Knee Dislocation in a 9-Year-Old Boy

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A traumatic knee dislocation is an exceedingly rare occurrence in children, with at best scant citations in the orthopedic literature. Treatment is unique in this age group, because of the limited reconstructive options available for the open growth plates about the knee. Compared with the ligamentous structures, the physis is generally considered the weaker link within the knee of children, and therefore most injuries described have involved the growth plates about the knee.[1]

In the orthopedic literature, we found only 2 cases of knee dislocations in children younger than 10 years; in 1 of these cases, there was not much detail or follow-up.[2-4] In addition, these 2 cases were managed before magnetic resonance imaging and arthroscopy were in common use.

Here we describe our experience in treating and following up the case of a complete posterior lateral knee dislocation sustained by a 9-year-old boy in a football game.

Case Report

A 9-year-old boy sustained an injury to the right knee during a football game. He was running when struck by another player on the anterior aspect of the right lower leg. Instantly having pain and deformity in the knee area, he was taken by emergency medical services to the emergency department. Gross deformity of the knee was seen on initial examination, and anteroposterior and lateral x-rays (Figures 1, 2) showed a posterior lateral knee dislocation. The patient was neurovascularly intact, with +2 posterior tibial and dorsalis pedis pulses. He underwent emergent reduction and was splinted. Confirming postreduction x-rays were obtained. Postreduction examination found the patient still neurovascularly intact and having soft compartments, gross instability in an anteroposterior direction, and varus-directed force. He was then admitted for diligent serial examinations[5] and pain control.

Magnetic resonance imaging (MRI) of the knee showed a posterior lateral corner (PLC) disruption, a posterior cruciate ligament (PCL) tear, a contusion of the lateral condyle and plateau, and increased signal in the medial collateral ligament (Figure 3). The patient was seen back in the office and was scheduled to undergo surgery after the swelling began to resolve. Examination under anesthesia revealed a negative Lachman test with a firm endpoint, grade III laxity with posterior drawer, and varus stress. Medially, the knee could not be gapped. There was positive external rotation at both 30° and 90° of knee flexion. Arthroscopy showed a torn PCL with a small intact proximal stump, a meniscocapsular anterior horn tear of the lateral meniscus, a torn popliteus tendon, and a positive drive-through sign. The well-visualized anterior cruciate ligament (ACL) was intact.

Acute repair of the PLC involved fixing a proximal substance tear of the popliteus back to its attachment site on the femur (Figure 4). Also found and repaired was a chondral avulsion of the lateral plateau by the lateral capsule, with capsule attenuation (Figure 5). Both repairs were augmented with suture anchors. Evident capsule attenuation was imbricated. Varus instability was significantly improved after the lateral capsular repair. The lateral collateral ligament on direct examination was intact. An anterolateral meniscal tear was then repaired with 3 vertical mattress sutures. After surgery, the patient was splinted just short of full extension and was made non-weight-bearing. Postoperative x-rays confirmed that joint reduction was maintained.

After the first postoperative visit, the patient's postoperative course consisted of 2 weeks of long-leg casting in near full extension. Over the next several months, progressive motion and weight-bearing were implemented

Figure 1. Anteroposterior x-ray of knee.

Figure 2. Lateral x-ray of knee.

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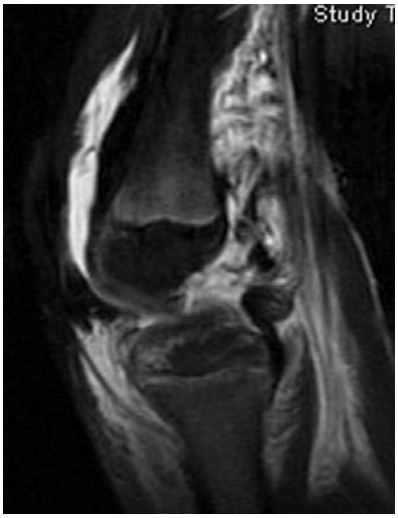

Figure 3. Sagittal T_2-weighted magnetic resonance imaging scan shows posterior cruciate ligament disruption.

with the patient wearing a hinged brace and eventually being fitted for a functional brace. At 9 months, his participation was not limited to certain activities, and he was back to playing baseball and running, but he still had a minor limp and occasional stiffness. On examination, he showed some quadriceps atrophy and was stable to varus/valgus stressing and rotation but again had +2 posterior laxity and a positive quadactive test. Range of motion (ROM) was 115° on the affected side and 145° on the uninjured side. The patient was to continue his home therapy program and activity as tolerated.

