EVALUATING THE RELATION OF STRUCTURAL DAMAGE BY MRI TO CLINICAL PAIN SCORES, PAIN SENSITISATION AND TYPE II COLLAGEN DEGRADATION IN KNEE OSTEOARTHRITIS

Background: The evolution of pain in relation to damage in the synovium, bone and cartilage in osteoarthritis (OA), coupled with their relation to wet biochemical markers are not well understood.

Objectives: In this study we evaluated the relation between structural damage by MRI, clinical and pain sensitisation measures and wet biochemical biomarkers in knee OA.

Methods: We recruited 130 participants fulfilling ACR criteria with advanced OA requiring total knee replacement (TKR) (n=80), mild OA having standard care (n=42) and non-OA controls (n=8). Knee MRI in 90 subjects (72 F, 18 M) was acquired and assessed by two radiologists with the MRI Knee Osteoarthritis Score (MOAKS). Overall MOAKS scores were created for Bone Marrow Lesions (BML), Cartilage Degradation (CD) and effusion/Hofa synovitis (tSyn). Type II collagen cleavage products (CTX-II) were determined by ELISA. Clinical scoring was performed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for pain levels (WOMAC P), Hospital Anxiety and Depression Scale (HADS). Body mass index (BMI) and pain sensitisation with pain pressure thresholds (PPT) of the patella by Quantitative Sensory Testing (QST).

Results: The mild OA group had an average age of 63 +/- 9 yr and the advanced OA group 69 +/- 7 yr. The advanced OA group had higher levels of pain, with a mean WOMAC P of 58 +/- 22 compared with the mild OA group who had a mean WOMAC P of 40 +/- 22. WOMAC P correlated with the total number of regions with cartilage damage (nCD) (R=0.225, p=0.033) and total number of BMLs (nBML) (R=0.195, p=0.065) using BMI, age and HADS as covariates. Levels of CTX-II correlated with tSyn (R=0.313, p=0.03), nBML (R=0.252, p=0.019), number of osteophytes (R=0.33, p=0.002) and nCD (R=0.218, p=0.042), using BMI and age as covariates. The correlation for urinary CTX-II with tSyn (p=0.006) is shown in Figure 1 using a partial linear regression analysis of MOAKS, BMI and age. We also found CTX-II correlated with lesion load scores (total number of lesions multiplied by MOAKS size by% damage scores) for CD (R=0.277, p=0.009) and BML (r=0.308, p=0.004). PPT correlated with patella MOAKS scores for nBML (R=0.221, p=0.038) and nCD (R=0.279, p=0.009), with HADS, BMI and age as covariates.

Conclusion: There is a direct correlation between the degree of cartilage damage and BMLs in pain OA. Type II collagen degradation products were higher when there was more severe MRI-detected synovitis. BMLs and cartilage damage in the knee joint, suggesting that the source of enzymes degrading type II collagen in OA, including matrix metalloproteinases, are also likely to be produced by synovium and bone (1) and not just cartilage, as previously hypothesised in other studies. There was also a correlation between pain sensitisation and frequency of BMLS and cartilage degradation, suggesting that molecular mediators of pain sensitisation, which we have shown are produced by BMLs (1), are a cause of patient-reported OA pain.

REFERENCES:

Figure 1

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DEGRADATION IN KNEE OSTEOARTHRITIS SENSITISATION AND TYPE II COLLAGEN DAMAGE BY MRI TO CLINICAL PAIN SCORES, PAIN SENSITISATION AND TYPE II COLLAGEN DEGRADATION IN KNEE OSTEOARTHRITIS OVER 10 YEARS OF FOLLOW-UP

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Background: Structural joint pathology on MRI has been found in knees without radiographic evidence of osteoarthritis (OA). We have previously shown that structural abnormalities on MRI may be precursors of disease and associated with the detection of incident radiographic knee OA (ROA) up to 2 years later, and in some circumstances up to seven years later. The prognostic value of structural abnormalities on MRI for knee OA, however, is unknown.

Objectives: Estimate the probability of incident ROA over 10 years of follow-up, according to structural abnormalities detected on baseline MRIs.

Methods: A subcohort of participants (862 knees, one knee/person) from the Osteoarthritis Initiative (OAI) with at least one knee at risk of developing ROA (i.e., Kellgren-Lawrence (KL) 0.1 at baseline) was randomly selected. MRI-detected structural features of the knee were assessed by expert readers using the MRI Osteoarthritis Knee Score (MOAKS). Participants underwent bilateral posteroanteri- rior fixed-flexion weight-bearing knee radiography at baseline and annually through year 4, and then every two years until year 10. Radiographs were centrally read for KL grade, with ROA defined as KL=2. Survival was estimated with the Turnbull non-parametric maximum likelihood estimator, a generalization of Kaplan Meier curves for interval censored data. Survival curves were compared using a log rank permutation test available in the R package interval. Hazard ratios were estimated using Cox models fit using the R package icenReg, designed for interval censored data. Features were considered one at a time, with no adjustments.

Results: Knees with any of the following structural abnormalities had higher estimated probabilities for the development of radiographic OA within two, four and 10 years of follow-up: effusion-synovitis, Hoffa-synovitis, bone marrow lesions in the meniscal compartment and whole knee, surface area and full thickness cartilage damage in the meniscal compartment and whole knee, and meniscal extrusion (Table 1). Differences in the probability of the development of ROA within two, four and 10 years of follow-up were significant (pointwise 95% confidence intervals did not include 0), between knees without the abnormality and knees in the most severe category for all features, with one exception at the two-year follow-up. All of these abnormalities were significantly associated with time to ROA over 10 years of follow-up.

Table 1. Knees with MRI-Detected Structural Abnormalities in KL = 0.1 at Baseline

<table>
<thead>
<tr>
<th>Feature</th>
<th>Mortality</th>
<th>Non-mortality</th>
<th>ROA</th>
<th>Mortality</th>
<th>Non-mortality</th>
<th>ROA</th>
<th>Mortality</th>
<th>Non-mortality</th>
<th>ROA</th>
</tr>
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<tr>
<td>Effusion-synovitis</td>
<td>0.03</td>
<td>0.05</td>
<td>0.07</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
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</tr>
<tr>
<td>Hoffa-synovitis</td>
<td>0.04</td>
<td>0.05</td>
<td>0.07</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
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</tr>
<tr>
<td>Bone Marrow Lesion</td>
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<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>0.03</td>
<td>0.04</td>
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</tr>
<tr>
<td>Meniscal Extrusion</td>
<td>0.06</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.04</td>
<td>0.05</td>
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</table>

Conclusion: Our results demonstrate the prognostic value of effusion-synovitis, Hoffa-synovitis, bone marrow lesions, cartilage damage, and meniscal extrusion.