Review Article

Multiligamentous Knee Injuries: Acute Management, Associated Injuries, and Anticipated Return to Activity

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ABSTRACT

Multiligamentous knee injuries (MLKIs) are devastating injuries. The energy and severity of these injuries encompass a wide range from low-energy single-joint mechanisms to high-energy polytrauma settings. Currently, there is no consensus on surgical treatment approach, surgical timing, or the return to preinjury activity levels after injury. There does appear to be a difference in the rate of return to activity and level of activity based on whether the injury was sustained during sport, in a trauma setting, or while on active military duty. The purpose of this descriptive review was to summarize current concepts related to (1) the acute management of MLKIs; (2) the effect of concomitant neurovascular, meniscal, and chondral injury on MLKI outcomes; (3) the effect of surgical versus nonsurgical treatment of MLKI on outcomes; and (4) rates and predictors of return to sport, work, and active military service after an MLKI.

Multiligamentous knee injuries (MLKIs) are devastating injuries to patients who can have long-lasting ramifications. An MLKI is defined as injury to at least two of the major ligamentous structures of the knee, including the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL). Of note, most publications consider an injury to the LCL as a component of a posterolateral corner (PLC) injury. The Schenck classification is one of the classification schemes used to describe the pattern of MLKI with knee dislocation (KD) (Table 1).[1] These are rare injuries representing 0.02% to 0.20% of all orthopaedic injuries, but this may be an underestimation due to spontaneous reductions in the field.[2] Dislocations can occur from a variety of mechanisms, including high-energy traumas, sports injuries, and lower energy mechanisms. Ultra-low-energy mechanisms are also encountered in obese patients, such as from simply stepping off of a curb. Figure 1 shows the radiographs of an obese patient who sustained an MLKI with a KD by the low-energy mechanism of stepping awkwardly while pitching a softball. Although the energy of the injury varies, the severity of the injury has been shown to not correlate with the amount of energy absorbed.[4] The treating

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Table 1. Schenck Classification of MLKIs[1]

Schenck Classification	
KD I	Multiligamentous injury with involvement of the ACL or PCL
KD II	Injury to the ACL and PCL only (2 ligaments)
KD III	Injury to ACL, PCL, and PMC or PLC (3 ligaments)
KD IV	Injury to ACL, PCL, PMC, and PLC (4 ligaments)
KD V	Multiligamentous injury with periarticular fracture

ACL = anterior cruciate ligament, KD = knee dislocation, MLKI = multiligamentous knee injury, PCL = posterior cruciate ligament, PLC = posterolateral corner, PMC= posteromedial corner

practitioner should have a high suspicion for vascular injuries, nerve injuries, and associated fractures when confronted with an MLKI or KD. There are still large variation and general lack of high-quality evidence for the preferred treatment of MLKIs. However, an understanding of the current evidence is important to better educate patients on their ability to return to preinjury levels of activity after injury. The purpose of this descriptive review was to summarize current concepts related to (1) the acute management of MLKIs; (2) the effect of concomitant neurovascular, meniscal, and chondral injury on MLKI outcomes; (3) the effect of surgical versus nonsurgical treatment of MLKI on outcomes; and (4) rates and predictors of return to sport, work, and active military service after an MLKI.

Initial Evaluation and Management of Multiligamentous Knee Injury in the Acute Setting

The rarity and complexity of MLKIs and KDs can make creating a standardized algorithm difficult. However, certain initial management principles are generally agreed upon, some of which will be discussed below.

Assessment of Stability, Reduction, and Concomitant Fracture

When a patient presents with a KD or concerns of a spontaneously reduced KD, the treating physician should obtain orthogonal radiographs to assess for concomitant fracture. Postreduction radiographs should be obtained if applicable to assess for adequate reduction. The practitioner should note that up to 50% of KDs may spontaneously reduce in the field.[3] If the knee is reduced on presentation, a high suspicion for KD and its sequelae including vascular insult should persist if there is clinical instability including opening to varus or valgus stress with the knee in full extension.[3] Therefore, if the patient does not have a KD on presentation but has a concerning mechanism and has laxity on examination, the injury must be treated as a spontaneously reduced KD and be treated appropriately.

