T2 Mapping And dGEMRIC Of Patellar Cartilage In Young Adults With Recurrent Patellar Dislocation

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Disclosures:

Introduction: Recurrent patellar dislocation in childhood is a common condition; affecting 1: 1000 in the age group 9 - 15 years of age. Previous studies of adult patients with recurrent patellar dislocations have indicated a risk of cartilage lesions, future degenerative changes and osteoarthritis in the patellar cartilage. Delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) and T2 mapping are two MRI methods that have become increasingly used to identify early stages of cartilage degeneration. Typically, these include decreased T1 in the presence of gadolinium (T1Gd or the dGEMRIC index), and prolonged T2 values. The aims of the present study were to 1) examine the cartilage quality in young adults with recurrent patellar dislocation using both these MRI parameters, and 2) to evaluate if the cartilage quality is correlated to gender, age at injury, recurrence rate, muscle weakness and activity level.

Methods: 16 young adults with non-operatively treated unilateral recurrent patellar dislocations were investigated ≥5 years (mean 8,5 years) after the onset of symptoms. The KOOS and Kujala scores were used to assess the patient’s self-reported functional knee status and the activity level was registered according to Tegner. Muscle strength tests of both injured and non-injured knee were performed. Both knees were investigated with two different MRI parameters, quantitative T1 and quantitative T2 analysis (T2 mapping). T2 mapping was performed pre-contrast and quantitative T1 analysis was performed both pre-contrast and 2 hours after an I.V. injection of 0.2 m M/kg Gd-DTPA. T1Gd values were corrected for BMI differences. T1 and T2 analyses were performed in a centrally positioned axial slice of the patellar cartilage. A region of interest (ROI) was drawn to cover all patellar cartilage. Using the MOKKULA software (eveliina.lammentausta@oulu.fi), this ROI was divided into 4 deep and 4 superficial cartilage regions, (fig 1). SPSS® was used for the statistical evaluation and the level of significance was set at p ≤ 0.05. T-test and three-way ANOVA were used to compare MR parameters between injured and reference knees. When analyzing knee-function, non-parametric tests were used.

Results: Comparing injured to non-injured side, T1Gd was shorter in the central part of the medial facet of the superficial cartilage layer in the affected knee (p<0.05) (fig 2). T2 mapping revealed shorter T2 values in the periphery of the superficial cartilage of the affected patella (p<0.05) (fig 3). Neither T1 nor T2 differed between the injured and the reference knee regarding the deep cartilage layer. The cartilage changes could not be explained by macroscopic lesions, or reduced cartilage height. The mean Tegner activity score was 5.1 of 10, Kujala score 78 of 100, BMI 22.3 (range 7.6), and the concentric peak torque in knee extension was slightly lower in the affected limb, mean leg symmetry index of 82%. The recurrence rate was 5.3. The patients scored lower than age-matched controls in all of the five subscales of the KOOS, especially regarding sports and recreation and quality of life. There was no correlation between the patient demographics and the dGEMRIC index. Neither the self-reported knee-function nor the muscle function correlated to the degenerative changes seen with MRI.

Discussion: To our best knowledge, this is the first study to include both dGEMRIC and T2 mapping for the evaluation of patellar cartilage in patients with recurrent patellar dislocation. Despite that our group of patients was young and active; both T1Gd and T2 differed between injured and reference knees. The low dGEMRIC index in the central parts of the superficial patellar cartilage indicates early degenerative cartilage changes, including loss of proteoglycans. Similar to other dGEMRIC studies, T1Gd did not correlate with age or gender. The lack of correlation between the dGEMRIC index and functional parameters may be explained by the low number of patients in this pilot study. Several factors influence the T2 values of cartilage. It was recently shown that T2 heterogeneity was associated with OA progression. The shorter T2 values in our study may indicate disruption or reorganization of the collagen network. In support, recent reports have demonstrated shorter T2 as an effect of loading, but also in the reparative processes after cartilage injuries. Similar to the process described in ACL tears, the instability in recurrent dislocations may alter the contact area and load of the patellar cartilage, thereby altering the micro architecture of the cartilage matrix.

Significance: This study of patients with patellar instability demonstrates alterations in both T1Gd and T2 in superficial patellar cartilage, both indicative of early degenerative changes. The clinical significance of these findings needs to be evaluated in future.

- Tegner activity score
- KOOS (Knee injury and Osteoarthritis Outcome Score)
- Kujala score
studies. As a next step, the combination of these parameters will be used to evaluate the effects of surgical treatment for patellar dislocation.

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**References:**
