Operative Repair of an Adolescent Knee Dislocation: A Case Report

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Introduction

A knee dislocation involves a multi-ligamentous injury (MLI) that result in disruption of the tibiofemoral articulation. These are an uncommon orthopedic injury with prevalence between < 0.02% and 0.2% of orthopedic injuries.[1-4] In adults, these injuries can occur in high energy trauma, such as a motor vehicle collision, or through low energy mechanisms, typically related to sports injuries.[5] Low velocity injuries have been reported to be more common, representing up to 75% of MLI knees.[3] Knee dislocations during sports occur with excessive varus or valgus force on a hyper-extended knee. The increased size and strength of athletes in today's contact sports may lead to higher collision forces that are capable of causing a MLIs. In reviewing current literature, there are no examples of MLIs specific to adolescent patients. Musculoskeletal injuries in the immature musculoskeletal system require a different set of considerations than injuries in adult individuals. In this case report, we describe a sports related MLI knee in an adolescent athlete with open physes. Written authorization for this case report was provided by the patient's family prior to its submission.

Case Information

A 13+0 year-old male football player was tackled in a game, resulting in a lateral femorotibial dislocation (Figure 1). He was reduced and transferred to our facility. Upon arrival, he had a normal neurovascular status, confirmed by ultrasound, but the knee was unstable. He was Tanner III with open growth plates. Magnetic resonance imaging (MRI) study demonstrated complete tear of anterior cruciate ligament (ACL), medial collateral ligament (MCL), and avulsion of the posterior cruciate ligament (PCL) off of the medial femoral condyle, a Schenck Classification KD-IIIM (Figure 2). Fifteen days post-injury, the patient underwent arthroscopic PCL suture repair over a bone bridge and excision of the ACL remnant. The patient's distal femoral growth plate was open, so intra-operative fluoroscopy was utilized to ensure the physis was not breached during tunneling. Two weeks post-operatively, the patient began a standard PCL physical therapy protocol. At 2 months, repeat MRI demonstrated healing of the MCL and repaired PCL. Four months post-injury, he returned to the operating room for trans-epiphyseal ACL reconstruction with autologous hamstring graft, sparing the femoral physis but traversing the tibial side.

The patient was started on a standard ACL reconstruction physical therapy protocol post-operative day one. He was cleared for moderate sports training, with no cutting, three months after surgery. He began sport-specific training five months post-operatively and returned to all activities, including competitive football, ten months post-injury. Over the following year he excelled as a three sport athlete. Final follow up at 26 months post-injury demonstrated full athletic function, no growth restriction, pain, mal-alignment, ongoing instability, arthrofibrosis or hardware irritation/prominence.

Prior Reports and Relevant Literature

Knee dislocations are uncommon, and are even rarer in the presence of open physes. Existing studies of MLI demonstrate high variability in study sample size, injury severity, concomitant injuries, and treatment techniques. Furthermore, the lack of subjective outcome

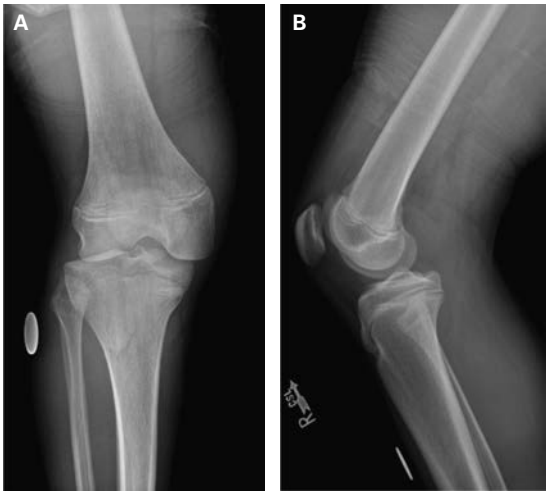

Figure 1. Initial AP (A) and lateral (B) radiographs demonstrating lateral femorotibial dislocation.