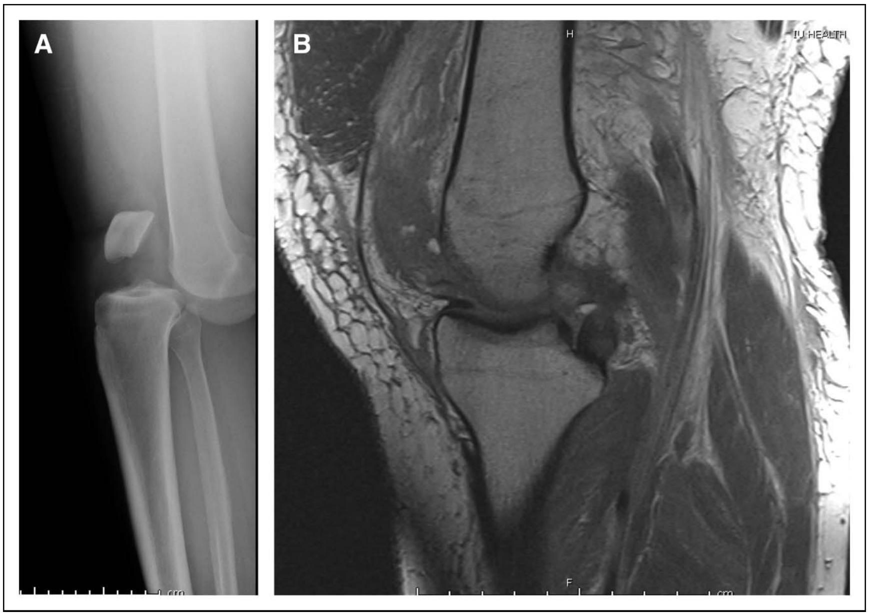
Vascular Assessment

Both high-energy and low-energy mechanisms can result in MLKIs, with Georgiadis et al[4] citing 53% high-energy etiology and 47% low-energy etiology. However, the low-energy mechanism is not protective against neurovascular injury.[5] In fact, several studies have referenced higher rates of neurovascular injury in low-energy mechanism MLKIs compared with high-energy mechanism.[4,6] In the initial evaluation, one must be aware that 18% of MLKIs have associated vascular injuries.[7] The highest prevalence of vascular injury has been found to be a Schenck classification KD III (dislocation with disruption of ACL and PCL with either MCL or LCL) (32%) or MLKI presenting as a frank posterior dislocation (25%).[7] A delayed diagnosis of vascular injury of even 8 hours can lead to increased risk of above-knee amputation.[8] Medina et al[7] noted that 80% of all patients with a vascular injury required surgical intervention and 12% ultimately required amputation. Although this evaluation usually starts with palpation of pulses, this is not the most reliable test to detect a vascular issue. Mills et al[9] argued that obtaining Ankle Brachial Indices (ABIs) on a patient can be an accurate screening examination for vascular injury. In this study, patients with a screening ABI less than 0.9 were all ultimately diagnosed with a vascular injury requiring surgical intervention, but no patient with an ABI greater than 0.9 had a vascular injury that was identifiable by ultrasonography or that required surgical intervention, arguing for the effectiveness of the test for screening. Prompt diagnosis and vascular surgery involvement are key for successful management in these patients. Based on current evidence, the authors recommend obtaining ABIs as a screening tool for all patients with KDs and spontaneously reduced KDs, with CT angiography to follow in those with abnormal ABIs to identify the level and severity of the vascular injury.[10]

Neurologic Assessment

Patients with MLKI with a resulting transient or sustained KD are at high risk of neurologic injury. The common peroneal nerve is the most frequently injured

Figure 1



Representative injury XR (A) and MRI (B) images from a 39-year-old morbidly obese male revealing complete tears of the ACL, PCL, and PLC. The patient injured his knee after stepping awkwardly while pitching a softball and subsequently dislocating his knee.

nerve in KDs, with Medina et al[7] citing that 25% of patients presenting with KD also had a concomitant peroneal nerve palsy. Variation in reported outcomes could be due to the varying definitions of a nerve palsy and whether partial nerve palsies were included.

