Periosteal Avulsion of the Posterolateral Corner of the Knee in an Adolescent: An Unreported Case

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Abstract: Isolated injuries of the posterolateral corner of the knee are uncommon injuries in adults and are relatively unheard of in the pediatric population. This article reports a case of a 13-year-old boy who sustained an external rotation injury to his proximal tibia on a slightly flexed knee while playing football. Radiographs showed an avulsed fragment from the lateral femoral condyle. A magnetic resonance image was read as an avulsion of the femoral insertion of the lateral collateral ligament with associated bone bruise of the lateral femoral condyle. At operation, the fragment consisted of the femoral insertion of the popliteus tendon and the lateral collateral ligament, which was anatomically reduced and internally fixed with a screw and soft tissue washer. Six weeks postoperatively, the patient had full range of motion. To our knowledge, this injury has not been reported in the pediatric population.

Isolated injuries of the posterolateral corner of the knee are uncommon. These injuries are often associated and combined with other ligamentous injuries, such as the anterior cruciate (ACL) and/or posterior cruciate ligaments (PCL). These injuries can cause severe disability and articular cartilage degeneration. Common causes of injury include athletic trauma, motor vehicle accidents, and falls. Isolated injuries of the posterolateral corner of the knee involve mechanisms that cause a posterolateral or external rotation force directed against the proximal part of the tibia with the knee at or near full extension.

In the pediatric population, pure ligamentous injury is rare because the ligaments are generally stronger than the physeal plates. Significant bending injuries usually produce physeal fractures. Although pure ligamentous disruption can occur in children and has been reported, an isolated avulsion of the posterolateral corner from its femoral insertion has never been reported in the literature. This article presents a case of a 13-year-old boy with open growth plates who injured his right knee while playing football and sustained an isolated avulsion of the posterolateral corner off the femoral insertion. To our knowledge, no such injury has been reported in a pediatric patient.

Case Report
A 13-year-old boy presented to our office 2 weeks after sustaining an injury to his right knee while playing football. History revealed a direct blow to the anterolateral aspect of the proximal tibia of his right knee in almost full extension. The patient was unable to walk on the right lower extremity and developed an effusion over the next several hours. He reported pain in the posterior and lateral aspects of his right knee. He was evaluated later that day in a local emergency room, and radiographs showed a minimally displaced avulsion fracture of the lateral femoral condyle on the anteroposterior view. He was placed in a knee immobilizer and made nonweight bearing on crutches. Magnetic resonance imaging (MRI) of the right knee was obtained within the week of injury and was read by the radiologist as an avulsion of the femoral insertion of the lateral collateral ligament (LCL) with associated bone bruise of the lateral femoral condyle (Figure 1).

On physical examination in our office 2 weeks after injury, he continued to have a moder-
ate effusion. The range of motion (ROM) of his injured knee was decreased, and he had pain to palpation over the posterior and lateral aspect of the distal femur. Manual testing revealed a negative posterior drawer at 90° of flexion, a negative anterior lachman, and a stable medial collateral ligament with valgus stress at 30° of flexion and full extension. He had no neurological deficits. Varus stress testing of the lateral collateral ligament in 30° of flexion revealed +3 laxity. There was +2 laxity at full extension. Since he was grossly unstable and had an obvious avulsion fracture of the femoral insertion of the LCL, surgical intervention was recommended. After discussion of risks, benefits and possible complications were reviewed with the patient and family. They elected for surgery, and appropriate consent was obtained.

The patient was taken to surgery the following day. He was placed under general anesthesia, and a thigh tourniquet was used to control bleeding. Intravenous antibiotics were used preoperatively for prophylaxis. A longitudinal incision was used directly over the injury on the lateral femoral condyle. Sharp dissection was taken down through the skin and soft tissue to the iliotibial tract. This was then split sharply in line with the incision and retracted. Blunt dissection was then used through the hemorrhagic tissue, and the avulsed fragment was immediately present in the surgical field. The piece was a 1×1.5-cm piece of periosteum with some bone attached that had the femoral insertion of the popliteus tendon and the LCL attached to it (Figure 2). The fragment and bed where it came from was freshened until good bleeding bone was seen, and the fragment was reduced anatomically. Fixation was then completed with a 6.5-mm cancellous bone screw and soft tissue washer with the use of fluoroscopy for proper position of the screw, being careful not to violate the growth plate or the articular cartilage of the knee joint. The fragment was secured with the screw with the knee in slight flexion.

The knee was then taken through full ROM with no difficulty and was stable in all planes. The wound was then irrigated and closed in layers. A sterile dressing was applied, and a hinged knee brace locked in slight flexion was placed on the right lower extremity. He was initially made nonweight bearing and placed on crutches. The first postoperative visit was at 10 days, and the incision looked appropriate, with no surrounding erythema, edema, or signs of infection. Staples were removed, and steri strips and a dry dressing were placed over the wound. Physical therapy was initiated and weight bearing and ROM was advanced while maintaining the brace. By 6 weeks, he had full ROM and was full weight bearing. Radiographs were obtained of the operative knee with the screw and fixation well aligned and in good position. Examination at that time revealed a minimal effusion, full ROM, and a stable knee with no instability noted with varus stress testing at both 0° and 30° (Figure 3). External rotation stressing was within normal limits and equal to his opposite extremity. The patient was doing well and had no complaints.

