449 RADIOGRAPHIC SUBCHONDRAL BONE TRABECULAR INTEGRITY PREDICTS OSTEOARTHRITIS STRUCTURAL OUTCOMES AFTER ANTERIOR CRUCIATE LIGAMENT RUPTURE

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Purpose: The course of post-traumatic osteoarthritis (OA) is an invariable paradigm for discovery of markers of the very earliest stages of the OA disease process. Subchondral bone trabecular integrity (BTI) predicts structural progression of radiographic knee OA based on radiographic and MRI outcomes. The goal of this study was to determine if the BTI in a knee injury cohort, measured within 5 weeks after an anterior cruciate ligament (ACL) tear, is an early indicator of risk for development of OA over the subsequent 5 years. We hypothesized that thinning and loss of the subchondral vertical bone trabeculae, detected by BTI, would predict joint space width and joint space area loss.

Methods: Bone trabecular integrity (BTI) of the medial tibial plateau was determined from analysis of knee radiographs from the completed randomized controlled KANON clinical trial (http://www.controlled-trials.com; ISRCTN 84752559), designed to compare rehabilitation plus early ACL reconstruction (ACLR, n = 61) versus rehabilitation plus optional delayed ACLR (n = 60) with follow-up out to 5 years. The KANON study enrolled 121 young adult individuals (aged 18–35 years) with acute ACL rupture within the prior 5 weeks to a previously uninjured knee. There was no loss to follow-up at 2 years and only 1 individual lost to follow-up at 5 years; none of the index knees had radiographic OA at baseline. Weight-bearing knee radiographs, obtained at baseline (at time of enrollment), 2 years and 5 years using a modified Lyon-Schuss protocol, were analyzed using KneeAnalyzer software (Optasia Medical Ltd, Manchester, UK) to obtain fractional dimensions for computing BTI, minimum medial joint space width (mJSW), and medial joint space area (JSA). Multivariable regression models, adjusted for age, gender and body mass index, were used to evaluate the ability of baseline (BL) BTI parameters of index knees to predict the change in mJSW and JSA between BL and 2 and 5 years after injury.

Results: Based on BTI profiles injured knees on average showed thinning of vertical trabeculae over 2 years with further thinning between 2 and 5 years. Horizontal trabeculae showed thickening over 2 years with little further change to 5 years. Baseline BTI parameters were statistically significantly associated with change in mJSW over 2 (R2 0.19, p = 0.036) and 5 (R2 0.16, p = 0.04) years, and change in JSA over 5 (R2 0.22, p = 0.004), but not 2 (R2 0.13, p = 0.16) years.

Conclusions: The qualitative changes in BTI parameters over time after injury, reflecting vertical and horizontal trabecular structure, were similar to changes earlier reported over similar time intervals in knee OA progressors. The remarkable finding that baseline BTI predicted subsequent changes in mJSW and JSA suggests that acute injury leads to dramatic acute alterations in bone structure, and/or, that pre-injury BTI identifies and perhaps contributes to, risk of knee injury. Longitudinal surveillance, initiated prior to injury, is needed to determine if BTI might identify individuals at high-risk for post-injury OA and who could be targeted with interventions to prevent subsequent development of OA.

450 LONG-TERM EFFECT OF REMOVAL OF KNEE JOINT LOADING ON CARTILAGE QUALITY EVALUATED BY DELAYED GADOLINIUM-ENHANCED MAGNETIC RESONANCE IMAGING OF CARTILAGE

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Purpose: Ankle fracture patients were used as a model to study the long-term effect of the removal of joint loading on knee cartilage quality in human subjects.

Methods: The knees of ten patients with ipsilateral ankle fractures were investigated using delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) at the time of ankle injury. After 6 weeks’ prescribed unloading of the affected leg, but no restrictions regarding knee movement, the cast was removed from the ankle and the patient underwent a second dGEMRIC examination. Physiotherapy was then initiated. A third dGEMRIC examination was performed 4 months after remobilization, and a final examination 1 year after the injury.

Results: Baseline T1Gd values for the ten patients were within a narrow range. No significant change in mean T1Gd was observed after 6 weeks’ prescribed unloading (p = 0.5), but the T1Gd range had increased significantly (p = 0.002). Four months after remobilization, the mean T1Gd was significantly lower than in the previous examinations (p = 0.05), and the range remained significantly greater than at baseline (p = 0.012). At the 1-year follow-up, the mean T1Gd was almost identical to the value after remobilization (p = 0.8), and the T1Gd range still showed a significant increase compared to the baseline investigation (p = 0.003).