By 1 year, the boy had achieved near full ROM in the injured knee compared with the uninjured knee. No appreciable swelling was present, dial testing was negative, Lachman test was negative, and there was +2 posterior drawer on examination. The patient had been using a functional brace and playing Little League baseball that summer, just before this follow-up. Subjectively, he had no complaints of pain or instability, but his mother had noticed he limped occasionally when participating in some higher- level activities.

Discussion

The literature strongly supports surgery for knee dislocation in adults. An adult with our patient's ligamentous injury likely would have undergone PCL reconstruction and PLC repair or reconstruction.[6,7]

In our review of the orthopedic literature for children with a knee dislocation, we found only 2 cases involving children younger than 10 years. (Older children and children near skeletal maturity may be treated as adults.[4]) One case, in a series of dislocation cases in adults, was an 8-year-old who was treated conservatively with immobilization.[3] No specific information or follow-up was available.

The other case was a 9-year-old who sustained a posterior lateral dislocation in a go-cart accident.[4] The patient was found to have a combined injury (ACL, PCL, posterior lateral), which was treated with open repair of the ACL, PCL, and lateral capsule and with a medial meniscectomy. After surgery, the patient was placed in a long-leg cast with a tibial pin to prevent subluxation. At the latest follow-up (4 years), the patient had a positive pivot shift, +1 instability at 30°, no medial instability, +1 anterolateral instability, and an 8-mm overgrowth on a scanogram.

Very little information exists for decisions regarding this injury in children. In our patient's case, the PLC injury was treated with a primary repair to address instability while minimizing risk for complications, such as precocious physeal closure. The question, then, is whether to repair or reconstruct the PCL injury or leave it alone. ACL reconstruction has been successful in the prepubescent patient, but our Medline search turned up no cases of PCL reconstruction.[8] PCL reconstruction would also pass much more peripherally and obliquely through the physis compared with ACL reconstruction, risking physeal arrest.[9] A few cases of PCL avulsion injuries treated with acute repair are cited in the literature.[10-12] A substance tear was mentioned in a patient who, though treated with casting, developed knee pain 5 years after injury. However, the patient was also found to have a PLC injury at later follow-up.[13] Some

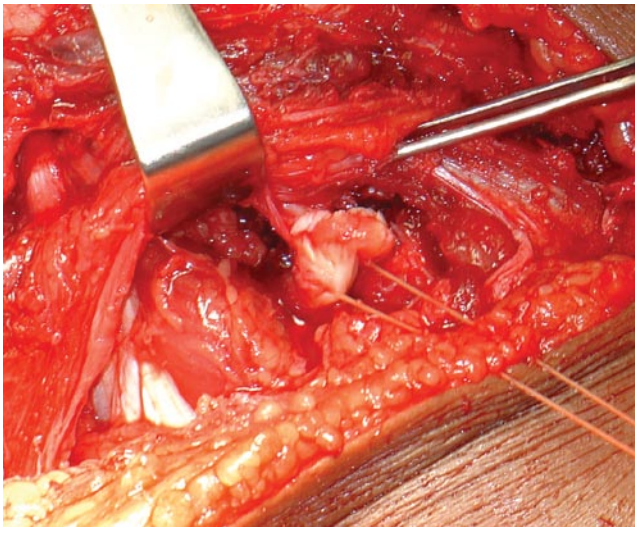

Figure 4. Popliteus tendon disruption.

