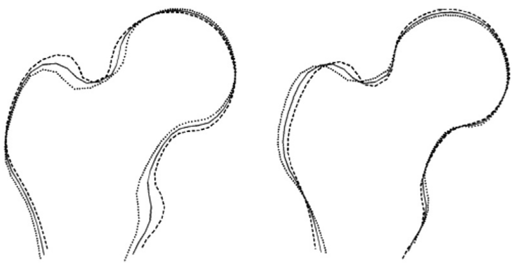

Fig. 1. Modes associated with prevalent radiographic knee OA (mean: solid line; +2SD: dashed line; -2SD: dotted line).

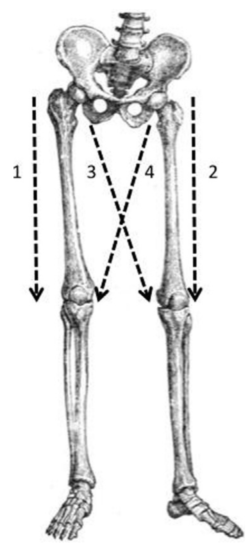

Fig. 2.

Table. Associations between prevalent radiographic knee OA and 1-SD decrease in hip shape mode scores

	Unadjusted OR (95% CI)	Adjusted for age, sex, race, BMI, ipsilateral hip OA*, OR (95% CI)
Made 2 (16% of variance)		
1†	**1.42 (1.02, 1.99)**	**1.72 (1.18, 2.56)**
2	0.93 (0.69, 1.27)	1.06 (0.77, 1.47)
3	1.01 (0.73, 1.37)	1.22 (0.86, 1.72)
4	1.09 (0.79, 1.52)	1.35 (0.96, 1.92)
Mode 3 (12.5% of variance)		
1	**1.49 (1.09, 2.04)**	**1.45 (1.03, 2.04)**
2	**1.56 (1.18,2.08)**	**1.49 (1.06, 2.08)**
3	1.35 (0.96, 1.39)	1.19 (0.83, 1.69)
4	**1.75 (1.25, 2.44)**	**1.79 (1.23, 2.56)**

*Ipsilateral to hip mode scores
†Sec figure at left: 1) right hip/right knee (n = 341); 2) left hip/left knee (n = 338); 3) right hip/left knee (n = 341); 4) left hip/right knee (n = 338)

430

LATE SYNOVIAL ENHANCEMENT DETECTS EFFECTS OF INTRA-ARTICULAR STEROIDS ON SYNOVITIS BETTER THAN SYNOVIAL VOLUME

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Purpose: Previous work has shown that synovial tissue shrinks in response to an intra-articular steroid injection and this volume reduction might be used to measure the effect of treatments targeting synovitis in knee osteoarthritis (OA). While synovial volume reduction is seen on static post-contrast MRI scans, dynamic contrast enhancement highlights features of a medical image which may not otherwise be seen on "static" scans, and may be more sensitive to change with treatment than volumes measured on static scans. If so, parameters from dynamic scans may improve the ability to detect effects of OA treatments targeting synovitis.

Methods: We studied patients meeting ACR criteria for knee OA participating in a steroid injection trial. At baseline pre-injection and 10 day post-injection follow-up, all patients acquired MRI's with a gadolinium (Gd)-enhanced dynamic image sequence just after contrast injection. Knee osteoarthritis outcome score (KOOS) and nominated visual analogue scale (VAS) pain data were collected at each visit. On the sagittal static Gd-enhanced MRI images (TR 500 ms, TE 17 ms, FoV 16 cm, 384 × 384), a region containing the synovial tissue and synovial fluid was manually segmented at baseline and follow-up (where the segmenter was blinded to the order of images for each patient). Image analysis on the segmented region in this and another registered image allowed (a) the exclusion of cartilage and (b) the separation of fluid and synovial tissue, producing a volume of synovium for each knee. To assess dynamic parameters within the synovial tissue, we first transformed the segmented synovial tissue region from the sagittal sequence to the axial dynamic sequence (TR 5.4 ms, TE 1.9 ms, FoV 14 cm, 256 × 256); then, within the transformed region, we (1) used the basic Tofts model to calculate the parameters v_e (fractional extracellular volume) and K^{trans} (transfer coefficient: a direct measure of perfusion) at each voxel; and (2) calculated parameters from the intensity curve of the dynamic sequence at each voxel: (a) the maximum gradient G_{max}, (b) the maximum relative enhancement $S_r = S_{max}/S_0$ and (c) the late relative enhancement $S_l = (S_n + S_{n-1} + S_{n-2} + S_{n-3})/(4*S_0)$. We calculated the median of each of these five parameters, and this median multiplied by the static volume V within the synovial tissue region. To evaluate which parameter would best measure response to treatment, we calculated the standardized response mean (SRM) of change and examined the correlation of change in pain with the change in the MRI parameter. The higher the value of each of these, the better the measure for treatment response.