Acute Workup and Management

When evaluating a patient with suspected KD or MLKI, an initial trauma evaluation for life threatening injuries is first indicated. A thorough physical examination of the injured extremity is then required, including palpation for pulses and evaluation of neurologic status distal to the injury, as previously discussed. A radiographic assessment with adequate orthogonal views is then required. If the knee is persistently dislocated, an urgent closed reduction in the emergency department is required with placement of a knee immobilizer. After the closed reduction, post-reduction radiographs and repeat assessment of the limb should be obtained. ABIs should then be obtained with CT angiography to follow, if applicable. MRI provides valuable information about the patient's knee injury. It can demonstrate nondisplaced fractures of the tibia or femur, correlate ligament and tendon injuries with physical examination findings, and help prepare the treating surgeon for the possibility of having to address chondral or meniscal pathology. MRI should be obtained before any definitive surgical procedures are done. If a fracture is present, fracture fixation should first take place. External fixation may be necessary to allow for soft-tissue swelling to decrease before fracture fixation. In this case, some experts recommend delayed ligamentous reconstruction until bony healing occurs, after 4 to 6 weeks.[3] This delay helps ensure adequate osseous tunnels for ligamentous reconstruction. For purely ligamentous injuries, available evidence for timing of surgery is varied. Levy et al[11] argued in a systematic review that early surgical treatment within 3 weeks of injury yields improved clinical and functional outcomes. Alternatively, Mook et al[12] in a systematic review noted that delayed and acute surgical intervention yielded equivalent results. They noted that acute intervention was associated with increased rates of instability and flexion deficits than delayed treatment.[12] Mook et al[12] also stated that staged procedures, defined as procedures both during the acute and delayed phases, may produce better subjective outcomes and lower rates of stiffness than acute treatment.[12] However, they theorized that the difference may be prevented with more aggressive postoperative rehabilitation.[12]

Effect of Concomitant Injuries and Treatment Approach on Outcomes

Effect of Neurological Injury

Plancher and Siliski[13] stated that the functional recovery rate for a complete nerve palsy is 38%, but the rate of complete recovery in a partial common peroneal nerve palsy is approximately 87% (Table 2), although no clear

Table 2. **Influence of Neurovascular Injury on Outcomes After an MLKI**

Nerve Injury With MLKI Knee Dislocation	Recovery Rate, %	Lysholm Score
Partial peroneal nerve palsy	87	89
Complete peroneal nerve palsy	38	74.5

MLKI = multiligamentous knee injury
[a]Data extracted from Plancher and Siliski,[13] $P < 0.05$ for both columns.

definition for partial or complete injury was provided. A statistically significant difference in Lysholm scores has been demonstrated between patients who had a complete or partial nerve recovery (score of 89) and patients who sustained permanent peroneal nerve palsies (score of 74.5). Woodmass et al[14] conducted a systematic review on the topic; the authors stated that if there is no improvement in nerve conduction studies and EMG at 6 weeks and 3 months with no symptomatic improvement in function, they will offer patients a posterior tibial tendon transfer at 1 year postinjury.

Effect of Meniscal or Chondral Injuries

Krych et al[15] evaluated the association between time until surgery and presence of chondral and meniscal injuries in patients with MLKI and KD. Overall, 76% of patients had concomitant injuries with 55% having meniscal tears, and 43% had cartilage injuries. Lateral-sided MLKIs had significantly more cartilage and meniscal injuries (80% versus 59% $P = 0.04$).[15] A higher prevalence of chondral injury in the patellofemoral and lateral articular compartments was encountered in patients treated with delayed surgery compared with those who underwent acute surgical repair, defined as less than 1.5 months from time of injury.[15]

Moatshe et al[16] evaluated the rate of chondral and meniscus injuries in patients with MLKI. Meniscal injuries were present in 37.3% of patients, and these injuries were equally distributed between the medial and lateral side of the knee. Chondral injuries were present in 28.3% of patients, with injuries to the femoral condyles being the most common area of injury. Patients with meniscal injuries had significantly higher odds of having a chondral injury ($P = 0.034$). In addition, chronic injuries were more likely to have concomitant chondral damage than acute injuries (47.7% in chronic injuries, 20.1% in acute; $P < 0.001$).

