Weight-bearing Osteochondral Lesions of the Lateral Femoral Condyle Following Patellar Dislocation in Adolescent Athletes

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abstract

In patients with patellar dislocation, osteochondral injury is often an indication for early surgical intervention. However, no studies have identified a relationship between injury to the weight-bearing surface of the lateral femoral condyle following a patellar dislocation and the eventual need for surgical treatment. The authors hypothesized that a significant number of patients sustain injury to the weight-bearing surface of the lateral femoral condyle following an acute patellar dislocation.

Radiographs and magnetic resonance images were retrospectively reviewed and the patterns of injury were evaluated for 80 patients with a diagnosis of acute patellar dislocation, including the presence of osteochondral damage, the location of the medial patellofemoral ligament injury, and concomitant meniscal pathology. Magnetic resonance imaging identified a 27.5% incidence of osteochondral injury involving the articular, weight-bearing region of the lateral femoral condyle following an acute lateral patellar dislocation. Surgical intervention was performed in more than 60% of these injuries, and most were not identified with plain radiographs. Injury to the weight-bearing surface of the lateral femoral condyle following patellar dislocation was 3.6 times more common in boys in the current study population.

Osteochondral injury to the weight-bearing surface of the lateral femoral condyle may occur in a high percentage of patients following a lateral patellar dislocation and in a higher percentage of boys than girls. Patients with tenderness over the lateral femoral condyle following an acute lateral patellar dislocation should undergo magnetic resonance imaging.

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Figure: T2-weighted sagittal magnetic resonance image showing a full-thickness chondral defect involving the midlateral weight-bearing surface of the lateral femoral condyle.
Acute lateral patellar dislocations are a common source of morbidity in athletically active children and adolescents. They are typically noncontact injuries secondary to a combined mechanism of knee valgus, flexion, and external rotation. The true incidence is unknown because the majority of patellar dislocations reduce spontaneously, and less than 20% of patients seeking treatment will have a frank dislocation at presentation. Nonetheless, patellar dislocations are a common cause of acute knee hemarthrosis in adolescents. Osteochondral damage is a well-accepted associated injury following a traumatic lateral patellar dislocation. This includes a spectrum of injuries that range from a bone contusion to chondral fraying with mild articular surface incongruity to a displaced osteochondral defect. Magnetic resonance imaging (MRI) evidence of osteochondral injury following an acute patellar dislocation has been reported in 40% to 70% of patients. In a systematic review, Stefancin and Parker found a nearly 25% incidence of osteochondral fracture with first-time dislocations. Although many aspects of patellar instability management remain controversial, the presence of osteochondral damage is an indication for early surgical intervention.

The typical findings after a lateral patellar dislocation have been well described and include a bone contusion pattern or osteochondral injury involving the inferomedial pole of the patella and the anterolateral aspect of the nonarticular portion of the lateral femoral trochlea. In contrast, the current authors identified a significant number of patients who sustained osteochondral injury to the weight-bearing surface of the lateral femoral condyle following patellar dislocation.

The purpose of this study was to characterize the pattern, location, and extent of osteochondral injury to the lateral femoral condyle as identified on MRI following a traumatic patellar dislocation. Classification of associated injuries and correlation of intraoperative findings with preoperative MRI images was attempted in patients undergoing some type of surgical procedure. The authors hypothesized that a significant number of patients sustain injury to the weight-bearing surface of the lateral femoral condyle, and that many of these patients ultimately require surgical treatment.

Materials and Methods
Institutional Review Board approval was obtained. A retrospective review was performed of all patients referred to a single pediatric primary care sports medicine clinic over a 3-year time frame with a diagnosis of closed patella dislocation (International Classification of Diseases 836.3). Inclusion criteria included a documented patellar dislocation and/or a reduction maneuver and the presence of a post-injury MRI. Patients with obligatory or habitual instability, an underlying connective tissue disorder, or associated multiligamentous knee injury were excluded. Patient age and sex and the status of the distal femoral and proximal tibial physes from radiographs were recorded. Available radiographs and MRIs were reviewed, and the injury patterns were evaluated, including the presence of osteochondral damage, the location of the medial patellofemoral ligament injury, and concomitant meniscal pathology. All films were reviewed by a fellowship-trained pediatric orthopedic surgeon (K.E.K.), a current pediatric orthopedic fellow (W.P.S), and a fourth-year orthopedic resident (M.C.B.).

The study population comprised patients with an osteochondral injury on the weight-bearing surface of the lateral femoral condyle, defined to be midlateral in the region of the sulcus terminalis, posterior to the anterior horn of the lateral meniscus on sagittal cuts, and extending medial to the lateral meniscus in the coronal plane. In that subgroup of patients, the authors further evaluated associated injury patterns, relevant surgical history, and intraoperative findings. Due to the retrospective nature of data collection, mechanisms of injury were not routinely identified.

