

Articular Cartilage Damage Worsens from First-time to Recurrent Patellar Dislocation—A Longitudinal Magnetic Resonance Imaging Study



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Purpose: To compare the frequency and severity of articular cartilage injury on longitudinal magnetic resonance imaging (MRI) in patients after their initial dislocation and subsequent recurrent dislocations for those undergoing patellar stabilization surgery. **Methods:** Between January 2012 and December 2017, patients undergoing patellar stabilization surgery were retrospectively reviewed. Only patients with an MRI after both the initial dislocation and subsequent dislocation events were included. The MRI scans were blindly examined to assess the Outerbridge classification grade of articular cartilage injury following each dislocation. Comparison was performed of each MRI for grade of articular cartilage damage and location. **Results:** Thirty-five patients undergoing patellar stabilization surgery with recurrent instability were eligible. The incidence of articular cartilage injury following initial dislocation was 45.7%. Following a second dislocation, the incidence of articular cartilage injury increased to 62.9%, a statistically significant increase of 17.2% ($P = .031$). Furthermore, of the 16 patients with articular cartilage injury following their initial dislocation, 56.2% of patients (9) had an increase in grade of articular cartilage injury following the second dislocation, whereas 43.8% (7) of patients had no progression in their articular cartilage injury. Six (17.1%) patients had no articular cartilage injury following their initial dislocation but did have articular cartilage injury following their second dislocation. **Conclusions:** Articular cartilage injury following patellar dislocation is common, and delayed surgical treatment may lead to an increase in articular cartilage damage. The incidence of articular cartilage injury following recurrent patellar dislocation was high (62.9%), and the majority of patients experienced an increase in their articular cartilage injury grade between their initial and recurrent dislocation on MRI evaluation. **Level of Evidence:** Level IV, retrospective case series.

The incidence of patellar instability is common, affecting between 7 and 49 people per 100,000 persons.^{1,2} In many instances, surgical treatment is reserved for patients with multiple dislocation episodes.

In patients undergoing conservative treatment following initial patellar dislocation, the incidence of recurrence is noted to be between 15% and 44%.³⁻⁶ However, there is concern that multiple dislocation events may result in a greater incidence of articular cartilage injury.⁷ The frequency of chondral and osteochondral lesions following patellar dislocation has been reported to be between 32% and 96%.⁸⁻¹³ Analysis of the patellofemoral joint by magnetic resonance imaging (MRI) following initial patellar dislocations commonly shows a torn medial retinaculum and medial patellofemoral ligament, contusions of the cartilage of the lateral femoral condyle and medial patella, chondral and osteochondral fragments, and joint effusion.^{14,15}

The incidence of articular cartilage disease following initial and recurrent patellar dislocation remains poorly understood, with many studies reporting the incidence only following arthroscopic evaluation. The purpose of this study is to compare the frequency and severity of articular cartilage injury on longitudinal MRI in patients

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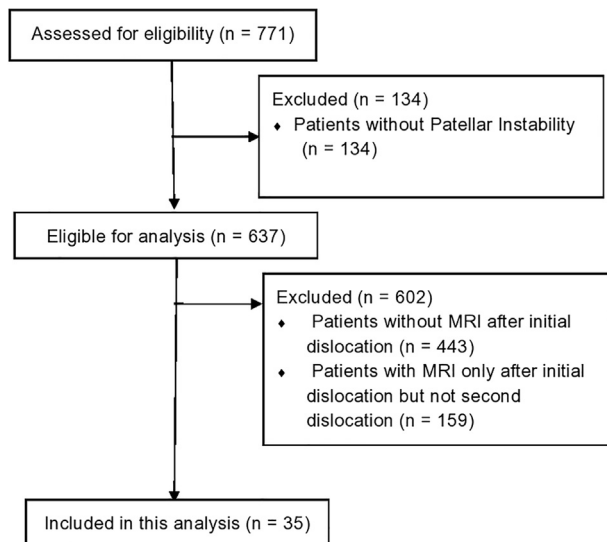


Fig 1. Patient flow diagram. (MRI, magnetic resonance imaging.)

after their initial dislocation and subsequent recurrent dislocations for those undergoing patellar stabilization surgery. We hypothesized that the incidence of articular cartilage injury would be significantly greater on subsequent MRI scans compared with the initial MRI scan in patients with recurrent patellar dislocations.

