

T2 VALUES OF PATELLAR CARTILAGE IN PATIENTS WITH OSTEOARTHRITIS

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INTRODUCTION

Osteoarthritis (OA) is a debilitating disease which affects articular joints throughout the human body. Recently, the calculation of T₂ values for articular cartilage obtained from MRI has been developed to aid the diagnosis of OA [1]. T₂ values of cartilage are sensitive to the disruption of collagen fibers and changes in water content of cartilage seen during the onset of OA. Limited studies have been performed *in vivo* across varying degrees of OA (e.g. [2]). Relating T₂ values of cartilage to standard clinical staging methods of OA would be beneficial for determining the clinical applicability of this new technique. Therefore, the purpose of this study was to quantify differences of T₂ values of patellar cartilage across different stages of OA as defined by radiological examination.

METHODS

Following IRB approval with obtained consent, 39 subjects (56 ± 11 y.o., 12 M, 27 F) were enrolled in the study. Standing lateral radiographs centered on the patella were obtained for each subject. Radiographs were graded for patello-femoral OA based on the Kellgren and Lawrence (KL) scale from 0 (no OA) to 4 (end-stage OA). Following the radiological exam, MR images of each subject's patellae were obtained. Examinations were performed with a clinical 1.5 T MRI system (Signa Excite 11.0, GE Healthcare, Waukesha, WI). A series of axial T₂-weighted single spin-echo images were acquired along the length of the patella: TR = 1000ms, TE = 8,17,26,34,43,51,60,68,77 ms, 256x256 image matrix, slice thickness = 2mm, slice spacing = 4mm. After image acquisition, patellar cartilage was manually segmented on each image. T₂ values of patellar cartilage were calculated on a pixel-by-pixel basis using a custom written linearized least-squares program. Data from the first echo image was discarded in calculating T₂ values [3]. Pixels with T₂ values greater than 200 ms were considered outliers and were excluded from statistical analysis [4]. An average T₂ value generated from all analyzed pixels of each patella was used for statistical analysis. A one-way ANOVA was performed to determine any differences of patellar cartilage T₂ values across the KL stages of OA. Statistical significance was set at p<0.05.

RESULTS AND DISCUSSION

A representative T₂ map of patellar cartilage is shown in Figure 1. Average calculated T₂ values of patellar cartilage across the KL stages of OA is shown in Table 1. The calculated T₂ values are similar to those in previous studies [1]. The T₂ values of patellar cartilage were approximately 63 ms for KL stages 0, 1, 2 and 3 with an increase to 74 ms for KL stage 4 OA. The statistical analysis found no significant differences among T₂ values across the KL stages of OA. The lack of differences of T₂ values across OA stages may be due to several factors. First, the KL staging of a joint assigns

an OA stage based on the overall radiographic appearance of a joint. Therefore, the KL staging is more likely to detect advanced stages of OA rather than the initial onset of the disease. If there is a rapid change of T₂ values during the onset of OA and not at later stages, then we would not expect to find differences using a KL protocol for staging OA. Second, the effects of volume averaging and chemical shift near the cartilage-subchondral bone interface may have artificially increased the calculated T₂ values. Finally, we had a limited number of patellae for KL stage 4 OA (n=2). An increase in the sample number may have resulted in T₂ differences among the OA groupings.

CONCLUSIONS

T₂ mapping of patellar cartilage may provide a non-invasive method for accurate staging of OA within the knee. Additional studies evaluating different methods of grading OA may highlight the benefits and sensitivity of T₂ mapping in a clinical setting.

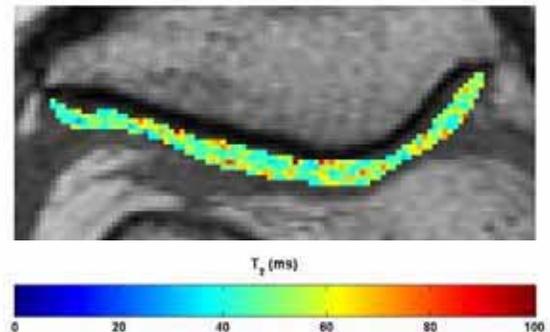


Figure 1. Representative T₂ map of patellar cartilage

Table 1. T₂ values of patellar cartilage at each stage of OA

Kellgren-Lawrence OA Stage	n	T ₂ Values (ms) (Average ± Std.Dev.)
0	16	63.02 ± 6.25
1	25	62.15 ± 10.24
2	22	63.72 ± 7.85
3	10	64.18 ± 10.66
4	2	73.97 ± 2.33

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