King et al[17] argued that meniscal tears and chondral injuries can be predictive of inferior patient outcomes. They analyzed the International Knee Documentation Society (IKDC) scoring system for patient outcomes and found 78% of patients in their study had concomitant injuries at the time of surgery. Forty percent had articular cartilage injuries, and 56% had meniscal injuries. Patients with cartilage damage had significantly lower IKDC scores than those without damage, and those with combined medial and lateral meniscus injuries had significantly lower scores.[17] Table 3 summarizes the IKDC scores for the study population.

Effect of Definitive Treatment Approach

The current literature supports treating patients with MKLI surgically instead of nonsurgically in most situations (Table 4). Wong et al[18] evaluated 26 cases of KD with an MLKI, 11 treated with cast immobilization and 15 treated surgically. Although the surgery group had on average 3 degrees of less flexion, patients reported knee instability in 26.7% of the surgery group versus 90.9% of the nonsurgery group ($P = 0.002$). IKDC scores were improved in the surgery group ($P = 0.005$). The surgery group was further subdivided into repair of all ligaments versus partial repair of some ligaments. More patients in the partial repair group reported subjective knee instability than in the complete repair group. The mean AP translation and IKDC scores were significantly better for the complete repair group compared with the partial repair group ($P < 0.05$).[18] Thus, surgically treated patients had superior clinical results to nonsurgically managed patients, and those with complete repair did better than those who had partial repairs.

Richter et al[19] evaluated 89 patients who sustained an MLKI and were treated nonsurgically (26 patients), with repair of cruciate ligaments (49 patients), or with reconstruction of cruciate ligaments (14). Significantly improved clinical outcome measures were seen in patients treated surgically versus nonsurgically ($P < 0.05$). In addition, significantly improved clinical outcome measures were seen in patients treated with transosseous ACL/PCL fixation with cortical screws versus suture fixation. Finally, improved clinical outcomes measurement scores in the patients were seen in patients who underwent functional progression rehabilitation compared with postoperative immobilization.

Plancher and Siliski[13] discussed surgical versus nonsurgical treatment of MLKIs in a retrospective review of 48 patients with 50 KDs. Nonsurgical treatment consisted of patients treated with casting, bracing, or external fixation. Of these 19 nonsurgical patients, 4 required above-knee amputation and 2 required arthrodesis. No patients in the surgically treated group

Table 3. Knee Function After Surgical Treatment of MLKIs According to Cartilage and Meniscus Status

Structure Injured	Number	IKDC Score
Cartilage		
+Lesion	38	64 (15-99)
−Lesion	57	74 (12-100)
Meniscus		
+Tear	53	69 (12-100)
−Tear	42	71 (19-100)
Cartilage + Meniscus injury	17	63 (15-100)

MLKI = multiligamentous knee injury, IKDC = International Knee Documentation Society
[a]Data abstracted from the work of King et al.[17]

required either of these interventions. Thirty-one knees underwent surgery with 29 undergoing surgery within 3 weeks. The mean Lysholm scores were significantly different between surgical (84.3) and nonsurgical (70.5) treatment ($P < 0.01$), as well as the mean Hospital for Special Surgery scores for surgically (82.3) versus nonsurgically (63.7) treated knees ($P < 0.01$), favoring surgical management.[13]

Peskun and Whelan[20] published a systematic review comparing nonsurgical and surgical treatment. The pooled average Lysholm score was 84.3 for the surgically treated group compared with 67.2 for the nonsurgically treated group ($P = 0.027$), favoring surgical management. No statistically significant difference was observed in IKDC scores, Tegner scores, knee range of motion, or instability according to the treatment strategy.[20]

In summary, current literature supports surgical treatment of MLKI due to improved outcomes. Surgically managed patients have improved clinical outcome scores, better knee stability, decreased rates of early arthritic change, and higher rates of return to work and sport.[15,18-20] However, not all patients treated with surgery will have a good outcome; Hanley et al[21] identified a subset of patients at risk for postoperative stiffness, which is linked to a KD injury ($P = 0.04$) or having three or more injured ligaments that required surgical fixation.[21] Although most studies favor surgical management, patient-specific factors must always be taken into account when indicating a patient for surgical repair. As such, patients with low functional demands or who have high surgical risks may benefit from nonsurgical management.

