Patellar Cartilage T2 Relaxtion Time Mapping in Children: The effect of arthritis and gender.

A. Rajagopal[1], B. Dardzinski[1], W. Bommer[1], K. O'Brien[1], T. Graham[2], T. Laor[3]

[1]Radiology, Imaging Research Center, CCHMC, Cincinnati, OH, United States, [2]Rheumatology, CCHMC, Cincinnati, OH, United States, [3]Radiology, CCHMC, Cincinnati, OH, United States

Introduction

This study was designed to evaluate the T2 relaxation time of patellar cartilage in the knees of healthy children and in children with juvenile rheumatoid arthritis (JRA). The groups were age and gender matched.

Materials and Methods

MR images of the knee were obtained in the axial plane using a Bruker 3.0 T 30/60 MR scanner (Bruker-Biospin, Ettlingen, Germany) using a 12 -14 cm diameter Litz coil (Doty Scientific, Columbia, SC) or home-built T/R wrap coil. There were a total of 121 children enrolled in this study (9 boys with JRA, 30 girls with JRA, 28 healthy boys and 54 healthy girls). The knee selected for imaging was the dominant in healthy children. In children with JRA the knee that was selected for imaging was the more clinically involved knee unless both knees had similar involvement then the dominant knee was imaged.

A multi-slice multi-echo (MSME) spin echo imaging technique was performed to calculate the T2 relaxation time maps. The axial images were acquired with a repetition time (TR) of 1500 msec, echo time (TE) from 9 to 99 msec in 9 msec increments, 3 mm slice thickness, 1 mm gap, 12 x 12 cm field of view (FOV), 256 x 160 (read x phase) matrix, bandwidth of 71.43 kHz, for a total scan time of 4 min and 15 sec.

The region of interest (ROI) was defined by using CCHIPS (a semi-automated software program developed with IDL (RSI, Boulder, CO)) to define the patellar cartilage (1). Multiple profiles extending from the subchondral bone to the articular surface of the cartilage were generated. These profiles were averaged for all the patients in each group to obtain the average T2 values. The averaged T2 values were compared between different groups using a two-sampled T-test. The groups are defined in the table.

Results and Discussion

The table below summarizes the subjects, the number of profiles and the average age of the subjects in each group.

Figure 1 summarizes the group average T2 relaxation time profile comparison. There was a significant difference for each normalized distance (two-sampled T-test) p < 0.001. The spatial variation of patellar cartilage T2 relaxation times from the subchondral bone to the articular surface is significantly higher in children with JRA vs healthy control children in both girls and boys. There is a trend of higher T2 in the girls than the boys when all data is combined (Fig 1A).

Conclusions

The spatial variation of T2 relaxation time maintains a similar shape in the patellar cartilage independent of gender, age or disease. It was also observed that the spatial variation of the T2 relaxation time in JRA was always higher for all cartilage within the knee. Similar results were shown by Kight et al., in the distal femoral weight bearing cartilage (1). These differences in spatial variations are possibly due to collagen concentration or orientation differences and/or the difference in water content. These differences might arise from changes in cartilage morphology with age and/or disease.
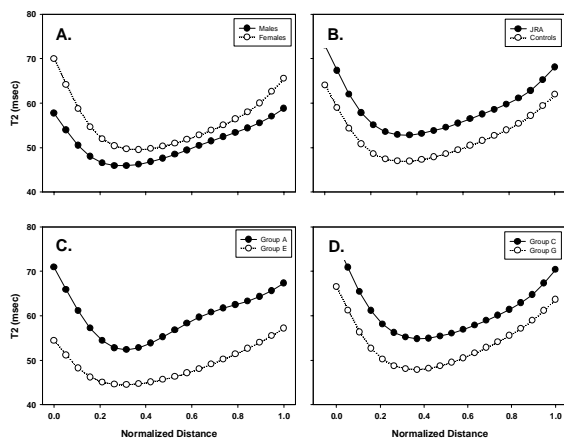
Figure 1: Average spatial variation of T2 relaxation time (msec) in the patellar cartilage for **A.** All boys (n = 37) vs. girls (n = 84) 5-18 years old. **B.** All children with JRA (n = 39) vs. control children (n = 82) 5-18 years old. **C.** JRA boys (n = 6) and male controls (n = 17) 5-11 years old. **D.** JRA girls (n = 23) vs. female controls (n = 31) 5-11 years old.

Groups	Total number of subjects	Total number of profiles	Average Age ± sd
Male JRA ages 5 to11 yo **(A)**	6	729	7.0 ± 1.2
Female JRA ages 5 to 11 yo **(C)**	23	3752	7.2 ± 2.2
Male Control ages 5 to 11 yo **(E)**	17	2706	8.5 ± 1.5
Female Control ages 5 to 11 yo **(G)**	31	5763	8.0 ± 1.8
JRA ages 5 to 18 yo	39	6469	8.9 ± 3.5
Females ages 5 to 18 yo	84	16645	9.7 ± 3.5
Males ages 5 to 18 yo	37	6429	10.3 ± 3.3
Control ages 5 to 18 yo	82	16605	10.6 ± 3.4

References

1. Kight et al., Arthritis Rheum. 2004 Mar;50(3):901-5.