Purpose: The aim of this study is to develop a MRI grading system for hip osteoarthritis (OA) based on morphologic changes in cartilage, labrum, and bone.

Methods: We devised a MRI grading system for early hip OA with standard definitions of morphologic changes with corresponding pictorial atlas. 50 MR images were obtained from 25 patients with hip dysplasia and 25 patients with femoroacetabular impingement. Images were acquired on a Siemens Avanto 1.5T scanner. Truspf imaging with FoV 140 mm, matrix size 384, slice thickness 0.6 mm were used for morphologic grading. Three-dimensional dGEMRIC scan was obtained using two angle fast T1 mapping sequence. Additionally, standard pelvic radiographs and WOMAC outcome scores were obtained. The truspf images were reconstructed in 6 radial projections rotating around the femoral neck axis. These radial images were scored for bone and soft tissue lesions at 7 different positions encompassing most of the articular surface and avoiding the acetabular fossa. A sum score of all lesions seen in the joint was calculated. The sum score (OA score) ranges from 0 to 197 with higher score indicating more OA. We looked at correlations between OA score, Tönnis grade, joint space width (JSW), dGEMRIC index, and WOMAC pain using Spearman rank correlation.

Results: Mean age of the patients was 29 years. Fig 1 shows an example of hip with no radiograph OA (fig 1a). On MRI, this hip had cartilage damage and bony changes (fig 1b). The OA score ranged from 20 to 87 with mean value of 43. Significant correlation was found between OA score and Tönnis grade ($r_t=0.39$, $p=0.008$), dGEMRIC index ($r_t=-0.35$, $p=0.01$), and WOMAC pain score ($r_t=0.48$, $p=0.001$) (fig 2). No correlation was found between OA score and JSW.}

Conclusions: In this preliminary result, we attempted to score the bony and soft tissue morphologic changes that occur in early hip OA. We have found good correlation with clinical outcome measure and dGEMRIC index suggesting that this measure is potentially a clinically relevant measure. We are currently attempting to look at the reproducibility of this grading system as well as the local correlation between morphologic changes and local dGEMRIC index.

**MRI OF CARTILAGE (DGERMIRIC) AT 3 TESLA**

CARTILAGE AND REPARATIVE TISSUE IN PATIENTS AFTER DIFFERENT CARTILAGE REPAIR PROCEDURES USING THREE-DIMENSIONAL, DELAYED GADOLINIUM-ENHANCED MRI OF CARTILAGE (DGERMIRIC) AT 3 TESLA

S. Trattnig1, T.C. Mamisch2, K. Pinker3, S. Domayer1, P. Szomolanyi1, S. Marlowska1, F. Kutscha-Lissberg1, G.H. Welsch1.

1Medical University of Vienna, Vienna, AUSTRIA, 2University of Bern, Berne, SWITZERLAND

Purpose: To use a newly developed short 3D-GRE sequence with two flip angle excitation pulses for dGEMRIC to evaluate the relative glycosaminoglycan (GAG) content of repair tissue in patients after microfracture (MFX) and matrix-associated autologous chondrocyte transplantation (MAC) of the knee joint.

Methods: In a phantom study, T1-mapping based on a 3D-GRE sequence with two flip angle excitation pulses was compared to a standard inversion recovery (IR) sequence at 3.0T for T1 values in the range of 200 to 1200 ms. Twenty patients treated with microfracture (MFX) or matrix-asssociated autologous chondrocyte transplantation (MACK) (ten in each group) were enrolled. For comparability, patients from each group were matched by age (MFX: 37.1 ± 15.4 years; MACT: 37.7 ± 8.9 years) and post-operative interval (MFX: 33.0 ± 5.2 months; MACT: 32.0 ± 13.1 months). The relaxation rate (ΔR1) for repair tissue and normal hyaline cartilage and the relative Δrelaxation rate (ΔR1/R0) were calculated, and mean values were compared between both groups using an analysis of variance. Figure 1 shows an exemplary patient after MFX whereas figure 2 is visualizing a patient after MACT.