Table 4. Influence of Surgical or Nonsurgical Treatment on MLKI Outcomes

Treatment Plan of MLKI	Lysholm Score	Tegner Score	Mean Hospital for Special Surgery Score
Surgically	84.3	4.0	82.3
Nonsurgically	67.2	2.7	63.7

MLKI = multiligamentous knee injury
[a]Data extracted from the work of Plancher and Siliski[13] and Richter et al,[19] $P < 0.01$ for all three groups

Expected Functional Outcome After MLKI

Return to Work

MLKIs often have adverse outcomes on patient's lifetime earning potential and ability to return to their previous level of work (Table 5). Multiple studies have reported on patients' ability to return to work. Richter et al[19] noted 75% of their patients were able to return to work; reasons for not returning included knee pain, knee instability, and concurrent injuries. Plancher and Siliski[13] reported that between 69% and 84% of patients were able to return to work. Levy et al[11] noted surgically treated patients were able to return to work more often than nonsurgically treated patients (72% versus 52%). Peskun and Whelan[20] combined the outcomes of eight studies of surgically treated patients and two studies of nonsurgically treated patients and found 80.9% of surgically treated patients returned to full employment compared with 57.8% of nonsurgically treated patients ($P < 0.001$).

Wajsifsz et al conducted a retrospective review of surgically treated patients who sustained a cruciate ligament injury along with a PLC injury. Of 30 patients, only 3 patients, all laborers, were unable to return to their previous level of occupation and had to change jobs; the other 27 were able to return to their previous line of work.[22] Mook et al[12] conducted a systematic review and discovered that patients who were immobilized to less than 30 degrees of passive and active range of motion for 3 weeks after surgery were significantly less likely to return to work than those who were mobilized early after surgery ($P = 0.008$). Everhart et al[23] conducted a systemic review and stated that return to work with minimal to no modifications was higher for patients treated surgically for MLKI compared with nonsurgically treated patients (79.3% versus 65.2%, $P = 0.04$). They noted that a lower percentage of patients return to work who sustain a Schenck grade IV or V KD compared with a lower grade KD (66% versus 100%, $P = 0.017$). They also noted a better chance of returning

Table 5. Return to Work After an MLKI

Treatment of Patients Who Sustained an MLKI	Percentage of Patients Who Successfully Returned to Work, %
Treated surgically	79.3
Treated nonsurgically	65.2
MLKI & grade I-III KD	100
MLKI & grade IV-V KD	66

MLKI = multiligamentous knee injury, KD = knee dislocation
[a]Data extracted from the work of Everhart et al,[23] $P < 0.04$ for both groups

to work without restrictions if the patient did not sustain a vascular or peroneal nerve injury.[23]

Return to Sport

For some patients, return to sport is an important marker of functional recovery from an MLKI (Table 6). It should be noted that when analyzing studies' return-to-sport rate, few studies specify what kind of sport their patients returned to. The level of knee function required to participate in contact sports and sports requiring rapid cutting activities may be higher compared with that in noncontact sports and sports requiring only linear motion.

Reported rates of return to sport are more varied across the literature than rates of return to work. Wong et al[18] observed that of 26 patients analyzed, none of their patient population was able to return to previous level of sports participation. Plancher and Siliski[13] noted a significant difference in the percentage of patients able to return to sport with 74% in the surgery group and 31% in the nonsurgery group returning to sport ($P = 0.015$). Ritcher et al assessed rates of return to sport of patients with cruciate ligament avulsion injuries. They reported that 56% of patients were able to return to sport in the surgically treated group, compared with 17% in the nonsurgically treated group ($P = 0.004$).[19] In addition, 58% of patients in the transosseous fixation group were able to return to sport compared with 29% in the suture fixation group ($P = 0.02$), and in the different rehabilitation groups, 39% of patients treated with immobilization were able to return to sport compared with 63% in the functional rehabilitation group ($P = 0.05$).[19] Two other studies compared repair versus reconstruction of MLKIs and return to sport. Stannard et al found 46% of patients treated with repair of PLC versus 68% of patients treated with reconstruction returned to sport, and Mariani et al found 0% of patients treated with repair of cruciate ligaments and 33% of patients treated with reconstruction returned to sport.[24,25] Finally, Peskun and Whelan[20] found that 50% of surgically treated patients and 22.2% of nonsurgically treated patients were able to return to preinjury level of athletic activity ($P = 0.001$).