Logistic regression analysis to determine whether sex, laterality, open vs closed physes, or patellar vs femoral-sided medial patellofemoral ligament injury had a significant effect on injury patterns. All tests were conducted by SAS version 9.1.3 software (SAS Institute Inc, Cary, North Carolina). Statistical significance was set at $P \leq .05$.

Results
Over the 3 years reviewed, 229 patients were seen at a single pediatric primary care sports medicine clinic for a diagnosis of acute patellar dislocation. From that group, 80 (35%) patients met the inclusion criteria and had an MRI available for review. Magnetic resonance images were obtained for patients who, after an acute patellar dislocation, presented with a significant hemarthrosis and tenderness over the medial or lateral condyle or had a questionable osteochondral injury on plain radiographs. Study patients were 37 boys and 43 girls with an average age of 13.8 years. Open physes, as documented by plain radiographs, were present in 41% of patients. A total of 22 knees in 21 patients were identified with a weight-bearing lesion of the lateral femoral condyle; 16 (76%) boys and 5 (24%) girls with an average age of 14.2 years were in this subgroup. The left knee was involved in 14 patients and the right knee in 8 patients. One patient had bilateral injuries that occurred on 2 separate episodes. Eleven (52.4%) patients had open physes at injury. Sixteen knees had MRI evidence of a true osteochondral defect, whereas the remaining 6 knees had a bone contusion, without identifiable articular surface breach, extending down to the mid-lateral weight-bearing surface (Figure 1). Plain radiographs were available for review in 18 of 22 knees: all 18 radiographic series included antero-
posterior and lateral views, 8 included an additional Merchant view, and 2 included a notch view. Osteochondral injury was identified on plain radiographs in 4 (22.2%) of 18 patients.

In patients with weight-bearing lesions of the lateral femoral condyle, 13 (59%) of 22 knees were identified with the combined and unique injury pattern consisting of a patellar-sided medial patellofemoral ligament avulsion with associated osteochondral fracture or bone bruise of the midlateral weight-bearing region of the lateral femoral condyle. Other less frequent associated injuries include: osteochondral defects of the medial pole of the patella (n = 6), femoral-sided medial patellofemoral ligament injury (n = 2), lateral meniscus tear (n = 1), and patellar sleeve fracture (n = 1).

Of 22 knees with weight-bearing lesions, 14 (63.6%) underwent operative intervention. Indications for surgery were based on the size and location of articular defect, the presence of associated injuries, and patient consent. Presence and location of medial patellofemoral ligament injury was not considered an indication for surgery. Procedures included microfracture (n = 8), lateral release (n = 6), medial imbrication (n = 6), chondroplasty (n = 5), loose body removal (n = 5), open reduction internal fixation (ORIF) of osteochondral fracture (n = 3), Galeazzi procedure (n = 2), and autologous chondrocyte implantation approximately 1 year after loose body removal and microfracture of the lateral femoral condyle (n = 1).

Figure 2 shows preoperative MRI images, an arthroscopic photograph of the lateral femoral condyle defect, and the postoperative radiographs of a 13-year-old boy treated with arthroscopy, medial imbrication, and ORIF of the osteochondral fracture through a lateral arthrotomy. The lateral fluoroscopic image shows the midlateral location of osteochondral injury in this patient.

Boys had a significantly higher probability of having the injury pattern involving the weight-bearing surface of the lateral femoral condyle (P = .0174; odds ratio = 3.609). A patellar-sided medial patellofemoral ligament injury had a significantly higher probability of having the specific pattern of injury investigated (P = .0076, odds ratio = 4.278). No significant difference existed between left and right legs (P = .1367) or between open and closed physes (P = .5647) in having a weight-bearing injury.

**DISCUSSION**

In this retrospective review, MRI identified a subset of adolescent athletes with an osteochondral injury involving the articular, weight-bearing region of the lateral femoral condyle following an acute, lateral patellar dislocation. More than 60% of these injuries underwent surgical intervention and were more common in boys. The combined and unique injury pattern consisting of an osteochondral weight-bearing lateral femoral condyle lesion with a patellar-sided medial patellofemoral ligament avulsion occurred in 59% of patients.