**DISCUSSION**

Disruption of the ligaments of the knee is a rare injury in children and adolescents because their ligaments are stronger than the adjacent growth plates.5,9-11 However, ligament injuries occur in children and adolescents, with failure usually occurring at the insertion as an avulsion fracture.9 Most acute traumatic knee effusions in children are a result of injury more commonly to the ACL, PCL, meniscus, or patellofemoral joint, especially in girls, according to study by Luhmann.10 Isolated injury to the posterolateral corner of the knee is rare in adults and even more so in children and...
adolescents. Isolated avulsions of the popliteus tendon off its femoral insertion has been described.1,12,13 Most recently, Nakhostine et al14 reported on 4 patients with a mean age of 17 years (range, 14-22 years) with an isolated avulsion of the popliteus tendon off the femoral insertion. They were all external rotation injuries of the knee in slight flexion. All were fixed anatomically, and all had excellent function knee scores at an average of 35 months postoperatively. To our knowledge, these are the only cases reported in the literature similar to the injury sustained in our patient.

A study by Kannus et al9 reported on knee ligament injuries in adolescents. There were 32 patients with various knee ligament injuries: medial collateral ligament (MCL), ACL, ACL with MCL, and LCL. There were 25 grade II and 7 grade III ligament injuries, and all were treated nonoperatively. Mean age at the time of injury was 14.8 years (range, 10-18 years), with an average follow-up of 8.2 years. Long-term functional results of the grade II injuries were good to excellent in all patients, but in grade III injuries, all results were poor. No posterolateral corner injuries were reported specifically, but they showed residual rotatory instability, especially posterolateral in 3 patients.

Nonoperative treatment of grade I or II injuries of the posterolateral corner can have a good outcome.1,8 Nonoperative treatment of grade III or complete tears have generally led to poor functional results.1 When grade III injuries of the posterolateral corner of the knee are diagnosed acutely in adults, direct anatomic repair of all injured structures within 3 weeks has had the highest likelihood of optimal results.1 Since our patient’s injury was an avulsion fracture of the femoral insertions of the popliteus tendon and LCL on 1 fragment of periosteum, anatomic repair of these structures was much easier than typically seen in adults with this injury.

Recent literature has addressed the specific anatomic structures that make up the posterolateral corner of the knee. The major structures include the iliotibial tract, the LCL, the popliteus complex, the middle third of the lateral capsular ligament, the fabellolobular ligament, the arcuate ligament, the posterior horn of the lateral meniscus, the lateral coronary ligament, and the posterolateral part of the joint capsule.1,15-18 The anatomy can also be variable. The avulsion injury in our patient only involved the femoral insertion of the LCL and the popliteus tendon, but according to Nielsen et al,19-22 they are the major stabilizers of the posterolateral corner to varus and external rotation from selective ligament sectioning in cadaver knees. This is why we consider our patients injuries as a posterolateral corner injury of the knee.

Preoperative examination of our patient showed grade III laxity (severe or >10 mm knee joint opening with a soft or no end point) in 30° of flexion. At the time, we did not test for external rotation or posterolateral corner instability. Also, the avulsion fracture of his lateral femoral condyle concentrated our focus on repairing the LCL. Since all the other structures of the posterolateral corner were intact, it would have been interesting to see if there was external rotation instability present. We tested this postoperatively since we then knew the extent of his injury. He did not have laxity or instability 6 weeks postoperatively to varus stress testing at 0° and 30° or external rotation testing.

Many tests have been developed for examining the posterolateral corner of the knee. The dial test, the posterolateral external rotation test, the external rotation recurvatum test, the posterolateral drawer test, the dynamic posterior shift test, and the standing apprehension test are all used to test the stability of the posterolateral structures of the knee.3 We were able to examine the patient’s posterolateral corner postoperatively using the dial test at both 6 weeks and 1 year. The test was performed at both 30° and 90° with the patient in the prone position. The injured extremity examination was equal to that of the uninjured extremity at both 30° and 90°.

Postoperatively, the patient had no signs of posterolateral corner injury at 6 weeks or 1 year.

Isolated posterolateral corner injuries of the knee are rare and even more so in children and adolescents. When they do occur, anatomic repair of all involved structures is recommended within 3 weeks after injury for optimal results. We believe this is the first and only case of a periosteal avulsion fracture of the femoral insertion of the posterolateral corner of the knee in the pediatric population. Direct anatomic repair was completed of the avulsed fragment, and so far the patient has been doing well. His most recent follow-up was at 1 year. The patient’s ligamentous examination was within normal limits in all planes and equal to his other extremity. He has returned to all activities, including full-contact sporting events, with no limitation. The patient reports no pain currently or over the past 9 months.

REFERENCES