Table 6. Return to Sport After an MLKI

Type of MLKI Sustained	Percentage of Athletes Who Returned to Sport, %	Average Time to Return to Sport, d
ACL/MCL	43.5	305
ACL/PCL/LCL	18.5	459
ACL & KD	N/A	609

ACL = anterior cruciate ligament, KD = knee dislocation, LCL = lateral collateral ligament, MCL = medial collateral ligament, MLKI = multiligamentous knee injury, PCL = posterior cruciate ligament
[a]Data extracted from Bakshi et al,[27] $P < 0.01$ for both columns.

Everhart et al[23] noted that the rate of return to sport among studies where all patients were treated surgically (59.1%) was significantly higher than studies with a combined population of patients treated nonsurgically and surgically (46%, $P = 0.02$). Hirschmann et al evaluated return to sport of elite athletes with complex bicruciate knee injuries. They found 79% of patients were able to return to their previous sport at a mean time of 5.5 months; however, only 33% returned to the preinjury level of competition.[26] In addition, Bakshi et al reported that the overall return-to-play rate of NFL football players who sustained an MLKI was 64%. A statistically significant difference was observed in mean time to return to play for athletes depending on the specific injury: MCL/ACL injuries took 305 days to return to play, ACL PCL/LCL injuries took 459 days, and KDs took 609 days to return. Finally, patients sustaining ACL/MCL injuries were more likely to return to prior performance level (43.5%) compared with those sustaining an ACL with PCL/LCL injury (18.5%, $P < 0.001$).[27]

In summary, multiple studies have demonstrated that patients treated surgically for an MLKI have a better chance of returning to sport than patients not treated surgically. Two studies demonstrate that patients treated with ligament reconstruction have a higher percentage of return to sport than those treated with ligament repair, one analyzing PLC and the other analyzing cruciate ligaments.[24,25] In addition, after surgical treatment, functional rehabilitation is superior to immobilization regarding return to sport. Finally, an MLKI can be a career altering or ending injury for elite athletes, with one study noting 33% able to return to preinjury level and another noting only 18.5% of athletes with ACL and PCL/LCL injury

Table 7. Return to Military Active Duty After an MLKI

Service Men and Women Who Sustained an MLKI	Percentage Returned to Active Duty
Total (n = 24)	54
Senior enlisted and officers	75
Junior enlisted and officers	33

MLKI = multiligamentous knee injury
[a]Data extracted from the work of Ross et al.[28]

returning to the previous level.[26,27] This should help guide treatment and guide counselling of athletes about the reality of returning to sport after an MLKI.

Return to Active Service

The last group of patients discussed are service men and women who had sustained MLKIs (Table 7). One can surmise that active service members may sustain very high-energy injuries, such as an improvised explosive device (IED) blast injury, that can be complicated by polytrauma and limited early access to medical care. In addition, like athletes, most military personnel must be able to return to a high fitness level to return to active duty. We review the return to active duty rates for combat personnel and how this patient population may differ compared with others previously described.

Ross et al evaluated 24 patients with MLKI from motor vehicle accident, parachute landing, and various sports injuries. They found 54% of patients were able to return to active duty. In addition, a higher percentage of senior enlisted and officers (75%) were able to return to duty compared with junior enlisted and officers (33%).[28] Barrow et al[29] reviewed 46 service members who sustained a combat-related MLKIs; the overall return-to-duty rate was 41%. Factors that significantly decreased patients' ability to return to active duty included high-energy mechanism, peroneal nerve injury, vascular injury, compartment syndrome, traumatic knee arthrotomy, and intraarticular femur fracture (all $P < 0.05$). Of the patients unable to return to active duty, 70% were directly associated with the MLKI.[29] In addition, Richards and Dickens found most MLKIs sustained by service members are actually low-energy, non–combat-related injuries from minor falls (less than 5 ft), sports injuries, and low-speed bicycle accidents. These low-energy MLKIs have higher rates of return to duty than their high-energy counterparts. Ross et al and Richard and Dickens both noted that senior enlisted members were more likely to return than more junior members. Proposed explanations include more control over their work environment, higher job security, and less physically demanding work.[28,30]

In summary, most MLKIs are not sustained in a combat setting, but in a similar fashion to those sustained in civilian lifestyle. However, compared with the civilian literature, soldiers who sustain combat-related MLKIs are more likely to experience extensive polytrauma injuries. In addition, the more stringent requirements of active service make it harder for these patients to return to active duty compared with civilian rates of return to work.