Methods

This study was approved by institutional review board (Thomas Jefferson University institutional review board Control #: 19D.418). All the included patients had an MRI after their initial dislocation as well as an MRI after their subsequent dislocation to assess for the grade of articular cartilage injury after each dislocation. An MRI was performed following a first dislocation and a recurrent dislocation to assess for articular cartilage injury and was recommended in conjunction with the patient's physical examination findings. The grade of articular cartilage injury was assessed using the modified Outerbridge Classification as previously described by Potter et al.¹⁶ The MRI scans were blindly examined by 2 authors (C.J.H., S.R.) to assess the Outerbridge classification grade of articular cartilage injury following each dislocation. In addition, axial, sagittal, and coronal T1/T2 MRI scans were reviewed to assess the quality of the cartilage, depth of the defect, and diameter of the defect to assign the Outerbridge score. In instances in which interobserver agreement was not obtained between the authors, author (K.B.F.) reviewed the MRI reports and images and determined the Outerbridge classification. Patellofemoral stabilization was indicated for patients with multiple dislocation episodes and for patients with severe articular cartilage injury following their initial dislocation.

Statistics

The McNemar test was performed on the incidence of articular cartilage injury following initial dislocation and recurrent dislocation to determine significance. Statistical significance was set at $P < .05$. All statistical analyses were performed with Statistical Package for the Social Sciences (SPSS) Statistics software 26 (IBM Corp., Armonk, NY). Furthermore, interobserver reliability was assessed.

Results

A total of 771 patients were initially identified. Of these, 134 were excluded because surgery was performed for patellofemoral pain or arthritis without a documented dislocation (Fig 1), 443 were excluded for not having an MRI after initial dislocation, and 159 were excluded for having an MRI only after initial dislocation but not after the second dislocation. This left 35 patients for inclusion in the analysis. The average age of patients in this series was 18.5 years old (range, 14.2-53.3 years). There were 17 (48.6%) male patients and 18 (51.4%) female patients, and the average body mass index was 23.9 (range, 16.8-32.1).

The average number of dislocations before surgery was 2.4 (range 2.0-3.0). A total of 22 (62.9%) patients suffered 2 dislocations, and 13 (37.1%) patients suffered 3 dislocations before surgery. The average time between a patient's initial dislocation and second dislocation was 37.1 months (range 2.9-156.5). The average time between the second dislocation and third dislocation was 30.1 months (range 4.9-53.9); however, a third MRI was only performed in 3 (23.1%) of the 13 patients who sustained a third dislocation.

The average time from initial dislocation to initial MRI was 14 days (range 0-179 days). Following the initial MRI, 16 (45.7%) patients had an articular cartilage injury. Of the patients with chondral injury, a total of 8 (50.0%) patients had grade I articular cartilage damage, 4 (25.0%) patients grade III, and 4 (25.0%) patients grade IV (Table 1). Articular cartilage injury in the patella was the most common location following initial dislocation and was found in 10 of 16 patients (62.5%).

Table 1. Grade of Articular Cartilage on MRI Following the Initial and Second Dislocation

Grade of Cartilage Injury	Articular Cartilage Injury on MRI After Initial Dislocation (n = 16)	Articular Cartilage Injury on MRI After Second Dislocation (n = 22)
Number of Patients	n = 16	n = 22
0	19 (54.2%)	13 (37.1%)
I	8 (22.9%)	5 (14.3%) 22.7%
II	0 (0.0%)	8 (22.9%) 36.4%
III	4 (11.4.0%)	3 (8.6%)
IV	4 (11.4.0%)	6 (17.1%)

MRI, magnetic resonance imaging.

Table 2. Location of Articular Cartilage Injury Following Initial Patellar Dislocation (n = 16 Patients) and Recurrent Patellar Dislocation (n = 22 Patients)

	Articular Cartilage Injury on MRI After Initial Dislocation (n = 16)	Articular Cartilage Injury on MRI After Second Dislocation (n = 22)
Medial femoral condyle	2 (12.5%)	0 (0.0%)
Lateral femoral condyle	7 (43.8%)	8 (36.3%)
Patella	10 (62.5%)	16 (72.7%)
Central trochlea	0 (0.0%)	0 (0.0%)
Medial trochlea	0 (0.0%)	1 (4.5%)
Lateral trochlea	0 (0.0%)	1 (4.5%)
Medial tibial plateau	0 (0.0%)	0 (0.0%)
Lateral tibial plateau	1 (6.3%)	1 (4.5%)

NOTE. Three (18.8%) patients had articular cartilage injury in more than 1 location following their initial dislocation. Four (18.2%) patients had articular cartilage injury in more than 1 location following recurrent dislocation.

MRI, magnetic resonance imaging.

Of the 10 patients with articular cartilage injury in the patella, the most common area was the medial facet (8; 80.0%), followed by the vertical ridge (1; 10.0%) and the lateral facet (1; 10%). Three (18.8%) patients had articular cartilage injury in more than 1 location following their initial dislocation. There were 2 patients with a lesion in 2 locations and 1 patient with a lesion in 3 locations. The location(s) of articular cartilage injury following initial dislocation is summarized in Table 2.