Nomura et al reported their findings in 7 patients with weight-bearing lesions at arthroscopy. Sanders et al reviewed 25 MRIs with evidence of prior patellar dislocation, identifying 10 (40%) with chondral defects involving the articular surface of the lateral femoral condyle; 3 on the articular surface of the trochlear groove, 5 isolated to the midlateral weight-bearing surface of the lateral femoral condyle, and 2 involving the trochlear groove and the midlateral weight-bearing surface. They suggested a mechanism for such injury whereby the osteochondral injury to the lateral femoral condyle results from a shearing force that occurs during the initial dislocation. The precise location of osteochondral damage depends on the degree of knee flexion at the time of dislocation, with more posterior and midlateral weight-bearing injuries implying a greater degree of knee flexion at the time of dislocation.

To the authors’ knowledge, no sex predilection for acute patellar dislocations has been reported in the literature. However, the current study identified a significant male predominance in patients with weight-bearing osteochondral le-
Boys were 3.6 times more likely than girls to sustain these injuries. Larger future series are needed to determine whether this sex predilection is true. However, it may suggest that different sex-specific sports and activities can lead to increased risk in the male population. Prospective data, collected at a patient’s initial presentation after a lateral patellar dislocation, including the mechanism of injury (contact vs noncontact), energy involved, and the position of the leg at the time of dislocation, would add further insight into the proposed etiology of articular injury following a patellar dislocation.

Furthermore, several authors have reported that the increased incidence of anterior cruciate ligament tears in women compared with men in similar sports is most influenced by the general differences in the level of neuromuscular training, specifically conditioning and muscle strength, between the sexes. These same differences may predispose women to patellar dislocation at lower degrees of knee flexion, thus protecting them from osteochondral injury to the weight-bearing region of the lateral femoral condyle. Arthroscopic photograph of the lateral femoral condyle defect (C). Fluoroscopic images (D, E) obtained following open reduction and internal fixation of the osteochondral fracture through a lateral arthrotomy.

In addition, anatomic factors that are known to predispose patients to patellar dislocation (eg, generalized ligamentous laxity, increased Q-angle, femoral antversion, and trochlear hypoplasia) may likewise predispose women to dislocation at lower degrees of knee flexion and protect against the more posterior, weight-bearing lesions. Such predisposing factors are more common in women than in men. Stanitski reported that the frequency of articular lesions following an acute patellar dislocation is 2.5 times greater in patients without articular hypermobility than those with more generalized joint laxity.

The medial patellofemoral ligament is well accepted as the primary restraint to lateral patellar translation and is a key component of the pathology following a patellar dislocation. Although classically reported to tear at its femoral attachment site, other authors have now shown increased frequency of medial patellofemoral ligament rupture from its femoral attachment. It has also been suggested that the location of the medial patellofemoral ligament injury may predict subsequent instability, specifically medial patellofemoral ligament avulsion from its femoral attachment. The current authors found that more than 60% of patients with osteochondral injury on the midlateral weight-bearing surface of the lateral femoral condyle have an associated medial patellofemoral ligament injury from the patellar side. Relevance of this combined injury pattern cannot be further discussed given the nature of the study and the number of patients involved.

Plain radiographs are inaccurate in the evaluation of articular cartilage injury following a patellar dislocation and tend to underestimate the presence of osteochondral damage. In the current study, 22% of lesions identified via MRI were visible on plain radiographs. This lack of a consistent radiographic series highlights the need for a more standardized algorithm in the evaluation of a suspected patellar dislocation. In addition, the discrepancy between radiographs and MRIs in detecting osteochondral injury further stresses the importance of obtaining an MRI if a patient presents with a large hemarthrosis or tenderness over the lateral femoral condyle following a patellar dislocation in an adolescent athlete.

The current study had several limitations. First, it was a retrospective review in which patients were not clinically evaluated. Therefore, an acute disloca-
tion could not be distinguished from an acute dislocation on the background of chronic instability. Mechanisms of injury were not well documented. In addition, no long-term follow-up is available regarding persistent symptoms or results following surgical treatment.

Second, because all patients were referred by a single pediatric primary care sports medicine clinic, findings cannot be extrapolated to all patellar dislocations, only to the subset of patients who underwent MRI after being diagnosed with a patellar dislocation from that clinic. It is likely that many patients who sustained a patellar dislocation did not undergo MRI. Therefore, the true incidence of weight-bearing articular lesions of the lateral femoral condyle following a patellar dislocation in the adolescent athlete cannot be determined. Nonetheless, this injury pattern should be noted, and physical examination following a suspected patellar dislocation must include careful palpation of the lateral femoral condyle.

CONCLUSION

Physical examination following a suspected lateral patellar dislocation must include careful palpation of the lateral femoral condyle, including flexion of the knee, to allow palpation of the more posterior, weight-bearing region. Furthermore, the authors advocate MRI for any patient with a documented or suspected patellar dislocation, especially in the setting of a knee hematoma and tenderness over the weight-bearing lateral femoral condyle.

REFERENCES


