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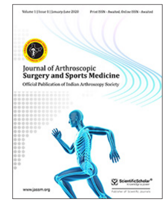

Review Article

Multiple ligament knee injuries: Clinical practice guidelines

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ABSTRACT

Multiple ligament knee injuries involve tears of two or more of the four major knee ligament structures, and are commonly noted following knee dislocations. These devastating injuries are often associated with soft-tissue trauma, neurovascular deficit, and concomitant articular cartilage or meniscus tears. The complexity of presentation, and spectrum of treatment options, makes these injuries unique and extremely challenging to even the most experienced knee surgeons. A high level of suspicion, and a comprehensive clinical and radiological examination, is required to identify all injured structures. The current literature supports surgical management of these injuries, with cruciate reconstructions, and repair/augmented repair/reconstruction of collateral ligaments. This review article analyses management principle of multiple ligament knee injuries, and formulates clinical practice guidelines with treatment algorithms essential to plan individualized management of these complex heterogeneous injuries.

Keywords: Knee dislocation, Multiple ligament knee injury, Ligament reconstruction, Clinical practice guidelines

INTRODUCTION

A multiple ligament knee injury (MLKI) is defined as one in which there is a tear of two or more of the four major knee ligament structures: The anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the posteromedial corner (PMC), and the posterolateral corner (PLC).[1] Since many knee dislocations reduce spontaneously and are associated with multiple ligament tears; multi-ligament injuries are synonymous with knee dislocations. MLKI may be secondary to high-energy trauma, such as motor vehicle accidents or fall from heights, and low-energy trauma, including sports injuries. MLKI may also occur in obese individuals as a result of ultra-low velocity trauma usually in the form of hyperextension. MLKI account for < 0.02% of all orthopedic injuries in the general population;[2] however, these are complex injuries associated with serious short-term complications such as neuro-vascular injuries, and long-term consequences such as persistent residual instability, and degenerative joint disease.[3] Over the years, the management of MLKI has evolved, but numerous treatment controversies still exist. MLKI are heterogeneous, and a thorough diagnostic workup and treatment plan is mandatory when dealing with these injuries. The purpose of this article is to review the recent literature on this relatively uncommon injury, and present clinical practice guidelines along with treatment algorithms for addressing these complex injuries.

CLASSIFICATION

MLKI are classified based on the ligaments disrupted in the process of injury [Table 1].[4] This anatomic system of classification describes the ligaments torn, and the higher the number, the more severe the injury. Determination of the ligaments torn is best done during the time of presentation or during EUA, and is useful in planning treatment. Neural and vascular injuries are also identified. This classification system ensures injury description is more accurate than the conventional positional classification system, and allows for comparison of like injuries in the wide spectrum of MLKI. This classification, however, does not include trauma to the soft-tissue envelope, extensor apparatus injuries, meniscal injuries, and chondral injuries that often decide the prognosis of MLKI.

ACUTE MLKI: CLINICAL PRACTICE GUIDELINES FOR EVALUATION AND TREATMENT

Most patients with MLKI present with a spontaneously reduced knee dislocation, though some may be dislocated on presentation [Figure 1].

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Table 1: Schenck anatomic classification system for knee dislocation and multiple ligament knee injury.

Type	Description
KD1	Knee dislocation with either cruciate intact
KD2	Bicruciate injury with collaterals intact
KD3	Bicruciate injury with one collateral ligament injury • KD3M - Bicruciate injury with medial sided ligaments injury • KD3L - Bicruciate injury with posterolateral ligaments injury
KD4	Bicruciate injury with both collateral ligament injury
KD5	Peri-articular fracture dislocation

Associated injuries: C=Arterial injury, N=Neural injury

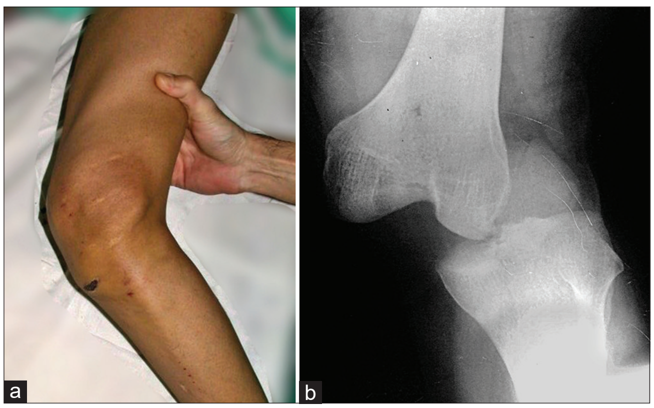

Figure 1: Clinical image (a) and radiograph (b) of an acute complex rotatory knee dislocation following a vehicular accident. An immediate reduction under GA followed by EUA revealed a KD4 multiple ligament knee injury. Surprisingly, he had no vascular or neural injury.