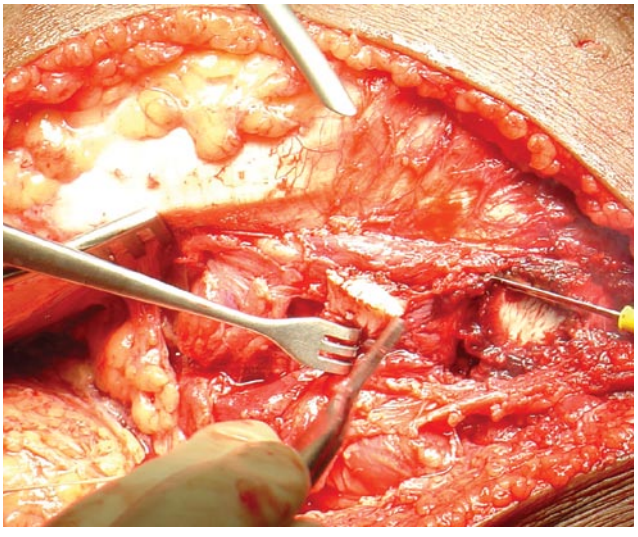

Figure 5. Chondral avulsion off lateral tibial plateau.

support is also mentioned for direct PCL repair in multiligamentous injuries.[14] However, results of primary PCL repair have proved no better in children than in adults.[15] Most of these injuries in the cited studies were treated after surgery with immobilization for 4 to 6 weeks in full or nearly full extension followed by rehabilitation.[14,16]

In our patient's case, the PLC was primarily repaired, but, with no supporting reports for any PCL reconstructions in this age group and poor results of repairing substance tears, the PCL was left alone. Critically reviewing our treatment, one could have attempted PCL repair even with its limited success, as proposed by Stanitski and colleagues.[16] There is some evidence that the PCL has some ability to "heal,"[17,18] and an isolated injury could be left alone with return to good function even with some residual laxity.[19] One could have also argued that a repair would have let the PCL heal in a more anatomical position in our patient. However, many patients who have undergone PCL repair have also had residual laxity, some similar to our patient's follow-up examination of +2. None of these repaired cases had multiligamentous injury or +3 instability, though. Theoretically, primary PCL repair may also have protected the PLC repair from attenuation in the short term. Later development of residual instability and symptoms possibly will necessitate PCL and PLC reconstruction once the patient reaches skeletal maturity. We informed our patient's parents that development of symptomatic instability was a possibility and that the long-term consequences of such an injury in a child are largely unknown.

Another option would have been to apply a hinged external fixator with or without PCL repair. The Compass Hinge Knee external fixator (Smith & Nephew, Memphis, Tenn) is being investigated for use in knee dislocations. Such a device could allow additional fixation, avoid the physis, and allow aggressive physical therapy and early ROM while protecting repaired structures and helping to avoid arthrofibrosis. In 2003, Stannard and colleagues[20] found a failure rate of only 7% with the hinged external fixator (vs 29% without the fixator) in short-term follow-up.

Conclusions

According to our experience in treating a knee dislocation in a 9-year-old boy and reviewing the literature, the critical treatment points are ruling out neurovascular injury and emergent reduction. One can then evaluate the injured structures with examination under anesthesia and MRI. However, the surgical manner in which to approach this injury is debatable, and long-term outcomes are nonexistent in this age group. Arthroscopic evaluation of the knee, localization of cruciate injury site (substance vs avulsion), and meniscal repair are essential steps in the treatment plan. In this age group, we are not able to address all aspects of these complex injuries as fully as we would in an adult. Our best efforts may lie in ensuring a concentric reduction and safely repairing some structures we would otherwise reconstruct in adults to avoid further physeal complications. Rehabilitating a repaired knee is a balance of protecting the repair and ensuring early motion to avoid arthrofibrosis. Advances such as the Compass Hinge Knee external fixator may help us to be more aggressive in this area. Our patient's case needs much longer follow-up, and more cases need to be reported, in order to develop a firm treatment recommendation for this age group.

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This paper will be judged for the Resident Writer's Award.