Results: The phantom study demonstrated a good correlation between dual flip angle excitation pulse 3D GRE and the IR sequence. The mean ΔR1 for MFX was 1.07 ± 0.34 versus 0.32 ± 0.20 at the intact control site, and for MACT, 1.90 ± 0.49 compared to 0.87 ± 0.44, which resulted in a relative ΔR1 of 3.39 for MFX and 2.18 for MACT. The difference between the cartilage repair groups was statistically significant.

Conclusions: The new 3D, dual flip angle excitation pulse, GRE-based dGEMRIC technique is comparable to a standard T1 IR technique for T1 mapping, but reduces scan time to four minutes. The preliminary in vivo study demonstrates the feasibility of the technique for the evaluation of relative GAG content in patients after different cartilage repair surgeries.
The presented fast T1 mapping technique attain T1 (dGEMRIC) even more for its clinical use and might in future present a valuable tool in the therapy follow-up after different treatment options with the goal to prevent or treat osteoarthritis.

**400 IMPACT OF THE CONTRAST AGENT GADOPENTATE DIMEGLUMINE ON QUANTITATIVE MAGNETIC RESONANCE IMAGING OF CARTILAGE MORPHOLOGY**

S. Mascher¹, W. Wirth¹, B.T. Wyman², R.J. Buck³, M. Hudekmaier⁴, M-P. Helfo Le Graverand², F. Eckstein², ¹Chondrometrics GmbH, Aining, GERMANY, ²Pfizer Global Research and Development, Groton, CT, USA, ³Paracelsus Medical University, Salzburg, AUSTRIA

**Purpose:** Delayed gadolinium enhanced MRI (dGEMRIC) has shown to be sensitive to the proteoglycan content of the cartilage and requires intravenous injection of gadopentate dimeglumine (Gd-DTPA) 90 mins before MR imaging. It is unclear, whether measurement of cartilage morphology (volume and thickness) is affected by Gd-DTPA. Therefore morphological and dGEMRIC imaging have been performed separately (before and after Gd-DTPA injection). As it would be logically easier to combine these in one single session, we have compared the sensitivity to change of cartilage morphometry with and without Gd-DTPA.

**Methods:** 41 participants completed baseline and 24 months follow-up MR imaging before and after intravenous Gd-DTPA injection. All participants displayed K-L grade 2 or 3 in either the anterior posterior or the perimeniscal, Baker cyst, adjacent to the PCL, ACL and loose bodies.

**Results:** The correlation between pre- and post-Gd cartilage morphology varied between 0.87 for cartilage volume of the MT and 0.94 for cartilage thickness (ThCtAB) of the LT. In the absence of Gd-DTPA, a 1.7% decrease in ThCtAB (~1.8% MC, SRM -0.34) was observed in the post-, but no significant change in the pre-Gd-DTPA scans (0.9% MC, SRM 0.22, p=0.16). Results of subregional cartilage analysis are shown in Table 1.

**Conclusions:** The high correlation between pre- and post-Gd cartilage morphology at baseline did not translate into a similar sensitivity to change. Although the differences in longitudinal change for pre- and post-Gd morphology were not significant, the pre-Gd-DTPA image pairs tended to show greater changes and higher SRMs than the post-Gd-DTPA images in the medial femoro-tibial compartment of participants with medial radiographic OA. These results indicate that sensitivity to change of cartilage morphometry in OA may be diminished by the presence of Gd-DTPA. Further testing is required, before morphological measurements can be made on post-Gd images in longitudinal studies.

<table>
<thead>
<tr>
<th>Pre-Gd-DTPA</th>
<th>Mean %</th>
<th>SRM</th>
<th>p-value</th>
<th>2h Post-Gd-DTPA</th>
<th>Mean %</th>
<th>SRM</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>central MT</td>
<td>-2.4</td>
<td>-0.32</td>
<td>0.045*</td>
<td>-0.7</td>
<td>-0.08</td>
<td>0.606</td>
<td></td>
</tr>
<tr>
<td>external MT</td>
<td>-4.5</td>
<td>-0.43</td>
<td>0.009**</td>
<td>-1.2</td>
<td>-0.14</td>
<td>0.378</td>
<td></td>
</tr>
<tr>
<td>central cMF</td>
<td>-2.8</td>
<td>-0.28</td>
<td>0.080</td>
<td>-0.9</td>
<td>-0.09</td>
<td>0.550</td>
<td></td>
</tr>
<tr>
<td>central cLF</td>
<td>-3.2</td>
<td>-0.44</td>
<td>0.028**</td>
<td>-1.6</td>
<td>-0.23</td>
<td>0.150</td>
<td></td>
</tr>
<tr>
<td>external cLF</td>
<td>-0.0</td>
<td>-0.01</td>
<td>0.949</td>
<td>-0.3</td>
<td>-0.04</td>
<td>0.803</td>
<td></td>
</tr>
<tr>
<td>central cLF</td>
<td>0.9</td>
<td>0.18</td>
<td>0.258</td>
<td>-2.4</td>
<td>-0.34</td>
<td>0.036*</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1: Longitudinal change in (sub)regional cartilage thickness over 24 months**