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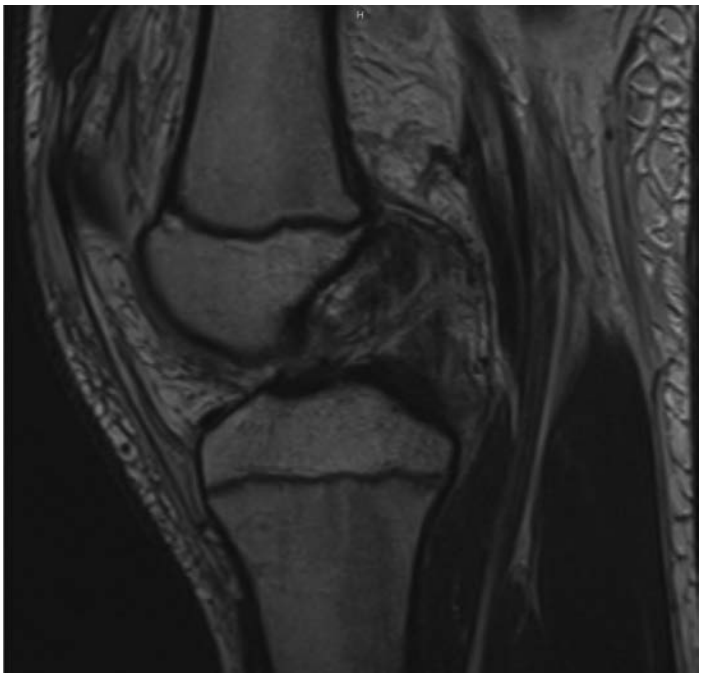

Figure 2. T2 weighted MRI demonstrating complete anterior and posterior ligamentous disruption of the knee.

instruments designed for these injuries makes outcomes comparison difficult. Prior literature rarely includes skeletally immature patients. A meta-analysis of 31 patients from 2000 – 2010 showed an average age of operatively treated patients to be 30.5 (range 22–35.1) years, and was similar to a previous aggregate of studies published before 2000.[6,7] Bui et al examined 20 patients with knee dislocations over a 6 year period.[3] Of these, three were 15-16 years of age, however, there was no comment on their physeal status. Two of these patients sustained their injury during sports, with one undergoing surgical repair. No outcome data was given. Two epidemiological studies included 255 children with traumatic knee injury and hemarthosis examined by MRI or arthroscopy and demonstrated zero patients with knee dislocation.[8,9] This report provides a treatment modality for a rare injury that led to complete return of function.

Discussion

Although the treatment approach of isolated ligamentous injuries is accepted, these principles cannot be extrapolated to MLIs. Unfortunately, no prospective study exists comparing surgical with non-surgical management. Non-operative management with prolonged immobilization has been associated with loss of motion, residual instability, and poor knee function,[10-12] The goal of surgery is to improve stability, retain motion, and achieve knee function that allows the patient to perform daily activities. However, the timing, graft selection, and surgical technique of MLI reconstruction remains debatable.[13-15] Delaying surgery 10-14 days allows for resolution of acute inflammation and soft tissue swelling, and has been shown to reduce the risk of post-operative arthrofibrosis secondary to improved ROM and quadriceps strength.[16] In a large systematic review, staged treatment of KDIII or IV was found to yield the highest percentage of excellent and good subjective outcomes and the least number of ROM deficits.[15] Repair of the PCL should occur first because PCL deficient knees result in posterior sagging that puts the knee in a state of misalignment, which is detrimental to healing of ligaments and the joint capsule. Open physeal plates complicated operative management of adolescent patients with MLI. In the initial repair of the PCL, the distal femoral physis was spared in order to avoid causing a growth disturbance to the affected leg. The repeat MRI obtained after just prior to the ACL reconstruction demonstrated interval closure of the proximal tibial physis so the tibial physis was not spared and a standard tibial tunnel was created (Figure 3). Post-surgical stiffness and loss of knee motion remain the primary post-operative concern. Rehabilitation protocols emphasize early protection with immobilization and gradual return to activities, but the clinician must balance these against the risks of loss of stability and failure of the reconstructed ligaments.

Conclusions

Given the low incidence of adolescent MLI, high-level evidence on which to base treatment decisions will be difficult. In this case report we have shown successful reconstruction of a knee MLI in a physeal immature patient. While further studies are needed to confirm the beneficence of our treatment plan, we believe this treatment approach can produce a positive outcome.

