

A National Collegiate Athletic Association Division I Athlete's Return to Play After Traumatic Knee Dislocation With Vascular and Nerve Injury

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Abstract

Traumatic knee dislocations are thought to be relatively uncommon; however, they are a devastating injury that can be life altering. A concomitant vascular injury carries a particularly high morbidity rate, with some studies reporting as many as one in five patients losing a limb. Neurologic injury can pose problems as well, in particular for athlete populations that have structure and function as integral parts of their activities. This case study looks at the journey of an elite-level football player (NCAA Division I Pac-12 conference) who sustained a traumatic knee dislocation with vascular and neurologic injury and, eventually, his return to play. The study analyzes the treatment and management course, his ultimate performance after injury, and potential benefits in aiding the management of future knee dislocation with vascular and neurologic injuries.

Traumatic knee dislocations are relatively uncommon but do represent a true orthopaedic emergency. These injuries typically occur during motor vehicle accidents or other high-energy traumas. To a lesser degree, they can also be related to sports injuries. The true incidence of knee dislocations is unknown but thought to be low despite the fact that nearly 50% of knee dislocations reduce spontaneously.¹⁻³

Two classification systems have been used to describe the knee dislocation. The first, the Kennedy classification system, breaks injuries down by mechanism⁴ (Table 1). The drawback of this system is that the structures involved in the injury are

presumed based on mechanism. Schenck et al⁵ classification system solves this problem by describing the specific structures involved (Table 2).

Although the injury to the structural stability of the knee is devastating, it is the associated vascular or neurologic injury that proves limb threatening. Approximately one-third of knee dislocations will have a popliteus artery injury.^{3,6} Amputation rates as high as 86% result if arterial flow is not restored within 6 to 8 hours.⁶ Additionally, the common peroneal nerve (CPN) is reported to be injured in one-third of cases, with more than 50% of these patients unable to recover.³

The potential morbidity of knee dislocations is significant. A recent

Table 1

Kennedy Classification System⁴		
Direction	Mechanism	Injury Pattern
Anterior ^a	Hyperextension	Posterior capsule, PCL, ACL tears
Posterior ^b	“Dashboard”	PCL torn
Medial	Varus/rotation	Collaterals, cruciate
Lateral	Valgus, flexion/adduction	Collaterals, cruciate
Rotatory ^c	Rotation around PLC	MCL, ACL, PCL tears

ACL = anterior cruciate ligament, MCL = medial collateral ligament, PCL = posterior cruciate ligament, PLC = posterolateral corner

^a Most common.

^b Second most common.

^c Posterolateral most common.

Table 2

Schenck Classification System⁵	
Category	Structures Involved
KD I	Anterior dislocation, PCL intact
KD II	ACL/PCL
KD III M	ACL/PCL/MCL
KD III L	ACL/PCL/LCL
KD IV	ACL/PCL/MCL/LCL
KD V	Multiligamentous injury with periarticular fracture

ACL = anterior cruciate ligament, C = circulatory injury, L = lateral, LCL = lateral collateral ligament, M = medial, MCL = medial collateral ligament, N = nerve injury, PCL = posterior cruciate ligament

Letter annotation added to category with respective injury present.

Lower Extremity Assessment Project study looked at patients who sustained a multiligament knee injury (MKI) with concomitant popliteus artery injury. Of 18 patients, only 14 knees were salvaged. Furthermore, using the Sickness Impact Profile, the patients scored 12.08 and 7.0 or moderate and mild disability at 1 and 2 years postinjury, respectively.²

Multiple studies have assessed management options for MKIs without a general consensus. Some of these studies have advocated for de-

layed (greater than 3 weeks) surgical management, whereas many others recommended early (less than 3 weeks) surgical repair or reconstruction. Furthermore, graft selection and surgical technique are highly debated as well. The only consensus in the management of MKIs is that surgical repair or reconstruction is superior to nonsurgical management.^{1,7}

In addition, fewer studies have examined return to play in athletes who have suffered an MKI. In 2010, Hirschmann et al⁸ reviewed 26 elite

athletes with traumatic knee dislocations. Of 24 athletes, 19 returned to some level of participation, whereas only 8 reached their pre-injury level.

