acquisition in the steady state; flip angle 55°; repetition time 58 ms; echo time 12 ms; 512x512 matrix with 0.31x0.31 mm resolution; 60 partitions at 1.5 mm thickness). Image segmentation was performed semi-automatically using custom software written in MATLAB, and measures of mean signal intensity for different regions of cartilage were obtained. Urinary levels of C-terminal cross-linking telopeptide of type II collagen (U-CTX-II) were measured. Cartilage defects were scored using a 5-point scale. Multivariable linear regression was used to test associations.

**Results:** Cartilage signal intensity varied by site (mean (SD) for femur: 120.1 (8.4); medial tibia: 94.5 (9.8); lateral tibia: 95.9 (11.6); patella: 123.4 (10.7)). After adjustment for confounders, BMI was negatively associated with mean signal intensity of cartilage in the medial femoral (β = −0.82 per kg/m², p = 0.005), lateral femoral (β = −0.69 per kg/m², p = 0.020), whole femoral (β = −0.60 per kg/m², p = 0.034) and lateral tibial (β = −0.80 per kg/m², p = 0.027) sites. Cartilage defects were associated with same-region mean intensity in the lateral tibia (β = −10.22 per grade, p = 0.017), and patella (β = −6.06 per grade, p = 0.002). After excluding cases with cartilage defects, CTX-II was negatively associated with mean signal intensity of cartilage in the medial femoral (β = −2.46 per pg/ml, p = 0.010), lateral femoral (β = −2.13 per pg/ml, p = 0.036), whole femoral (β = −2.44 per pg/ml, p = 0.010) and patellar (β = −2.77 per pg/ml, p = 0.031) sites.

**Conclusions:** Reduced cartilage signal intensity on MRI is associated with early osteoarthritic changes and thus may be used as a marker of early osteoarthritis.

414 FINDING DISCRIMINATIVE REGIONS THAT OPTIMALLY SEPARATE HEALTHY AND OSTEOARTHRITIS KNEES

D.R. Jørgensen¹, M. Lillholm², E.B. Dam², ¹Univ. of Copenhagen, Copenhagen Ø, Denmark; ²BiomedIQ, Rødovre, Denmark

**Purpose:** The pathogenesis of osteoarthritis (OA) is complex, likely consisting of systemic, biochemical processes as well as focal, biomechanical effects. Based on knee MRI, we investigated whether specific regions of the articular cartilage were particularly different between healthy and OA knees; providing evidence for OA to be mainly a focal or a global cartilage disease.

**Methods:** 286 right and left knees from 159 community recruited subjects aged 21 to 81 years were scanned using a Turbo 3D T1 sequence on a 0.18T MRI Esaote scanner. The medial tibial cartilage compartments were segmented. From the segmented cartilage sheets, average thickness was quantified on a 7x15 grid, aligned for anatomical correspondence. The knee radiographs were classified by a radiologist using the Kellgren-Lawrence (KL) scale (0–4).

The knees were divided in two groups, KL=0 (healthy, 144) and KL>0 (OA, 142). The reference ability to separate healthy from OA knees based on thickness was evaluated were all regions were equally important and evaluated in terms of required sample size. A Dynamic Partitioning Framework was used to split the cartilage grid into discriminative regions to optimize the separation of healthy and OA knees and evaluated through the required sample size. This process generates a non-negative importance weight for each of the 105 regions.

**Results:** The median sample size for the reference experiment was 302. For the optimized weight map, the sample size was 122. The improvement, in terms of required sample size, was significant, p = 1.4 × 10⁻¹⁵. The optimal weight map highlighted a sub-region in the medial tibial cartilage located in the central, external area.

**Conclusions:** The results demonstrated that there was a focal region providing improved discrimination between healthy and OA knees. The effect in this area could be explained by excess, focal load due to meniscal subluxation and/or varus alignment of the knee. This supports a biomechanically oriented disease progression.Initially, the framework can generate hypotheses for continued research into OA etiology. Eventually, the resulting reductions in sample size could lead to more cost-effective clinical trials.

