Table 1
Associations of weight-bearing pain with BML volumes and WORMS scores

BML Measure		No weight-bearing pain	Weight-bearing pain	p-value[1]
Total BML (mm^3)	n	54	61	0.01
	mean (sd)	1004 (1708)	1577 (2030)	
	median	416	865	
Total Femur BML (mm^3)	n	54	61	0.004
	mean (sd)	298 (522)	715 (1210)	
	median	0	308	
Total Tibia BML (mm^3)	n	54	61	0.17
	mean (sd)	706 (1370)	861 (1211)	
	median	270	367	
WORMS: Sum of all compartments	n	54		0.003
	mean (sd)	4(4)	60	
	median	3	7(5)	

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ULTRASONOGRAPHIC EVALUATION OF MENISCAL EXTRUSION: COMPARISON WITH MAGNETIC RESONANCE IMAGING ASSESSMENT

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Purpose: Magnetic resonance imaging (MRI) is a well-established method widely used for both, semiquantitative and quantitative assessment of meniscal extrusion. Ultrasound (US) is more cost-effective and readily available in comparison to MRI and may be applied for the evaluation of meniscal extrusion. The aim of this study was to validate both, semiquantitative and quantitative assessment of medial meniscal extrusion using US with MRI assessment as the reference standard.
Methods: Ninety-three consecutive subjects with knee pain referred for knee MRI were also evaluated by US in the same day. US of the knee was systematically performed before MRI using a 12-5 MHz linear probe with subjects in a supine position. The US evaluation of the medial meniscus was performed at the medial aspect of the knee in the longitudinal axis where meniscal extrusion was maximal. Two skin markers were placed in the medial aspect of the knee where extrusion was assessed. MRI was performed at 1.5T using routine sequences. The coronal T2-weighted fat-suppressed sequence was used to evaluate medial meniscal extrusion, using the slice displaying both skin markers placed during US. For both methods, the edge of the medial tibial plateau was the reference for meniscal extrusion measurements. Two musculoskeletal radiologists assessed meniscal extrusion on US and MRI separately and independently. Meniscal extrusion was semi-quantitatively graded as: 0 ($<$ 2mm), 1 ($\geq$ 2mm and $<$ 4mm), and 2 ($\geq$ 4mm). For both readers, the agreement comparing extrusion measurements between US and MRI was evaluated using weighted kappa (k) statistics. Also, intraclass correlation coefficients (ICC) were used to evaluate agreement using the absolute values of extrusion measurements (quantitative assessment). Inter-reader reliability for US and MRI extrusion grades was assessed using k statistics. We further evaluated the diagnostic performance of US for the detection of medial meniscal extrusion using MRI as the reference standard.
Results: For semiquantitative grading, the agreement between US and MRI was moderate for reader 1 ($k = 0.57$) and substantial for reader 2 ($k = 0.64$). When comparing quantitative assessment (absolute values) of meniscal extrusion between US and MRI, substantial agreement was found for both readers (ICC of 0.73 and 0.70, respectively). The inter-reader agreement for meniscal extrusion was almost perfect ($k = 0.98$) for US and substantial ($k = 0.70$) for MRI. US showed excellent sensitivity (95% and 95%) and good specificity (82% and 70%) in the detection of meniscal extrusion.
Conclusion: US assessment of meniscal extrusion is reliable and can be used for both quantitative and semiquantitative assessment, exhibiting excellent diagnostic performance for the detection of meniscal extrusion when compared to MRI. This might be of relevance since dynamic evaluation of meniscal extrusion using US could be explored in future studies, which would potentially help the understanding of causes and consequences of meniscal extrusion.