**S174**

**Osteoarthritis and Cartilage Vol. 16 Supplement 4**

**401 A NOVEL SEMIQUANTITATIVE WHOLE-KNEE SCORING SYSTEM FOR THE ASSESSMENT OF SYNOVITIS IN KNEE OA ON CONTRAST-ENHANCED MRI – THE MOST STUDY**

A. Guermazi¹, F.W. Roemer¹, M.D. Crema¹, J. Niui¹, M.D. Marra¹, J.A. Lynch², G.Y. El-Khoury³, L.B. Hughes³, M.C. Nevitt⁴, D.T. Felson⁴, ¹Boston University School of Medicine, Boston, MA, USA, ²University of California San Francisco, San Francisco, CA, USA, ³University of Iowa, Iowa City, IA, USA, ⁴University of Alabama Birmingham, Birmingham, AL, USA

**Purpose:** While osteoarthritis (OA) is usually considered a non-inflammatory disease process, there is a growing body of evidence that synovitis is both common and associated with poorer outcomes in terms of symptoms and structural progression. Synovitis is defined as inflammation of the synovial membrane and is characterized by thickening and enhancement after administration of i.v. contrast agents. To date, synovitis in large epidemiological OA studies is assessed on non-contrast-enhanced (CE) MRI using a surrogate marker of signal changes in Hoffa’s fat pad (infrapatellar, intercondylar). However signal changes in Hoffa’s fat pad are a non-specific finding and do not reflect whole joint synovitis. For these reasons, we suggest that assessment of synovitis at multiple sites on CE MRI is a superior measure of localized as well as diffuse synovitis of the knee joint. The aim of the study is to introduce a new detailed and reliable scoring system for the assessment of synovitis that covers the whole knee joint.

**Methods:** The MOST study is a NIH-funded longitudinal observational study of individuals who have or are at high risk for knee OA. Subjects are an unselected subset of the MOST who volunteered for CE MRI. Synovitis was assessed at 11 sites of the joint: the medial and lateral parapatellar recesses, suprapatellar, infrapatellar, intercondylar, medial and lateral perimeniscal, Baker cyst, adjacent to the PCL, ACL and loose bodies. Synovial thickness was scored semiquantitatively: grade 0 (<2mm), grade 1 (2–4 mm) and grade 2 (>4 mm) at each site. Two experienced musculoskeletal radiologists performed the readings. To assess whole-knee synovitis, we summed the scores for the 11 sites and categorized knees as follows: 0–4=normal synovium or equivocal synovitis, 5–8=mild synovitis, 9–12=moderate synovitis, ≥13=severe synovitis. Inter- and intra-reader reliability for each individual site was calculated using kappa statistics (50 knees for intra- and 50 for inter-reader reliability). In addition we assessed the association of the summed synovitis scores with the maximum value of 5 WOMAC knee pain items (none, mild, moderate) using an ordinal logistic regression model adjusting for age, gender, BMI and whole knee radiographic OA.

**Results:** 403 knees (one knee per subject) were included in the analysis (mean age 58.8 years ± 7.0, mean BMI 29.5 ± 4.9, 45.7% women). Intra-reader reliability for the individual sites ranged from 0.67 to 0.92. For the summed synovitis score of 11 sites, weighted-kappa for intra-reader reliability was 0.99 for reader 1, 0.96 for reader 2 and weighted-kappa for inter-reader reliability was 0.98 (Table 1).