415 EFFECTS OF SPIN-LOCK TIME SELECTION IN T1rho RELAXOMETRY

N.F. Klocke, D.R. Thedens, A. Amendola, D.R. Pedersen, The Univ. of Iowa, Iowa City, IA, USA

**Purpose:** Numerous studies have investigated T1ρ relaxation values for cartilage in vivo, but the variety in imaging parameters among multiple centers hinders elucidation of the mechanisms underlying T1ρ relaxation changes seen in OA progression. One important parameter in T1ρ imaging is the set of variable spin-lock (SL) times. Objectives: 1) To identify and document the effects of SL time selections on the resulting T1ρ relaxation properties of healthy cartilage at 1.5T and 3.0T fields; 2) To determine the minimal set of SL images necessary to properly ascertain absolute cartilage T1ρ relaxation times.

**Methods:** After Institutional Review Board approval and subject consent, one healthy 23 year-old female was imaged on the same day in a 3T Siemens TIM Trio scanner and an Avanto 1.5T scanner using a quadrature knee coil with a FSE-based T1ρ acquisition. Twelve SL times at 400 Hz were chosen (SL=0.5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80 ms) for a 2D oblique sagittal slice through the LFC midline. Other imaging parameters were slice thickness=4 mm, TR/TE=3000/10 ms (3.0T), 3000/12 ms (1.5T), echo train length=13, FOV=140 mm×140 mm, in-plane resolution=0.55 mm. All possible (4017) SL permutations of three or more SL times generated relaxation maps after automated registration of the SL images using a non-linear least squares, monoequational form fit with a bilinear squares robustness measure applied on a voxel-by-voxel basis using Matlab. A small cartilage ROI (n=177 voxels for 1.5T images, n=277 voxels for 3.0T images) was manually selected for further analysis in all images (mean, min, max, SD relaxation times reported for each map). Student’s two-tailed t-test with equal variance determined statistical significance (p < 0.05), to determine similarity to the full-data map made with all 12 SL times. For each number of SL times (3–11), the most similar SL combination was determined in both 3.0T and 1.5T. Another criterion for a “true fit” was normalized means (to the full-data map mean) which were between 0.975–1.025. The fraction of the maps per SL images within this criterion was also derived. Optimal SL times were determined for each number of SL images to generate equivalent relaxation maps at each field strength. The criteria were that a SL combination’s normalized mean signal intensity was within the 0.975–1.025 range, and had the highest pval seen in both 3.0T and 1.5T compared to the other common, high-scoring SL combinations.

**Results:** For the full-data maps, T1ρ relaxation means (±SD) were found to be 3.0T: 4.7 ± 1.1 ms at 1.5T, and 4.6 ± 1.0 ms at 3.0T. Reduced sets of SL times increased the magnitude and spread of T1ρ relaxation times. As the number of utilized SL times increased, the count of SL permutations within the normalized mean criterion increased (3.0T: 15.9% at 3SL to 91.7% at 11SL; 1.5T: 15.9% at 3SL to 91.7% at 11SL). Pvals for the results of this study were between 0.9744 (3 SL combination) and 1.0000 (10 SL combination), and at 3.0T these were between 0.9902 (3 SL combination) to 0.9984 (7 SL combination). The top three optimal SL combinations across fields which had the highest pval scores on both systems came from 4 SL=5, 25, 30, 80 ms (3.0T pval: 0.9963, 1.5T pval:0.9985), 7 SL=0.5, 5, 15, 20, 40, 70, 80 ms (3.0T pval: 0.9704, 1.5T pval:0.9922), and 9 SL=0.5, 5, 15, 20, 30, 40, 50, 70, 80 ms (3.0T pval: 0.9942, 1.5T pval:0.9897).

**Conclusions:** The results of this in vivo study demonstrate the importance of careful selection of suitable SL permutations for T1ρ within and across field strengths for consistent measurements. While this study has limitations (single subject), it suggests that image-based non-invasive characterization of cartilage on a routine clinical basis across platforms and field strength requires optimization of the tradeoff between scan time (small number of SL times) and accuracy (larger number) to produce consistent and accurate relaxation values. Both the number of and duration of SL times affected measured T1ρ cartilage relaxation. This study highlights the importance of using a carefully selected set of consistent parameters across platforms to capture reliable T1ρ measurements for eventual translation into clinical practice.

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