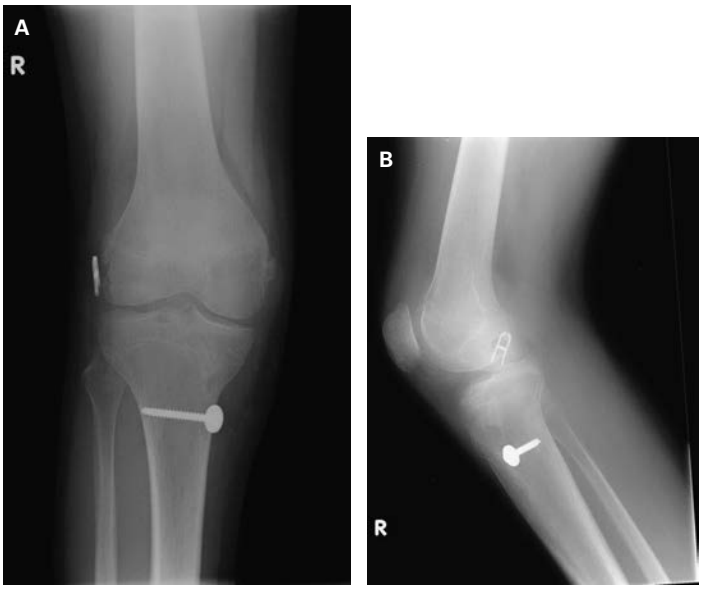

Figure 3. Postoperative AP (A) and lateral (B) demonstrating final surgical fixation and closed tibial growth plate.

References

1. Rihn JA, Groff YJ, Harner CD, et al. The acutely dislocated knee: evaluation and management. *J Am Acad Orthop Surg* 2004;12(5):334-346.

2. Kennedy JC. Complete dislocation of the knee joint. *J Bone Joint Surg Am* 1963;45:889-904.

3. Bui KL, Ilaslan H, Parker RD, et al. Knee dislocations: a magnetic resonance imaging study correlated with clinical and operative findings. *Skeletal Radiol* 2008;37(7):653-661.

4. Green NE, Allen BL. Vascular injuries associated with dislocation of the knee. *J Bone Joint Surg Am* 1977;59(2):236-239.

5. Skendzel JG, Sekiya JK, Wojtys EM. Diagnosis and management of the multiligament-injured knee. *J Orthop Sports Phys Ther* 2012;42(3):234-242.

6. Peskun CJ, Whelan DB. Outcomes of operative and nonoperative treatment of multiligament knee injuries: an evidence-based review. *Sports Med Arthrosc* 2011;19(2):167-173.

7 Dedmond BT, Almekinders LC. Operative versus nonoperative treatment of knee dislocations: a meta-analysis. *Am J Knee Surg* 2001;14(1):33-38.

8. Askenberger M, Ekstrom W, Finnbogason T,et al. Occult intra-articular knee injuries in children with hemarthrosis. *Am J Sports Med* 2014;42(7):1600-1606.

9. Vahasarja V, Kinnuen P, Serlo W. Arthroscopy of the acute traumatic knee in children. Prospective study of 138 cases. *Acta Orthop Scand* 1993;64(5):580-582.

10. Almekinders LC, Logan TC. Results following treatment of traumatic dislocations of the knee joint. *Clin Orthop Relat Res* 1992;(284):203-207.

11. Taylor AR, Arden GP, Rainey HA. Traumatic dislocation of the knee. A report of forty-three cases with special reference to conservative treatment. *J Bone Joint Surg Br* 1972;54(1):96-102.

12. Richter M, Bosch U, Wippermann B, et al. Comparison of surgical repair or reconstruction of the cruciate ligaments versus nonsurgical treatment in patients with traumatic knee dislocations. *Am J Sports Med* 2002;30(5):718-727.

13. Levy BA, Marx RG. Outcome after knee dislocation. *Knee Surg Sports Traumatol Arthrosc* 2009;17(9):1011-1012.

14. Tay AK, MacDonald PB. Complications associated with treatment of multiple ligament injured (dislocated) knee. *Sports Med Arthrosc* 2011;19(2):153-161.

15. Mook WR, Miller MD, Diduch DR, et al. Multiple-ligament knee injuries: a systematic review of the timing of operative intervention and postoperative rehabilitation. *J Bone Joint Surg Am* 2009;91(12):2946-2957.

16. Shelbourne KD, Porter DA, Clingman JA, et al. Low-velocity knee dislocation. *Orthop Rev* 1991;20(11):995-1004.