

ASSOCIATIONS BETWEEN dGEMRIC AND RADIOGRAPHIC FINDINGS AMONG WOMEN WITH MILD KNEE OSTEOARTHRITIS

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INTRODUCTION

The radiological definitions of Kellgren/Lawrence (K/L) for classifying osteoarthritis (OA) have been accepted as golden standard for almost 40 years. However, radiography gives no insight into status of articular cartilage, the key factor of early pathological changes of osteoarthritis. The objective of the current study was to determine by delayed gadolinium enhanced MRI of cartilage (dGEMRIC), whether knees with K/L grade 1 have different T1 relaxation times than knees with K/L grade 2.

MATERIAL AND METHODS

Sixty-three postmenopausal women (age 50 to 65 years), who had had knee pain on most days of the past month were recruited for a related intervention study. Informed consent was obtained from all participants and the study protocol was accepted by the local ethical committee. The tibio-femoral joints of each subject was bilaterally radiographed in postero-anterior view in semi-flexed position, and they all fulfilled the inclusion criteria of having K/L grade 1 (doubtful joint space narrowing, possible osteophytes) or 2 (definite joint space narrowing and osteophytes) at either one or both knees. The grading of the knee radiographs was done by an experienced musculo-skeletal radiologist. The subjective pain was assessed with the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index with the question; "How much pain do you have while standing upright?" on a 100 mm VAS score scale.

dGEMRIC imaging [1] was performed within 7 weeks from K/L-grading using a Siemens Magnetom Symphony 1.5 T scanner with a standard transmit/receive knee array coil. An intravenous administration of 0.4 ml/kg (double dose) of Gd-DTPA²⁻ (Magnevist, Schering, Berlin) was followed by a 90-minute delay and T1 mapping in sagittal plane using a single-slice inversion recovery fast spin echo sequence (FOV=14 cm TR=1800 ms, TE=13 ms, TI=1600, 800, 400, 200, 100 and 50 ms, ETL=5, 3-mm slice thickness and 0.55x0.55mm in-plane resolution). Single sagittal slices were positioned at the center of the lateral and medial femoral condyles. Regions of interest were manually segmented using in-house software under Matlab (Mathworks, Natic, MA, USA) by dividing the entire visible cartilage in the slice into superficial and deep halves and into different topographical locations according to predefined landmarks. Mean T1 values were calculated for bulk (full thickness), deep and superficial regions of the weight-bearing femoral and tibial regions (Figure 1). The mean difference and 95 % confidence intervals of the differences between the groups K/L 1 and K/L 2 were evaluated.

RESULTS

The average age of the group K/L 2 participants (n=41) was higher than the corresponding age of K/L 1 participants (n=22) (K/L 1: 56±4, K/L 2: 59 ±4 years, p=.015). Otherwise the groups did not differ significantly with regard to body mass index (K/L1: 26±3, K/L 2: 28±4 kg/m²) or knee pain (K/L 1: 12±12, K/L 2: 13±13 mm). The mean T1 (dGEMRIC) relaxation times and their differences for the groups K/L 1 and K/L 2 are given in Table 1. The T1 relaxation time was 3-11 % longer at every weight-bearing area in every compartment with K/L 1 group compared to K/L 2 group. The biggest differences, statistically significant or almost significant, were found in lateral femoral condyle and medial tibial plateau. The dGEMRIC index did not correlate highly with the WOMAC pain score at any regions of interest in either K/L-groups.

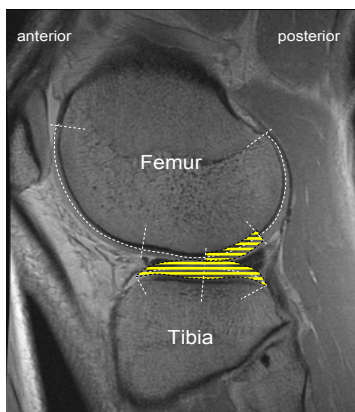


Figure 1. Segmental division of femoral and tibial cartilage surfaces.

DISCUSSION

The present results show that the dGEMRIC index becomes shorter during the progression of early OA. dGEMRIC reflects the relative distribution of glycosaminoglycan (GAG) concentration in cartilage, which is known to decrease in early phase of OA. All ROIs revealed a trend towards shorter dGEMRIC indices for K/L 2 grade group as compared to grade 1, however, only three ROIs showed a statistically significant difference. Previously, a trend toward lower dGEMRIC values with increasing K/L radiographic severity was reported, however, only few subjects with K/L grade 1 (N=5) or grade 2 (N=7) were studied [2]. Based on their previous observations a dGEMRIC index (ms) of more than 500 ms is considered high, 400-500 ms as mid-range and under 400 ms as low. In the present study, the dGEMRIC indices of K/L 1 group are placed in the mid-range (average of four full-thickness segments 412 ms) while dGEMRIC value of K/L 2 group is at low area (average of four full-thickness segments 388 ms). The present study implies dGEMRIC to be a sensitive method to detect early tibiofemoral cartilage changes. Further research needs to be done to find out if T2 is sensitive enough to detect cartilage changes also in more progressed stage of OA.

REFERENCES

[1] Burstein D et al. Magn Reson Med 2001;45:36-41. [2] Williams A et al. Arthritis Rheum. 2005;52:3528-3535.

Table 1. Mean (SD) T1 relaxation times (ms) of Kellgren-Lawrence (K/L) grades 1 and 2 for cartilage layers of femur and tibia

Segment	Layer	T1 (dGEMRIC) relaxation time			
		KL 1 (n=21)	KL 2 (n=42)	Mean Difference	95% CI of the Difference
Femur condyle	full-thickness	401 (58)	386 (64)	15	-19 to 49
	superficial	348 (74)	337 (51)	12	-21 to 44
	deep	456 (80)	436 (99)	20	-31 to 71
Femur condyle	full-thickness	426 (73)	386 (63)	41*	4 to 77
	superficial	363 (83)	332 (53)	30	-5 to 66
	deep	497 (90)	445 (88)	52*	4 to 100
Medial tibia	full-thickness	411 (50)	383 (45)	28*	3 to 54
	superficial	416 (58)	392 (52)	24	-6 to 53
	deep	415 (95)	373 (70)	42	-1 to 85
Lateral tibia	full-thickness	408 (71)	397 (51)	11	-20 to 43
	superficial	385 (60)	375 (50)	10	-20 to 39
	deep	432 (108)	417 (63)	15	-29 to 58

*significant at p<.05 level