Conclusions: Removal of knee cartilage loading for 6 weeks resulted in a measurable effect on the cartilage matrix, as evidenced by a broader T1Gd range. A decrease in mean T1Gd was observed 4 months after remobilization. These differences persisted a year after injury compared to baseline.

451 THE PATELLOFEMORAL AND FEMOROTIBIAL JOINTS ARE RELATED BASED ON PATTERNS OF MRI FEATURES AND THEIR ASSOCIATION WITH RADIOLOGIC PROGRESSION

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**Purpose:** Several MRI features in osteoarthritis (OA) have been found to associate with radiological progression. As these MRI features are known to be highly correlated with each other, we investigated the presence of patterns of MRI features by principle component analysis (PCA) and their association with radiological progression over 6 years' time.

**Methods:** 205 patients (mean age (SD) 60 (7) years, 79.5% woman, median BMI (range) 26 (20–40), were investigated. These patients were part of the Genetics, Osteoarthritis, and Progression (GARP) study, that includes probands and their siblings with symptomatic OA at multiple sites; patients were followed for 6 years. MRI of one knee, median (range) Kellgren-Lawrence (KL) score 1 (0–3), was made in every patient and included in the present study. At baseline coronal, axial and sagittal proton density and T2-weighted images as well as sagittal 3D T1-weighted spoiled gradient echo frequency-selective fat-suppressed images were made at 1.5T MRI. Cartilage damage (thinning and focal lesions), osteophytes (central and marginal), cysts, bone marrow lesions (BMLs) and effusion/synovitis were scored according the Knee Osteoarthritis Scoring System (KOSS) score for presence or absence in 9 compartments, including the patellofemoral joint (PFJ) and tibiofemoral joint (TFJ). Baseline and 6-year semi-flexed posterior-anterior and lateral knee radiographs were scored (0–3) for both osteophytes and joint space narrowing (JSN) at both TFJ and PFJ according to the Osteoarthritis Research Society International (OARSI) atlas and Burnett atlas, respectively. Radiographic progression was defined as an increase of 1 point in JSN. Patterns of MRI features were investigated in the whole joint, using principal component analysis (PCA). A factor was considered to load significantly on a component when loading exceeded 0.4. Subsequently, the association of patterns of MRI features with radiological progression adjusted for age, gender, BMI and baseline JSN was investigated, using generalized estimation equation (GEE) models to correct for possible family effects.

**Results:** Of 205 patients 139 (68%) had KL score ≥ 1 at baseline. 55% had an JSN score ≥ 1 and 50% osteophyte score ≥ 1 in PFJ or TFJ. Radiological follow-up was available in 133 patients. In TFJ progression of JSN was seen in 28.6% of patients and progression of osteophytes in 29.3% of patients. In PFJ progression of JSN was seen in 9.2% of patients and progression of osteophytes in 15.4% of patients. PCA of MRI features of the whole joint of all patients resulted in extraction of 6 components (Eigen value > 1), explaining 60% of variance. Component 1 was characterized by medial and lateral cartilage damage and osteophytes of the PFJ and medial and lateral osteophytes of the TFJ and was associated with JSN progression in the TFJ (OR(95%CI)1.8(1.1–3.1), whereas a trend was observed with progression of JSN in the PFJ (OR(95%CI)4.9(1.0–25.4)). Component 2 included lateral cartilage damage, cysts and BMLs of the PEJ and was significantly associated with JSN progression of the PFJ (OR(95%CI)8.7(1.8–41.6), not with JSN progression of the TFJ. Component 3 consisted of medial cartilage damage, cysts and BMLs of the TFJ and was associated with JSN progression in the PEJ (OR(95%CI)12.3(3.3–46.7)), whereas a trend was observed with JSN progression in the TFJ (OR(95%CI)1.5 (1.0–2.5)). Component 4 was characterized by medial cartilage damage, cysts and BMLs of the PEJ, in component 5 the lateral MRI features cysts and BMI were incorporated and component 6 included cartilage damage and osteophytes on both sides of the TFJ. Component 4, 5 and 6 did not associate with JSN progression. Interestingly effusion/synovitis was not incorporated in any of the components. When analysing only patients with KL grade ≥ 1 at baseline comparable associations of component 1,2 and 3 with JSN progression were seen.

**Conclusions:** Investigation of patterns of MRI features show that cysts and BMLs are related with cartilage damage in all compartments except in the lateral TFJ. Components including medial TFJ BMLs and lateral PFJ BMLs are associated with JSN progression. Furthermore, also components characterized by medial and lateral cartilage damage and osteophytes of both PFJ and TFJ are associated with JSN progression. These results suggest that JSN progression in PFJ and TFJ is related.