The average time from a patient’s second dislocation to a patient’s second MRI was 15 days (range 0-79 days). Following the second dislocation, articular cartilage injury was noted in 22 (62.9%) of the 35 patients. This represented a statistically significant increase of 17.2% ($P = .031$) compared with the rate of articular cartilage noted after the initial dislocation/MRI. Of the patients with chondral injury on their repeat MRI, a total of 5 (22.7%) patients had grade I articular cartilage damage, 8 (36.4%) patients grade II, 3 (13.6%) patients grade III, and 6 (27.3%) patients grade IV (Table 1). Articular cartilage injury in the patella was the most common location following subsequent dislocation and was seen in 16 of 22 patients (72.7%). Of the 16 patients with articular cartilage injury in the patella, the most common area was the medial facet (11; 68.8%) followed by the lateral facet (3; 18.7%) and the vertical ridge (2; 12.5%). Four (18.2%) patients had articular cartilage injury in more than 1 location following recurrent dislocation. The location(s) of articular cartilage injury following recurrent dislocation is summarized in Table 2. An example of the progression of articular cartilage injury is demonstrated in Fig 2 and Fig 3.

Of the 16 patients with articular cartilage injury following initial dislocation, 9 (56.3%) patients

experienced an increase in their articular cartilage injury grade (Table 3).

A total of 3 (8.6%) patients obtained an MRI after a third dislocation. One patient (33.3%) had articular cartilage damage on their third MRI. This patient had a grade IV cartilage injury, which was unchanged from the previous MRI after their second dislocation. The other 2 patients (66.6%) did not have an articular cartilage injury present on their third MRI. This represented no change in cartilage injury from the patient’s previous MRI scans where there was also no damage present. Interobserver reliability demonstrated values of 0.802 following initial MRI, 0.747 following the second MRI and 1.000 following the third MRI.

Discussion

Our analysis indicates that patients have a significant increase in articular cartilage damage following subsequent dislocation compared with initial dislocation on MRI. This included both frequency and severity of articular cartilage damage.

Other studies have evaluated the severity of articular cartilage damage following recurrent dislocation. Franzone et al.⁸ investigated, through arthroscopic assessment, the association between chronicity of patellar instability on the prevalence, grade, and location of chondral lesions in patients undergoing medial patellofemoral ligament reconstruction for patellar instability. The authors graded the patellofemoral

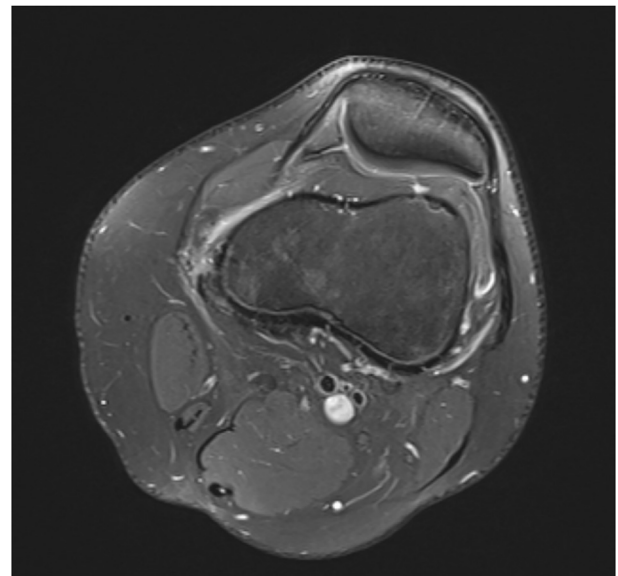


Fig 2. Patient is a 17-year-old male with a left knee injury. Magnetic resonance imaging, performed on a 3.0-Tesla unit following initial patellar dislocation, demonstrated bone marrow edema of the medial patella, slight lateral patellar subluxation, tangential signal in the cartilage of the central/medial patella, and a small cortical indentation of the articular cortex of the medial patellar facet.