Summary

Although MLKIs are relatively rare orthopaedic injuries, they can be associated with high patient morbidity. MLKIs can affect a patient's ability to return to work, sport, or active duty. It is crucial in the initial management to perform a thorough evaluation of the patient, as up to 50% of KDs can spontaneously reduce in the field. In addition, missing a vascular injury in the initial evaluation can have dire consequences and increase the chances that the patient may require amputation.[8] Vascular injuries, nerve injuries, chondral injuries, and meniscal injuries can all lead to worse satisfaction and functional outcomes.

Current evidence in the literature supports surgical management of MLKIs. There is still much debate regarding timing, surgical technique, and postoperative rehabilitation, but current evidence supports that patients return to work and sport at a higher rate with surgical treatment. Some research argues that ligament reconstruction may lead to a better result than repair. Early functional rehabilitation may lead to better range of motion and return to sport than postoperative immobilization. Overall, the return-to-work rate for patients treated surgically is relatively high when considering the overall morbidity associated with these injuries. The fact that the return-to-work rate is higher than return to sport or active military duty may illustrate that a large amount of the work force is able to better control the factors where they work to avoid pain, instability, or reinjury compared with those who want to return to sport or active duty. Many unanswered questions remain with the treatment of MLKIs. The rarity and variety of these injuries make performing a robust, prospectively randomized clinical trial difficult. However, as more surgeons adopt modern treatment strategies and postoperative rehabilitation protocols, we may be better able to answer the questions that remain with the treatment of MLKIs.

References

1. *The Multiple Ligament Injured Knee: A Practical Guide to Management*. New York, NY: Springer, 2004, pp 37-49.

2. Rihn JA, Groff YJ, Harner CD, Cha PS: The acutely dislocated knee: Evaluation and management. *J Am Acad Orthop Surg* 2004;12:334-346.

3. Maslaris A, Brinkmann O, Bungartz M, Krettek C, Jagodzinski M, Liodakis E: Management of knee dislocation prior to ligament reconstruction: What is the current evidence? Update of a universal treatment algorithm. *Eur J Orthop Surg Traumatol* 2018;28:1001-1015.

4. Georgiadis AG, Mohammad FH, Mizerik KT, Nypaver TJ, Shepard AD: Changing presentation of knee dislocation and vascular injury from high-energy trauma to low-energy falls in the morbidly obese. *J Vasc Surg* 2013; 57:1196-1203.

5. Vaidya R, Roth M, Nanavati D, Prince M, Sethi A: Low-velocity knee dislocations in obese and morbidly obese patients. *Orthop J Sports Med* 2015;3:2325967115575719.

6. Stewart RJ, Landy DC, Khazai RS, Cohen JB, Ho SS, Dirschl DR: Association of injury energy level and neurovascular injury following knee dislocation. *J Orthop Trauma* 2018;32:579-584.

7. Medina O, Arom GA, Yeranosian MG, Petrigliano FA, McAllister DR: Vascular and nerve injury after knee dislocation: A systematic review. *Clin Orthop Relat Res* 2014;472:2621-2629.

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

9. Mills WJ, Barei DP, McNair P: The value of the ankle-brachial index for diagnosing arterial injury after knee dislocation: A prospective study. *J Trauma* 2004;56:1261-1265.

10. Kelly SeanP, MC USA, Rambau Genevieve, et al; USAF: The role of CT angiography in evaluating lower extremity trauma: 157 patient case series at a military treatment facility. *Mil Med* 2019;184:9-10.

11. Levy BA, Dajani KA, Whelan DB, et al: Decision making in the multiligament-injured knee: An evidence-based systematic review. *Arthroscopy* 2009;25:430-438.

