

MR T2 values of the knee cartilage and meniscus in chronic kidney disease

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Introduction

Chronic kidney disease (CKD) is associated with a wide range of disorders of mineral and bone metabolism, including phosphate, calcium and parathyroid hormone dysregulation, renal osteodystrophy and vascular calcifications. Understanding this pathophysiology in mineral metabolism and bone diseases is very important, as recent evidence has suggested the concept of bone-vascular axis in CKD [1]. However, the information for the articular cartilage and meniscus in CKD is limited. Quantitative MR T2 measurement provides a noninvasive method to evaluate the early changes of fiber architecture and water content in cartilage and meniscus [2]. Therefore, our purpose of this study is to observe the MR T2 values of cartilage and menisci of the knee joint in CKD patients.

Materials and Methods

We prospectively enrolled 11 patients with CKD and 8 age- and sex-matched controls for this study, including 11 men and 8 women (see Table 1). All subjects underwent 3.0T MR examinations (GE Healthcare, Discovery MR750, USA), blood tests, and bone mineral density examinations. After three-plane tri-pilot imaging, 20 contiguous axial T1-weighted images were acquired using a spin echo sequence with TR/TE = 600/14 ms, NEX = 1, matrix = 256 × 256, and slice thickness = 5 mm, for the purpose of later slice positioning in sagittal view. The single axial plane showing the largest width of femoral condyles on both the medial and lateral sides of the knee joint, which cover most of the menisci, was selected as the reference plane. Subsequently, sagittal images for the knee were acquired (eight slices per meniscus) with orientation parallel to the long axes of the femoral condyles. The T2 quantification was based on a multi-slice turbo spin-echo sequence with the following parameters: TR = 800 ms, TE = 5.8/11.6/17.4/23.2/29.4/34.8/40.6/46.4 ms, FOV = 18 cm, matrix = 256×192, echo train length = 8, NEX = 2, slice thickness = 3 mm, slice gap = 0.6 mm, BW = 62.50 kHz, and acquisition time = 10 min 18s. The ROIs for measurements of the T2 values in the cartilage and meniscus were illustrated in Figures 1 and 2, respectively. The statistical analyses were performed with SPSS software (version 20, SPSS, Inc, Chicago, IL, USA). To compare groups with CKD and the controls, the Student t test was applied.

Results

T2 values of the anterior and posterior horns of the medial meniscus were significantly increased ($P = 0.03$ and $= 0.04$, respectively) in CKD patients as compared with the controls for men (Table 2). Such a difference was, however, absent in women. T2 values of the anterior and posterior horns of the lateral meniscus and of the medial and lateral femoral condyles/tibia cartilage were not significantly different in CKD patients compared with the controls for both genders.

Discussion

Preliminary findings from the present study suggest that CKD-related T2 changes in the medial meniscus may precede alterations in other cartilage regions. While the limited number of subjects included in this report precludes conclusive remarks, MR T2 measurements of cartilage and menisci may serve as an effective tool in the investigation of knee cartilage degradation in CKD.

References

1. London GM. Clin J Am Soc Nephrol, 2009;4:254-7
2. Rauscher I, et al. Radiology, 2008;249: 591-600

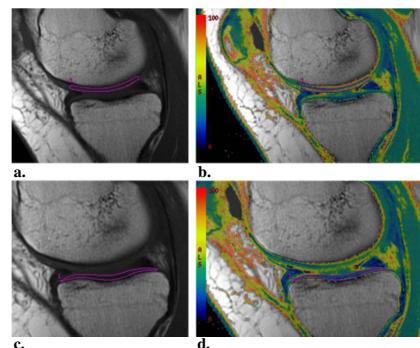


Fig 1. Examples of an ROI placement on a nearly sagittal slice of the medial tibiofemoral cartilage is shown. The ROIs include femoral condyle cartilage (a/b) and tibia cartilage (c/d).

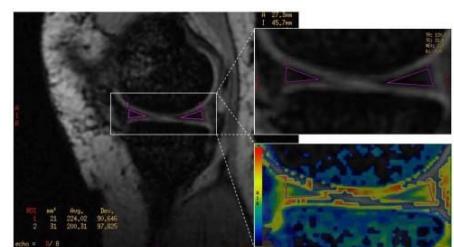


Fig 2. Example of an ROI placement on the medial menisci is shown. The ROIs include the anterior horn and posterior horn of the medial meniscus.

Table 1. Patient demography

Group	Men		Women	
	CKD (n=7)	Controls (n=4)	CKD (n=4)	Controls (n=4)
Age (years)	58.43±6.21	58.75±7.37	56.75±12.82	54.00±4.08
BMI	24.79±1.85	27.28±2.10	25.44±2.00*	20.93±2.57
eGFR (mL/min per 1.73m ²)	28.44±17.55**	102.84±4.21	11.21±8.43**	105.43±7.16
WOMAC pain score	0.57±0.79	0.75±0.50	0.25±0.50	0.25±0.50
BMD (g/cm ²)	0.99±0.17	1.03±0.17	0.85±0.25	0.86±0.10
BMD (T score)	-0.26±1.42	0.05±1.45	-1.33±2.1	-1.25±0.9
KL grade	1.43±0.79*	0.5±0.58	1.75±1.26*	0±0
MOAKS	10.17±4.26*	5.75±7.72	12.75±9.54*	0.25±0.5

* $P < 0.05$, ** $P < 0.001$, compared with controls.

Table 2. Cartilage and Meniscus T2 values (ms) results of subjects

Group	Men		Women	
	CKD	Controls	CKD	Controls
medial femoral condyle (MFC)	37.03±5.48	35.53±7.44	35.75±4.04	36.90±6.27
lateral femoral condyle (LFC)	32.64±5.96	34.96±6.31	33.94±6.53	31.45±8.23
medial tibia (MT)	34.94±3.66	33.19±3.01	35.48±1.70	34.56±4.82
lateral tibia (LT)	38.34±4.34	38.36±4.59	38.57±3.73	36.18±5.89
anterior horn medial meniscus (AHMED)	15.25±0.87*	14.66±0.78	14.72±1.52	14.53±2.65
posterior horn medial meniscus (PHMED)	17.84±1.51*	15.44±1.16	15.01±0.35	15.48±2.85
anterior horn lateral meniscus (AHLAT)	14.62±1.34	14.71±1.96	15.27±0.96	14.95±1.73
posterior horn lateral meniscus (PHLAT)	14.70±0.67	14.53±1.88	14.31±1.21	14.94±2.12