Table 1. Accuracy of location specific JSW measurements and mJSW

<table>
<thead>
<tr>
<th>Metric</th>
<th>X-location</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>mJSW</td>
<td>n.a.</td>
<td>75%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.1</td>
<td>67%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.125</td>
<td>76%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.15</td>
<td>75%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.175</td>
<td>78%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.2</td>
<td>76%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.225</td>
<td>82%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.25</td>
<td>76%</td>
</tr>
<tr>
<td>JSW</td>
<td>0.275</td>
<td>76%</td>
</tr>
</tbody>
</table>

Conclusions: Location-specific computer measures of JSW are feasible and potentially provide a more disease sensitive method to assess disease progression than mJSW in patients with OA. This method could prove useful to improve the power of clinical studies. In the future we anticipate performing this study with a larger number of subjects to establish a statistically significant difference between the two methods.

Acknowledgments: We would like to acknowledge the Health ABC Study for providing data.

A18
THE LOSS OF CARTILAGE VOLUME/THICKNESS ON THE WEIGHT BEARING AREAS IN KNEE OSTEOARTHRITIS PATIENTS, ASSESSED BY QUANTITATIVE MRI, IS CORRELATED WITH SEVERITY OF SYMPTOMS AND WORSENING OF PAIN OVER TIME

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Purpose: To explore on a symptomatic knee osteoarthritis (OA) cohort the correlation of the subregion of cartilage volume/thickness changes over 2 years as assessed by quantitative magnetic resonance imaging (qMRI) with demographic, clinical, radiological and MRI knee structure data, in order to better identify the risk factors of OA progression.

Methods: A cohort of 107 OA patients with the mean age of 62.4, 64% female, and average BMI of 30.6 kg/m² was studied. Patients with Kellgren-Lawrence grade IV radiographs were excluded. MRIs of the knee were analyzed at baseline and 2 years. Cartilage volume of the different subregions of the tibial plateau and femoral condyles was quantitated. The structural changes of bone edema and meniscal tear and extrusion were evaluated using semi-quantitative scales.

Results: The proportionally greatest cartilage volume/thickness loss at 2 years was found in the central portion of the medial tibial plateau (15%; p<0.0001) and of the medial femoral condyle (12.0%; p<0.0001). In the tibial plateau, greater cartilage loss was associated with medial meniscal extrusion (p<0.0001), severe medial meniscal tear (p=0.009), bone marrow edema (p=0.003), high body mass index (BMI; p=0.01), pain worsening (p=0.02), and joint space width (JSW) narrowing (p=0.03). In a multivariate stepwise forward regression, the severe medial meniscal extrusion (p=0.002) and pain worsening (p=0.05) were associated with cartilage loss in this subregion. In the medial femoral condyle, the associations with greater cartilage loss were severe medial meniscal tear (p<0.001), medial meniscal extrusion (p<0.001), JSW narrowing (p<0.0001), bone marrow edema (p=0.006), and high BMI (p=0.01). In a multivariate stepwise forward regression, severe medial meniscal tear (p=0.006), JSW change at 2 years (p=0.0005), and total WOMAC at baseline (p=0.06) were the most closely associated.

Conclusions: Meniscal damage and bone marrow changes are the most closely associated features with subregional cartilage volume/thickness loss. Interestingly, for the first time, the JSW narrowing was also demonstrated to be strongly associated with cartilage loss in weight bearing areas. This reflects that JSW change at its narrowest point may be closely related to cartilage loss in specific subregions. These data also further confirm the correlation between cartilage volume loss and symptomatic changes at 2 years.

A19
EARLY CHANGES OF CARTILAGE T2 TIME IN DYSPLASTIC HIPS USING 3.0 T MRI

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Purpose: Hip dysplasia is one of the major causes of hip osteoarthritis, and early detection of cartilage disorder in dysplastic hips is important for detailed assessment of cartilage pathology and determination of appropriate timing of osteotomy surgery. Evaluation of T2 relaxation time (T2 time) using MR imaging showed great potential for qualitative assessment in the knee cartilage, however, few reports assessed hip cartilage by T2 time because of difficulty in obtaining satisfactory image quality and in differentiation between the acetabular and femoral cartilages. MR imaging at higher magnetic field strength (>3 T) may provide improved image quality of the hip cartilage due to superior signal-to-noise contrast. Our objectives were to assess the feasibility of T2 changes using MR imaging at 3.0T for evaluation of early qualitative changes in the acetabular and femoral cartilages with hip dysplasia.

Methods: Three asymptomatic normal volunteers (3 hips) and 4 symptomatic patients with hip dysplasia (5 hips) were imaged on a GE 3.0 T MRI scanner using a flexible surface coil. All participants were female, and the mean age of the volunteers and the patients were 29 years and 39 years, respectively. In the 5 dysplastic hips, 3 hips showed no osteoarthritic changes (pre-arthritic group) and 2 hips showed slight joint space narrowing (early-arthritic group) on plain radiographs. A two-dimensional dual-echo spin-echo sequence with fat-suppression was used (TR/TE, 1500/10 and 45 ms; FOV, 16 cm, matrix, 512X256 interpolated to 512X512; 5mm slice thickness) to generate a sagittal T2 time map. On the mid-sagittal image, anterosuperior (AS) and superior (S) zones in the acetabular and femoral cartilages were manually segmented. Visual appearance of T2 mapping in the cartilage was classified into normal pattern (low T2 at the deep cartilage area and high T2 at the superficial cartilage area), and abnormal pattern. The appearance of T2 mapping and T2 values in each zone were compared between the normal, pre-arthritic and early-arthritic hips.