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ELEVATED CARTILAGE T2 AND INCREASED SEVERITY OF CARTILAGE DEFECTS AT BASELINE ARE ASSOCIATED WITH THE DEVELOPMENT OF KNEE PAIN OVER 7 YEARS

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Purpose: The purpose of this study is to determine whether baseline cartilage T2 relaxation time and joint abnormalities (cartilage, bone marrow, and meniscus morphology) predict the development of knee pain over 7 years.
Methods: We performed a nested case control study of knee pain onset in subjects from the Incidence Cohort of the Osteoarthritis Initiative (OAI). Cases were 30 subjects who developed pain in the right knee over 7 years (Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain score = 0 of 20 at baseline; WOMAC pain score $\geq$ 0 at 3 year follow-up; WOMAC pain score $>$ 3 at 7 year follow-up). Controls were 80 subjects who did not develop pain in the right knee over 7 years (WOMAC pain score = 0 at baseline, 3 year follow-up and 7 year follow-up). Baseline 3 Tesla MR images were analyzed using morphological gradings of cartilage, bone marrow and menisci (WORMS scoring). A T2 mapping sequence was used to assess the mean and heterogeneity of cartilage T2 (grey level co-occurrence matrix (GLCM) texture analysis). GLCM texture parameters including contrast, variance, and entropy were calculated in each cartilage region: an elevation in these parameters is suggestive of a greater heterogeneity in the distribution of T2 values. Logistic regression models (adjusted for age, gender, and BMI) were used to assess the relationship between baseline T2 parameters, WORMS scores, and the development of pain over 7 years. The reported coefficients are per 1 standard deviation (SD) increase in cartilage T2 parameters.
Results: The results demonstrate a positive association between cartilage T2 parameters at baseline and the development of pain over 7 years; subjects that developed pain over 7 years had greater baseline mean and heterogeneity of cartilage T2 than subjects that did not develop pain. The baseline mean T2 in the entire medial femur cartilage was 38.80 $\pm$ 2.81 ms in subjects that developed pain and was 37.00 $\pm$ 2.45 ms in subjects that did not develop pain (adjusted OR per SD T2 increase = 2.78, p = 0.027, CI = 0.96-6.11). The baseline mean T2 in the articular layer of the medial femur cartilage was 40.43 $\pm$ 3.37 ms in subjects that developed pain and was 38.74 $\pm$ 2.80 ms in subjects that did not develop pain (adjusted OR per SD T2 increase = 2.37, p = 0.033, CI = 1.07-5.25). The baseline variance of cartilage T2 in the medial femur was 309.97 $\pm$ 81.68 in subjects that developed pain and was 273.36 $\pm$ 68.86 in subjects that did not develop pain (adjusted OR per SD variance increase = 2.18, p = 0.026, CI = 1.09-4.33).
The results also demonstrate a positive association between cartilage WORMS scores at baseline and the development of pain over 7 years;

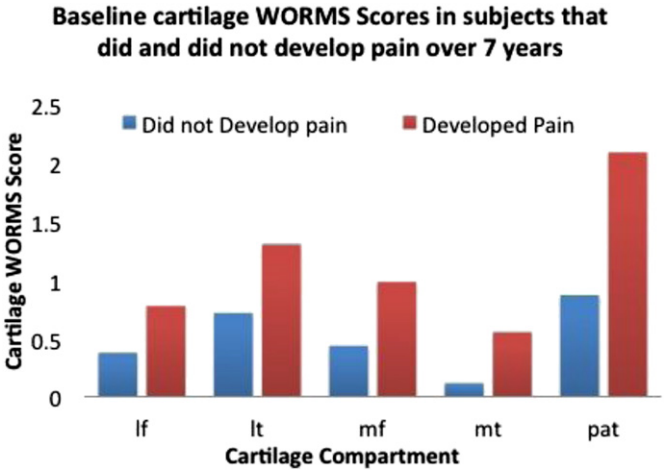

Figure 1. Mean baseline cartilage WORMS scores in the lateral femur (lf), lateral tibia (lt), medial femur (mf), medial tibia (mt), and patella (pat) in subjects that did (n = 30) and did not (n = 80) develop pain over 7 years.