To our knowledge, no studies to date have evaluated return to play in elite-level athletes with a knee dislocation and associated vascular injury. Our study reviews the treatment and outcome of an NCAA Division I football player who sustained a non-contact knee dislocation with a vascular and neurologic injury and his subsequent return to sport.

Case Report

A 20-year-old elite collegiate football player (starter Division I Pac-12 conference) was in the middle of a play when he planted his foot and sustained a noncontact hyperextension injury to his right knee, resulting in a traumatic posterior knee dislocation. He was emergently reduced and immobilized on the field and then taken to the visiting team’s trauma center for further evaluation. On initial presentation, good Doppler flow at the foot was noticed; however, over the next few hours, an arterial injury was highly suspected. The athlete was then taken to the operating room for angiography and arterial repair. Intraoperatively, acute occlusion of the distal popliteus artery at the bifurcation of the anterior tibial and tibioperoneal trunks was observed. A double interposition bypass with great saphenous vein using a posterior approach was ultimately performed, returning excellent flow distally. Finally, a long posterior splint was

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used to protect the bypass and stabilize the knee.

Once the patient had stabilized at the visiting team's hospital, he was referred to our outpatient facility. He was seen 5 days later for definitive management of his MKI. Physical examination was notable for decreased sensation in the CPN distribution, grade 4 weakness with ankle dorsiflexion and eversion, and moderate effusion with ecchymosis. Lachman's was positive as well as gross varus laxity. Review of the MRI revealed a KD III L MKI, complete anterior cruciate ligament (ACL) tear, partial posterior cruciate ligament (PCL) tear, lateral collateral ligament (LCL) fibular avulsion, and bicep femoris avulsion from the fibula. To assist with repair and clearance, vascular and plastic surgery were consulted. Once the team was established, it was decided that reconstruction would be performed in two stages. The first stage would be an open exploration of the CPN to determine the extent of injury and possible repair with plastic surgery, followed by repair versus reconstruction of the LCL and bicep femoris, with vascular surgery on standby. The second stage would be an ACL reconstruction using autograft. The plan was discussed extensively with the athlete and his family, and the decision to proceed was made.

Seventeen days after initial injury and vascular interposition bypass graft, a right-knee open LCL and bicep femoris repair with common peroneal neuroplasty was performed. Using a lateral incision, careful dissection was carried down to the lateral complex and CPN. Neuroplasty of the CPN was then performed from the thigh to the superficial and deep branches within the lateral compartment. It was noted that the CPN had some contusion at the tibial neck but was otherwise intact. Attention was then turned to the lateral complex,

and the LCL and fibular biceps femoris attachment were repaired back to the fibular head using two Mitek Lupine suture anchors at 30° to 40° of knee flexion. Doppler was performed at the end of the case with excellent flow, followed by a long posterior splint with medial and lateral struts.

Postoperatively, the patient was kept non-weight bearing. At 2 weeks post-op, he was converted to a hinged-knee brace locked at 30 to 40 flexion. At 4 weeks post-op, he began physical therapy to work on active range of motion (ROM) with the goal of zero to 120° and continued non-weight bearing. At this time, he began to show improvement in CPN function in both sensation and strength. During the 6-week follow-up, it was decided to proceed with an ACL reconstruction using bone-patellar tendon-bone autograft and was scheduled for 10 weeks status post-index procedure. During the same follow-up, the knee ROM was 5° to 110° of extension and flexion, respectively. Quadriceps and hamstring strength as well as ankle dorsiflexion and eversion were near normal.

The second stage of the MKI reconstruction commenced 10 weeks after the athlete's index procedure. Examination under anesthesia revealed a positive Lachman and pivot shift tests with negative dial test at 30° and 90°. Posterior offset of 6 to 8 mm with a firm end point on his posterior drawer and very minimal laxity of the lateral complex at only 20° was present. The rest of the examination under anesthesia was otherwise normal. During diagnostic arthroscopy, the medial and lateral menisci and articular surfaces were normal. A femoral-sided PCL injury that had healed was indicated. The ACL reconstruction using bone-patellar tendon-bone autograft was then completed through a two-incision approach. The reconstruction was

uneventful, with excellent Doppler pulses before and after surgery.

