Magnetization transfer contrast MR imaging of patellar cartilage during isometric knee extension exercise
Hiroki Kudo1, Naoki Mukai1, Yutaka Miyanaga2, Shinya Kuno1, Shumpei Miyakawa1,
1Graduate School of Comprehensive Human Sciences, Doctoral Program of Sports Medicine, University of Tsukuba, Japan
2National Institute for Materials Science, Japan

Introduction
Magnetization transfer contrast (MTC) is an imaging method which creates tissue contrast in a different manner as T1 and T2 relaxation time by the exchange of magnetization between macromolecular protons and bulk water, via cross relaxation or chemical exchange. Therefore it may be beneficial to evaluate articular cartilage using MTC, because it has abundant macromolecules and it's function should be specified by macromolecular protons. The aim of this study was to evaluate the quantitative effect of MTC during isometric knee extension in patellar cartilage.

Methods
This study comprised five healthy volunteers and 10 knees. MR imaging was performed with a 0.2T MR imaging system with a knee coil. Gradient recalled echo (GRE) and GRE-MTC sequences to obtain transverse axial images of patella cartilage were performed to all subjects for 38sec. GRE sequence was TR=100msec, TE=14msec, FA=30°. The off-resonance sinc pulse was set at a frequency offset of 1.2KHz from the free proton resonance with a duration of 10ms and an amplitude of 12.7x10^-6T as preparation for MTC images. GRE and GRE-MTC images were obtained before and during the course of isometric knee extension exercise (0,2,4min). The volunteers performed 6min. isometric knee extension with 1.0kg load in MR machine. The quantitative analysis was performed with $\frac{M_s}{M_o}$ between before and during knee extension exercise. $\frac{M_s}{M_o}$ was calculated as follows: $\frac{M_s}{M_o} = SNR_{with\ MTC} / SNR_{without\ MTC}$, where SNR is signal-to-noise ratio.

Result
Medial and lateral facet of patella cartilage had mean $\frac{M_s}{M_o}$ of 0.74±0.07 and 0.76±0.08, respectively, before exercise. The $\frac{M_s}{M_o}$ of medial facet during isometric knee extension (0,2,4min) increased by 0.79±0.08, 0.77±0.09, and 0.78±0.10. On lateral facet, $\frac{M_s}{M_o}$ also changed by 0.79±0.13, 0.79±0.12 and 0.78±0.12(Fig.1). However such change was not significant (p>0.05).

Discussion/Conclusion
We investigated the quantitative effect of MTC to evaluate the relationship between water and macromolecular protons before, during isometric knee extension exercise. The $\frac{M_s}{M_o}$ in patellar cartilage slightly increased during knee extension in healthy subjects. This result suggests that water content in patellar cartilage changed during exercise. The MTC technique would be a promising method to elucidate the effect of exercise on articular cartilage.

Fig.1 The $\frac{M_s}{M_o}$ of medial and lateral facet during isometric knee extension (0,2,4min)

Reference