral patellas, femoral and tibial condyles were evaluated.

Results and Discussion
Cartilage normal articular cartilage had a laminated appearance with internal intermediate signal intensity. In particular, articular surfaces were well contrasted by enhanced joint fluid and the synovial membrane. Cartilage abnormalities were shown as foci of nodular or fissure-like shape with high signal intensity. On the basis of a region-by-region comparison of MR imaging findings and arthroscopic findings of a total 360 regions, 69 articular lesions were depicted at arthroscopy while 47 lesion sites were found at MR imaging(G1,14; G2,8/14; G3 9/10; G4 29/31). MR grades were identical with arthroscopic grades in 58%(40/69), of one grade difference in 2, and of two grade difference in 5 sites. 31.8%(22/69) were missed on MR images. Of 291 arthroscopically normal surfaces, 7 falsely positive case were found. Sensitivity, specificity and accuracy for grading regional cartilage lesions were 58.0%, 97.6%, and 90%. Sensitivity for detection alone would increase up to 68.1%. Sensitivity for G3 or G4 was 80% and for G1 or G2 was 25%. Common lesion site was medial femoral condyle(n=19), lateral femoral condyle, medial tibial condyle in order of frequency.

Discussion
The high signal may be yielded by two possible enhancement mechanisms. One is that the diffusion of the contrast agent occurs through the synovial membrane and then the leaked contrast agent fills up cartilage defects, as suggested previously in a case reported by Peterfy et al(21). The other possible mechanism is that the contrast agent may permeate into the chondral defect regions from the subchondral bone with increased vascular supply. This method has a high sensitivity for G3 or G4 chondromalacia. In summary, a postcontrast, fat-suppression 3D SPGR MR imaging showed high specificity in excluding cartilage abnormalities and may be considered as an alternative to intraarticular MR arthrography when chondromalacia is suspected.

Table 1. Comparison of MR and Arthroscopic Results

<table>
<thead>
<tr>
<th>MR*</th>
<th>Arthroscopy</th>
<th>Sensitivity(%)</th>
</tr>
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<tbody>
<tr>
<td>G1</td>
<td>1 (0)</td>
<td>14</td>
</tr>
<tr>
<td>G2</td>
<td>8 (2)</td>
<td>14</td>
</tr>
<tr>
<td>G3</td>
<td>9 (2)</td>
<td>10</td>
</tr>
<tr>
<td>G4</td>
<td>29(3)</td>
<td>31</td>
</tr>
<tr>
<td>total</td>
<td>47 (7)</td>
<td>69</td>
</tr>
</tbody>
</table>

No.( ) indicate the number of false positive case

Reference