Results: For the 72 patients (41.7% female, mean age 64.3), every synovial parameter showed a reduction in response to treatment between baseline and follow-up (Fig. 1). S_l and G_{max} correlated well with v_e and K^{trans} respectively (r = 0.64; r = 0.77).

Of the synovial parameters tested, the one with the strongest correlation with change in VAS pain was change in S_l (r = 0.29, b = 0.64; 95% CI 0.11 to 1.17; p = 0.02); this was a stronger relationship than the correlation of VAS pain and change in static volume V (r = 0.19, b = 0.14; 95% CI – 0.07 to 0.47;

Variable	Observations	SRM (mean change / $SD_{(mean\ change)}$)
K^{trans}	72	-0.63
v_e	72	-0.53
V	72	-0.41
V×s	72	-0.37
$V \times K^{trans}$	72	-0.59
$V \times v_e$	72	-0.63
$V \times G_{max}$	72	-0.63
$V \times S_l$	72	-0.63
$V \times S_r$	72	-0.63
G_{max}	72	-0.63
S_l	72	-0.76
S_r	72	-0.73
KOOS Pain Subscale	72	1.14
Pain on nominated activity VAS	64	-1.17

Fig. 1. Standardised response means for change in each parameter in the study, following treatment.

$p = 0.14$) (Fig. 2). S_l also had the largest SRM (Fig. 1), suggesting that, of the parameters tested, it is the most sensitive to change.

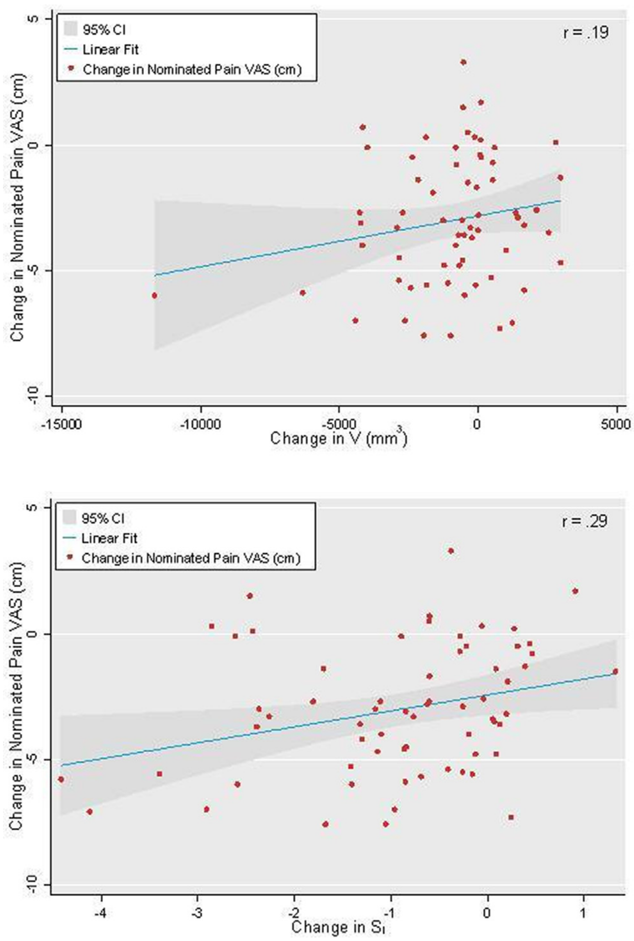

Fig. 2. Change in nominated pain VAS versus (a) change in V, (b) change in $S_{l.}$

Conclusions: Synovial volume and enhancement parameters all reduce in response to treatment. However, changes in the late relative enhancement S_l showed the strongest correlation with changes in pain following treatment. The correlation between S_l and v_e, the fractional extracellular volume, is consistent with the dependence of S_l on v_e. Measurement of synovial contrast enhancement may therefore be better than measuring volume for assessing response of synovium to treatment.