12. Mook WR, Miller MD, Diduch DR, Hertel J, Boachie-Adjei Y, Hart JM: Multiple-ligament knee injuries: A systematic review of the timing of operative intervention and postoperative rehabilitation. *J Bone Joint Surg Am* 2009;91:2946-2957.

13. Plancher KD, Siliski J: Long-term functional results and complications in patients with knee dislocations. *J Knee Surg* 2008;21:261-268.

14. Woodmass JM, Romatowski NP, Esposito JG, Mohtadi NG, Longino PD: A systematic review of peroneal nerve palsy and recovery following traumatic knee dislocation. *Knee Surg Sports Traumatol Arthrosc* 2015;23:2992-3002.

15. Krych AJ, Sousa PL, King AH, Engasser WM, Stuart MJ, Levy BA: Meniscal tears and articular cartilage damage in the dislocated knee. *Knee Surg Sports Traumatol Arthrosc* 2015;23:3019-3025.

16. Moatshe G, Dornan GJ, Loken S, Ludvigsen TC, LaPrade RF, Engebretsen L: Demographics and injuries associated with knee dislocation: A prospective review of 303 patients. *Orthop J Sports Med* 2017;5:2325967117706521.

17. King AH, Krych AJ, Prince MR, Sousa PL, Stuart MJ, Levy BA: Are meniscal tears and articular cartilage injury predictive of inferior patient outcome after surgical reconstruction for the dislocated knee? *Knee Surg Sports Traumatol Arthrosc* 2015;23:3008-3011.

18. Wong CH, Tan JL, Chang HC, Khin LW, Low CO: Knee dislocations-a retrospective study comparing operative versus closed immobilization treatment outcomes. *Knee Surg Sports Traumatol Arthrosc* 2004;12:540-544.

19. Richter M, Bosch U, Wippermann B, Hofmann A, Krettek C: Comparison of surgical repair or reconstruction of the cruciate ligaments versus nonsurgical treatment in patients with traumatic knee dislocations. *Am J Sports Med* 2002;30:718-727.

20. Peskun CJ, Whelan DB: Outcomes of operative and nonoperative treatment of multiligament knee injuries: An evidence-based review. *Sports Med Arthrosc Rev* 2011;19:167-173.

21. Hanley J, Westermann R, Cook S, et al: Factors associated with knee stiffness following surgical management of multiligament knee injuries. *J Knee Surg* 2017;30:549-554.

22. Wajsfisz A, Bajard X, Plaweski S, et al: Surgical management of combined anterior or posterior cruciate ligament and posterolateral corner tears: For what functional results? *Orthop Traumatol Surg Res* 2014;100: S379-S383.

23. Everhart JS, Du A, Chalasani R, Kirven JC, Magnussen RA, Flanigan DC: Return to work or sport after multiligament knee injury: A systematic review of 21 studies and 524 patients. *Arthroscopy* 2018;34:1708-1716.

24. Stannard JP, Brown SL, Farris RC, McGwin G Jr, Volgas DA: The posterolateral corner of the knee: Repair versus reconstruction. *Am J Sports Med* 2005;33:881-888.

25. Mariani PP, Santoriello P, Iannone S, Condello V, Adriani E: Comparison of surgical treatments for knee dislocation. *Am J Knee Surg* 1999;12:214-221.

26. Hirschmann MT, Iranpour F, Muller W, Friederich NF: Surgical treatment of complex bicruciate knee ligament injuries in elite athletes: What long-term outcome can we expect? *Am J Sports Med* 2010;38:1103-1109.

27. Bakshi NK, Khan M, Lee S, et al: Return to play after multiligament knee injuries in national football league athletes. *Sports Health* 2018;10:495-499.

28. Ross AE, Taylor KF, Kirk KL, Murphy KP: Functional outcome of multiligamentous knee injuries treated arthroscopically in active duty soldiers. *Mil Med* 2009;174:1113-1117.

29. Barrow AE, Sheean AJ, Burns TC: Return to duty following combat-related multi-ligamentous knee injury. *Injury* 2017;48:861-865.

30. Richards JT, Dickens JF: Multiligamentous knee injuries in the military tactical athlete. *Sports Med Arthrosc Rev* 2019;27:92-98.