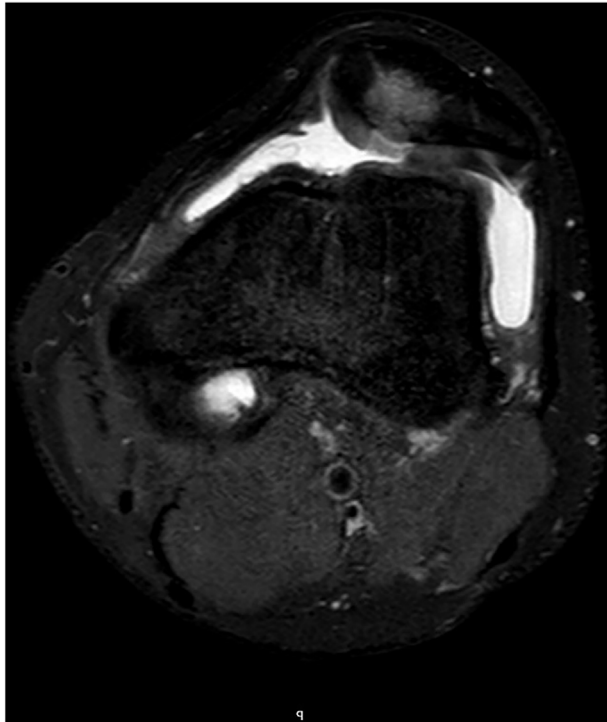


Fig 3. Patient is a 17-year-old male with a right knee injury. Magnetic resonance imaging, performed on a 1.5-Tesla unit following recurrent patellar dislocation, demonstrated a defect of the cartilage of the central patella, mild lateral subluxation with underlying bone marrow edema.

chondral status in 38 patients using the Outerbridge classification and found chondral lesions in 24 (63.2%) patients. In addition, patellar and trochlear lesions were observed in 22 (57.9%) and 5 (13.2%) patients, respectively. The authors noted that patients with increasing chronicity of patellar instability may have a greater likelihood and greater grade of patellofemoral chondral injuries, particularly trochlear lesions.⁸

Furthermore, von Engelhardt et al.⁹ investigated 40 patients following lateral patellar dislocation through MRI and arthroscopic evaluation. Twenty-one patients were first-time dislocators, whereas 19 patients were classified as recurrent. During arthroscopic assessment, 37 patients (92%) were observed to have cartilage disease. The authors noted that MRI evaluation more accurately assessed grade III and IV cartilage defects; however, the sensitivity was poor for grade I and II cartilage defects.⁹ Harris et al.¹⁷ investigated the sensitivity of MRI for patellofemoral articular cartilage defects through a systematic review. The authors found that MRI had sensitivities of 87% for patellar defects and 72% for trochlear defects, respectively. In addition, MRI was specific for patellar (86%) and trochlear (89%) defects and accurate for patellar (84%) and trochlear (83%) defects, respectively.¹⁷

The results of our study showed a similar frequency of articular cartilage injury following recurrent instability

as Franzone et al.,⁸ as they noted an incidence of articular cartilage injury in 63.2% of recurrent dislocators whereas our study found the incidence to be 62.9%. In our patient population, 16 (45.7%) patients had articular damage noted on MRI following their initial dislocation. Following a second dislocation, 6 (17.2%) additional patients had articular cartilage injury; which represented a statistically significant increase. Furthermore, of the 16 patients with articular cartilage damage after their initial dislocation, 9 (56.3%) patients experienced an increased grade in their articular damage. The majority of these patients (7; 77.8%) had initial cartilage damage of grade I and increased to grade II following the second dislocation (Table 3). In terms of the location of injury, the patella was the most common region of articular cartilage injury following both initial and recurrent dislocation. These findings are consistent with previous studies showing the patella as the most common region of injury.⁸

Limitations

Our study is not without limitations. First, our study population was limited to those patients who had MRI available from their initial dislocation and subsequent dislocation. This represented a small subset of the overall patient population undergoing stabilization surgery for recurrent instability. In addition, the population studied may be biased toward those with articular cartilage damage, since they may be more likely undergo patellar-stabilization surgery. Furthermore, the grade of articular cartilage injury was assessed solely on MRI, which has previously demonstrated more accurate assessment for grade III and grade IV articular cartilage injuries but poor sensitivity for grade I and grade II injuries.⁹ However, our ultimate goal was to establish the frequency of articular cartilage damage as well as the progression between initial and recurrent dislocations. One additional limitation of this analysis is that there is no control group to account for the contribution of recurrent dislocation events to progressive articular cartilage degeneration. It may be that the progressive damage seen to the articular

Table 3. Change in Articular Cartilage Injury in Patients With Articular Cartilage Injury Following Initial Dislocation

	Number of Patients (%)
No change in cartilage injury grade	7 (43.8%)
Grade I on initial MRI and second MRI	1 (6.25%)
Grade II on initial MRI and second MRI	0 (0.0%)
Grade III on initial MRI and second MRI	2 (12.5%)
Grade IV on initial MRI and second MRI	4 (25.0%)
Grade I to grade II change	7 (43.8%)
Grade II to grade III change	0 (0.0%)
Grade III to grade IV change	2 (12.5%)

MRI, magnetic resonance imaging.

cartilage is from the natural history of the initial injury, and not from the trauma of a repeat dislocation episode.

Conclusions

Articular cartilage injury following patellar dislocation is common, and delayed surgical treatment may lead to an increase in articular cartilage damage. The incidence of articular cartilage injury following recurrent patellar dislocation was high (62.9%), and the majority of patients experienced an increase in their articular cartilage injury grade between their initial and recurrent dislocation on MRI evaluation.

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