MR Evaluation of Meniscal Allografts

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Introduction
Patients who are meniscus deficient show rapid advancement of degeneration of the articular cartilage.1 In an effort to prevent, slow and/or reverse these degenerative changes multiple investigators have attempted to either replace or substitute for the lost meniscus with different autografts, allografts, various collagen scaffolds, and Teflon prostheses.2,4 Meniscal Allograft implantation has shown the best results so far. Milachowski first performed this procedure in 1984.3 Since then several other investigators have undertaken this procedure; however, none to date have been able to show that an implanted meniscus will function like a native meniscus or that articular cartilage changes are slowed, arrested or reversed. This study attempted to evaluate the allograft by determining its characteristics and movement during knee range of motion as well as assess the condition of the articular cartilage.

Methods
Five patients (six menisci) who had undergone either medial or lateral menisal allograft implantation were evaluated using weight bearing Magnetic Resonance Imaging (MRI) scans. All patients had undergone implantation of a cryopreserved Meniscal allograft (Cryolife Inc., Kennesaw, GA) by a single surgeon (FRN) using an arthroscopic assisted mini-arthroty technique. Inclusion criteria included patients who had a retained allograft, had a normal contralateral meniscus, and were ligamentously stable.

Patients were positioned standing in the Signa SP 0.5T vertically oriented open magnet (GE Medical Systems, Milwaukee WI) at Norton Hospital with their knee at isocenter. Hardware normally used to position the patient seated for knee or pelvic floor studies was adapted to serve as a backrest to support the patients in a position close to vertical.

Weight bearing, spoiled gradient echo, single slice sagittal and coronal MR images were obtained of both knees at 0°, 30°, 60° and 90° knee flexion angles. The slices were selected relative to the tibial plateau by positioning a 3D mouse (Flashpoint, KGT, Boulder CO) attached to a shin guard via a gooseneck. The 3D mouse position is automatically communicated to the scanner and its attachment to the shin guard allowed for reproducible slice positions at the various knee flexion angles. Semi-weight-bearing multi-sliced interleaved MRI images were obtained of both knees at 45° flexion. The semi-weight-bearing position was attained with the patient upright against the backrest and a strap across the proximal tibia to restrict motion and bear part of the weight. MR Fast Spin Echo (FSE) proton density (PD) and T1 weighted as well as FSE with fat saturation (FS) images in the patient’s weight. MRI Image Findings Summary

<table>
<thead>
<tr>
<th>Patient</th>
<th>Allograft Integrit % Poly</th>
<th>Articular Cartilage Status</th>
<th>Subchondral Bone Status</th>
<th>Effusion</th>
<th>Posterior Horn Excursio %</th>
<th>Anterior Horn Excursio %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>Intact</td>
<td>Grade 4</td>
<td>Very Small osteo -py</td>
<td>1→1−3</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Patient 2</td>
<td>Intact</td>
<td>Grade 2</td>
<td>Very Mild Edema, Small Osteoporhyte</td>
<td>1−12−0→4+</td>
<td>+2−4</td>
<td></td>
</tr>
<tr>
<td>Patient 3</td>
<td>Possibl e Tear</td>
<td>Grade 4</td>
<td>Edema, Large Osteoporhyte</td>
<td>0→4+</td>
<td>-10→40</td>
<td></td>
</tr>
<tr>
<td>Patient 4 (Latera l 1)</td>
<td>Indetermin ate</td>
<td>Grade 3</td>
<td>Subchondral Cyst Osteoporhyte</td>
<td>-3→4</td>
<td>-1→-</td>
<td></td>
</tr>
<tr>
<td>Patient 4 (Media)</td>
<td>Tear</td>
<td>Grade 3</td>
<td>Moder ate Osteoporhyte</td>
<td>Small</td>
<td>-4→−3</td>
<td>-6→+40</td>
</tr>
<tr>
<td>Patient 5</td>
<td>Failed, Disintegrate</td>
<td>Grade 3-4</td>
<td>Edema, Large Osteoporhyte</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Results
Meniscal allografts were difficult to discriminate on the spoiled gradient echo images. The meniscus in the normal knee was readily discernable, suggesting that the image quality was sufficient but the tissue properties had changed and there was less inherent contrast. In addition, artifacts from sutures and other surgical changes decreased the image quality and impeded the interpretation of the images. The posterior horn of the menisci were more easily evaluated than the anterior horn due to its larger size and less variability in its insertion site, especially in regards to the medial meniscus. Clinically all patients were either asymptomatic or had very minimal symptoms of pain in the involved compartment. No patient had obvious meniscal signs on examination and all were able to tolerate weight bearing without difficulty through the described knee range of motion for the duration of the MR exam.

Discussion
No conclusive findings can be generated from this limited number of patients, but the preliminary data indicates a number of trends. Patients with intact meniscal allografts based on MRI findings had relatively minor meniscal excision as compared to the excision of normal menisci. The size of the effusion and articular cartilage grading appeared to be inversely correlated with meniscal allograft integrity. Expanded data analysis will include comparisons of the pre-operative MRIs with those obtained in this study to evaluate changes in articular cartilage and subchondral bone status. With the limited data available in this short-term follow-up study it is impossible to determine if there is continued articualr cartilage degeneration or if allograft implantation has prevented further articular cartilage and/or bony degeneration.

References
1. Fairbank TJ: Knee joint changes after meniscectomy. JBJS 30-B: 664-670, 1948