The athlete's university postoperatively followed Multicenter Orthopaedic Outcomes Network ACL rehab protocol with the addition of no varus stress. At 5 months after LCL and bicep femoris repair with CPN neuroplasty and 3 months after ACL reconstruction, active ROM was symmetric to the contralateral side. Strength was decreased in the quadriceps, hamstrings, and great toe extension. Ankle dorsiflexion and eversion were excellent, and sensation had returned to normal. The knee was stable to varus/valgus stress and anterior/posterior translation. Finally, after extensive rehabilitation with team trainers and 13.5 months from injury, the patient had full recovery of the CPN as well as normal strength and ROM compared with the contralateral side, with excellent ligamentous stability in all planes. At this time, he was cleared to return to sport with use of a custom ACL knee brace for protection against varus and to avoid hyperextension mechanisms of injury.

Discussion

Traumatic knee dislocations are uncommon, severe, and potentially limb-threatening injuries. The unique nature of these injuries has led to multiple algorithms in management, and although the current literature has analyzed the morbidity of these injuries, very few have looked at return to play in athletes. This is the first study to our knowledge that reviewed an elite-level athlete's traumatic knee dislocation with vascular and neurologic injury and his return to sport as well. In previous studies, return to sport at preinjury levels after an MKI are disappointing.⁸ This athlete, when comparing pre- and postinjury season statistics, was able to achieve

near identical or improved statistics in the major categories for his position in one fewer game.

Although no universal approach to managing traumatic knee dislocations exists, it is accepted that the dislocation be reduced and stabilized immediately with the emergent addressing of any vascular compromise.⁷ Because many of these injuries spontaneously reduce, they will often appear deceptively benign. Thorough evaluation, including vascular and neurologic assessment, is paramount. Ankle brachial indices should routinely be performed with a low threshold for arteriography because arterial injury may still be present with normal pulses, capillary refill, and ankle brachial indices. Mechanism of injury is important because it has been reported that 40% to 50% of anterior or posterior knee dislocations have a concomitant vascular injury.³ For this athlete, angiography was used to make the definitive diagnosis despite normal Doppler on initial presentation.

In knee dislocations, repair versus reconstruction and the use of autograft or allograft are highly debated. Though technically a KD III L CN in terms of classification, the MKI this athlete sustained is relatively uncommon because of the incomplete rupture of the PCL.⁹ Through appropriate rehab and strengthening, the grade II PCL injury healed with minimal residual posterior laxity, which is acceptable for resuming sports. In regard to his lateral complex, avulsion injuries of the LCL when repaired acutely (less than 3 weeks) often have satisfactory results. If treatment were left until a later date or if a mid-substance tear was present instead of an avulsion, a reconstruction would have been the preferred method because of the inherent strength of reconstruction versus repair, the formation of scar

tissue, and soft-tissue contracture.¹ Another important aspect of this case was the neurolysis of the CPN into the lateral compartment. The CPN has poor recovery potential from injury, and an incomplete release would likely have led to a worse prognosis.¹ With the goal of an anatomic reduction and reconstruction of the knee and return to sport in mind, autograft was chosen for ACL reconstruction because primary repair of mid-substance cruciate tears has poor results.¹ Additionally, when we look at this patient's age and activity level, Kaeding et al¹⁰ have shown autograft to be the superior graft choice for ACL reconstruction.

In this study, a two-stage procedure addressing the athlete's MKI was necessary to allow for complete healing of his vascular repair, address the neurologic deficit acutely, and avoid loss of motion, in particular to knee extension. By addressing the LCL injury during the first stage of the procedure, we avoided performing a reconstruction. A single-stage procedure would potentially have led to notable scar tissue formation and ultimately poor ROM and might have disrupted the early vascular bypass.^{3,6,7}

Despite the uncommon nature of these injuries, continued research and analysis of our treatment algorithms are needed to continue reducing injury morbidity in an effort to improve function and quality of life as well as returning the athletes to sport.

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