431
HOW DOES THE MRI DEFINITION OF KNEE OSTEOARTHRITIS CORRESPOND TO THE ACR CRITERIA?

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Purpose: With the use of a Delphi approach an MRI definition for knee osteoarthritis (OA) was proposed. This definition has not yet been validated in other populations and against established definitions for knee OA used in clinical or research settings. In previous work, we showed that if this MRI definition of tibiofemoral (TF) OA (TFOAMRI) is applied, more cases of knee OA are detected than with the radiographic Kellgren and Lawrence grading (K&L). Together with a better content validity and at least equal construct validity, we concluded that the TFOAMRI is more sensitive in detecting structural knee OA. How the MRI definition for knee OA corresponds with the American College of Rheumatology (ACR) criteria for knee OA is unknown. The aim of the present study was to investigate how the MRI definition corresponds with the clinical, as well as the combined clinical and radiological ACR-criteria compared with the K&L grading.

Methods: In a subpopulation of 891 females (aged 45-60) participating in the open population-based Rotterdam Study, radiographs and MRI of both knees were assessed for knee OA. Radiographs were assessed with the K&L grading as well as separate OA features (osteophytes). OA features (osteophytes (OS), cartilage lesions, bone marrow lesions, cysts, meniscus lesions) were scored on all MRIs with a comprehensive semi-quantitative scoring system. Based on these scored features we applied the proposed MRI definition. We distinguished a PFOAMRI-definition from a TFOAMRI-definition. Knee OAMRI was defined as PFOAMRI and/or TFOAMRI. In addition, knees were categorized as having only K&L ≥ 2, only MRI based OA (TF/PF), or both. A physical exam of both knees was performed to obtain information about crepitus, bony tenderness and palpable warmth. Participants filled in a questionnaire with knee specific questions, such as if they had pain on most days of the last month and morning stiffness for less than 30 minutes.

Results: 889 Females and 1778 knees were included. Of 26 knees data was missing due to insufficient quality of the MRI; 4 knees missed radiographs of the knee; and in 74 knees no data on palpable warmth was available. Mean age was 55.0 years; mean BMI was27.0 kg/m^2. 135 knees were defined as having PFOAMRI; 160 knees met the TFOAMRI criteria; 81 knees met the K&L ≥ 2 grading; 48 knees met the clinical ACR criteria; 228 knees met the clinical + radiographic ACR criteria. Table 1 shows the agreement of the definitions with the ACR-criteria. None of the definitions corresponded well with the ACR criteria. Only approximately 10% of the knees with a MRI definition for knee OA and 17% of the K&L$\geq$2 fulfilled the clinical ACR criteria. The combined ACR-criteria were fulfilled in 10–15% of the knees with MRI based knee OA and in 30% of the K&L$\geq$2 knees. In the knees meeting both definitions, the highest agreement was seen (24% for clinical ACR-criteria and 39% for combined ACR-criteria).

Conclusions: All definitions (TF-, PFOAMRI and K&L$\geq$2) did not correspond well to the clinical as well as clinical and radiological ACR-criteria. In an open population of middle aged women a knee with both K&L$\geq$2 and a MRI definition for knee OA showed the highest agreement with the ACR-criteria. This is in agreement with previous research, which suggests that the ACR-criteria seem to reflect later signs in advanced disease.

Table 1
Correspondance of the imaging based knee OA definitions with the ACR criteria

	Clinical ACR criteria (n = 48)		Combined clinical and radiological ACR criteria (n = 34)	
	Yes	No	Yes	No
PF OAMRI (n = 135)				
Yes	13	112	13	122
No	34	1531	20	1608
TFOAMRI (n = 161)				
Yes	14	123	24	137
No	34	1530	10	1603
Knee OAMRI (n = 241)				
Yes	20	195	27	214
No	28	1448	7	1516
K&L≥2 (n = 81)				
Yes	12	57	24	57
No	36	1600	10	1687
Combined No OA (n = 1489)	25	1419	2	1487
K&L≥2 (n = 31)	3	26	5	26
Knee OAMRI (n = 194)	11	167	8	186
K&L≥2 & knee OAMRI (n = 46)	9	28	18	28

432
MENISCUS TREATMENT AND AGE PREDICT MEDIAL COMPARTMENT JOINT SPACE DIFFERENCE AT A MINIMUM OF TWO YEARS AFTER ACL RECONSTRUCTION: DATA FROM THE MOON ONSITE COHORT

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Purpose: ACL reconstruction can effectively restore knee stability and allow a return to athletic activities after ACL injury, but patients are still