Results: All normal hips showed normal pattern of T2 mapping in all examined zones, however, all dysplastic hips showed abnormal pattern in AS and S zones of the acetabular cartilage. Interestingly, pre-arthritic hips were likely to show decreased T2 time in the superficial area of the acetabular cartilage, while early-arthritic hips were likely to show disorganized T2 time distribution in the deep and superficial area of the acetabular cartilage (Fig. 1). Mean T2 time at the AS/S zones of the acetabular cartilage was lower in pre-arthritic hips (26.7±29.0 ms), but was considerably higher in early-arthritic hips (38.8±39.9 ms), as compared with normal hips (29.8±30.3 ms). Mean T2 time at the AS and S zones of the femoral cartilage was relatively higher in pre-arthritic and early-arthritic hips, as compared with normal hips.
**A20**

**PRECISION OF 3 TESLA MR IMAGING OF CARTILAGE MORPHOLOGY IN A MULTICENTER CLINICAL TRIAL**

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**Purpose:** Quantitative MR imaging of cartilage morphology has become an important and powerful tool in OA research. Recent studies (at single sites) have indicated that measurements at 3.0 Tesla (T) are more reproducible than at 1.5 T, but the precision errors in large, multicenter clinical trials with equipment from multiple vendors have not yet been evaluated.

**Methods:** 157 female participants, aged ≥ 40 years, were recruited at 7 clinical centers, using Siemens Magnetom Trio and GE Signa Excite (short and long bore) magnets. Conventional standing AP knee radiographs were obtained to determine the Kellgren Lawrence grade (KLG). 79 subjects had a BMI ≤ 28, no symptoms, and a KLG = 0 bilaterally; 78 subjects had a BMI ≥ 30, symptoms in one knee, and mild to moderate radiographic OA (16 = KLG 1, 35 = KLG 2, 27 = KLG 3). Two coronal MR image acquisitions were obtained in each participant with a water excitation T1-weighted spoiled gradient recalled sequence at 3T with a 1.0 x 0.31 x 0.31 mm³ resolution. One scan was acquired at baseline and one 3 months later. Cartilage volume (VC), mean cartilage thickness (ThC.Me), area of cartilage surface (AC), total area of subchondral bone (tAB) were quantified in the medial tibia (MT), lateral tibia (LT), medial femoral condyle (cMF) and lateral femoral condyle (cLF) using proprietary software (Chondrometrics GmbH, Germany). Segmentation of paired data sets was performed by the same (of 7) technicians in the same session, with blinding to time point. The segmentation was quality controlled by one expert. From the two consecutive measurements the root mean square (RMS) coefficient of variation (CV%) was computed.

**Results:** The RMS CV% values for measurements of cartilage volume (VC) were 2.4% in MT, 2.6% in LT, 3.0% in cMF, 3.4% in cLF, and 2.8% when averaging the CV% values in the 4 cartilage plates. The average CV% was 2.5% in the non-OA subjects (KLG 0), 3.3% in KLG 1, 2.6% in KLG 2, and 3.4% in KLG 3 participants. When only considering healthy participants (KLG 0), the RMS CV% was 2.7% on the Siemens Trio (n = 36), 2.4% on the GE short bore (n = 22), and 2.2% on the GE long bore magnet (n = 21). Precision errors for cartilage thickness were < 3% in single plates across all subjects (average across the 4 plates = 2.5%), and < 1.5% for surfaces (average across all plates = 1.4% for AC and = 1.2% for tAB). The trends in the subgroups were similar to those for VC. Systematic differences in cartilage thickness (3 months versus baseline) ranged from -0.5% (MT) to + 0.9% in LT in healthy participants, and from -0.3% (cMF) to + 1.4% (cLF) in KLG 2 and 3 subjects.

**Conclusions:** The findings show that 3.0 Tesla MR imaging provides highly reproducible measurements of cartilage morphology in multicenter clinical trials with equipment from different vendors, and a high degree of stability over short- to intermediate-term time intervals. If used appropriately, the methodology can thus be efficiently applied to large-scale, multicenter clinical trials.

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**A21**

**SAFETY AND EFFICACY OF NEAR INFRARED LIGHT FOR CARTILAGE RE-GROWTH OF DEEP OSTEO-CHONDRAL DEFECTS IN SHEEP AS ANIMAL MODEL**

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**Purpose:** To assess the safety and efficacy of near-infrared light from a power laser (HILT) to induce light-activated articular chondrocytes proliferation in vivo. High Intensity Laser Therapy (HILT) is a new non-invasive method to stimulate tissue repair in vivo.

**Methods:** The study was approved by the Italian institutional animal use and care committee at the Italian Ministry of Research and Education. At time zero (T0) monolateral cartilage full thickness surgical defects reaching the subchondral bone was created in ten female adult sheep, weighing 60±5 kg, by drilling (Ø = 14 mm) of the femoral trochlear sulcus of patella. All subjects (n=10) received antibiotics prophylaxis for 6 days postoperatively. One week later surgery all subjects were divided into two groups: the HILT group received 15 treatments (Tx) of laser while untreated group didn’t receive laser. Each subject of the HILT group received 15 Tx in 3 weeks (5 Tx/week) up to T1 (30 d. after T0). Each treated subject received the same amount of energy (2,500 J) with the following setting: 19 kW/cm² of peak intensity and 2.5 J/cm² of fluence with a spot size of Ø = 10 mm.

We used a prototype power laser designed by El.En. S.p.A. (Italy). To assess the effects of HILT we compared histological and immunohistochemical (IHC) findings of the samples collected from the lesion at 30 (T1), 45 (T2) 90 (T3), 120 (T4) and 180 (T5) days later the induction of surgical defect.

**Results:** The macroscopic observation of the defect areas has showed a progressive re-growth of a new tissue from the edges to the central area of the lesions in Treated group.