Clinical practice workflow for initial evaluation and management of patients who present with an acute MLKI

Emergency room protocol

- All high-velocity knee injuries should be viewed with suspicion, as these may be spontaneously reduced knee dislocations with associated neurovascular complications
- Grossly deformed limbs should be gently repositioned. This may itself reduce the dislocated joint. Formal reduction of the joint should be avoided prior to confirming the radiographic status of the knee, unless the deformity is severely compromising the skin and soft tissues
- Vascularity and neurological status of the limb should be evaluated
- An immediate radiograph should be performed to confirm the diagnosis, understand the type of knee dislocation, and determine the presence of an associated fracture.

Immediate reduction

- A knee dislocation warrants reduction on an emergency basis preferably under anesthesia
- Traction followed by gentle extension is often all that is required to achieve reduction; however, this is dictated by the type and direction of dislocation
- Following reduction, a detailed examination under anesthesia of knee ligament stability should be performed. The Lachman's test (ACL), posterior sag and posterior drawer test (PCL), valgus stress test (MCL), varus stress test (lateral collateral ligament [LCL]), and dial test (PLC) usually suffice in the acute setting. Tests which involve a greater degree of knee manipulation are unnecessary and best avoided
- If the knee is not grossly unstable and there is no indication for emergency intervention, the knee is immobilized in full extension in a long knee brace
- If the knee is extremely unstable, with a tendency to redislocate following reduction, then temporary external fixation may be warranted
- At times, the knee may require immobilization in flexion to avoid anterior tibial subluxation in anterior knee dislocations, or to avoid posterior tibial subluxation due to an incompetent posterior capsule.[5]

Post-reduction protocol

- Post-reduction antero-posterior and lateral radiographs are mandatory to confirm joint reduction, identify avulsion fractures around the knee, and assess the need for associated fracture surgery
- MRI is the imaging investigation of choice in knee dislocations and helps determine the extent of injury to soft tissues, ligaments, and muscle-tendon units.[6] MRI significantly aids in surgical planning and should be done early in the treatment process
- A CT scan may be useful for detailed characterization of fracture dislocations
- Stress radiography may be considered in select cases to document the extent of ligamentous laxity
- Regular monitoring of the distal pulsations and ankle brachial index (ABI) should be done in the acute setting for at least 72 h [Figure 2]. Although asymmetry of distal pulses, or fall of ABI below 0.9 is an absolute indication for angiography, many centers advocate routine vascular studies for any multiple ligament injured knee.

Emergency surgical intervention in the acute phase after MLKI

Acute MLKI are heterogeneous injuries, and a number of factors need to be considered when formulating a definitive treatment plan. These include condition of the soft-tissue envelope and presence of open injuries, neurovascular status, combination of ligaments torn, associated fractures, and concomitant intra-articular injuries to bone, articular cartilage, and meniscus. Individualized management after thorough assessment of all factors is key to achieving a good result in these complex injuries. Some situations will warrant emergency surgical intervention in the acute phase and the indications for this are described as below.

a. Vascular injuries: If dorsalis pedis and posterior tibial artery pulsations are not palpable (and confirmed to be absent on hand-held Doppler examination) despite reduction of knee dislocation, an immediate CT angiography is performed. Based on the type of vascular injury detected, arterial repair or bypass grafting may be necessitated [Figure 3]. Four compartment fasciotomy and a temporary joint spanning fixator may be required under such circumstances
b. Open knee dislocations: Immediate lavage, closure or soft-tissue cover under drains, immobilization, and antibiotic cover are required for these orthopedic emergencies. Extra-articular repair may be attempted, if the wound is clean after debridement. External fixators need to be applied so as not to interfere with future tunnel placement for ligaments and a margin of 10 cm above and below the joint line is preferable.[7] The external fixator is removed once acceptable healing of soft tissues or vascular repair is achieved
c. Irreducible knee dislocation: Incarceration of soft tissues or bone may cause irreducibility in a knee dislocation. MCL invagination into the joint causing medial femoral condyle buttonholing in a posterolateral knee dislocation is well described [Figure 4]. Popliteus muscle interposition causing irreducibility has also been described.[8] Displaced intra-articular fractures, or incarcerated large bony avulsions of ligaments may also cause irreducibility in a KD5 type of injury. All irreducible knee dislocations warrant urgent open reduction with repair of all extra-articular ligaments and avulsed cruciate ligaments
d. Extremely unstable knee: A temporary joint spanning external fixator would be indicated for knee immobilization till soft-tissue healing is achieved in this clinical situation
e. Unstable fracture dislocations: These often warrant immediate reduction and fracture fixation to prevent vascular and soft-tissue complications
f. Compartment syndrome: Immediate release of all four leg compartments.

Figure 2: The ankle brachial index (ABI) is calculated by taking the ratio of (a) the systolic blood pressure in the injured limb at the ankle measured by a Doppler probe to (b) the systolic arterial brachial blood pressure in the uninjured upper limb. (ABI = systolic blood pressure in the injured limb/systolic blood pressure in the uninjured upper limb). Any fall of the ABI below 0.9 is an indication for angiography.

Approach in acute MLKI associated with vascular injuries

Patients of acute MLKI with associated vascular injuries are special clinical scenarios and the incidence of vascular injury in knee dislocations has been reported from 18%[9] to 64%.[5] In the series with 64% incidence, 80% patients underwent a vascular repair, and 12% underwent an amputation. Most amputations were as a consequence of failed repair or an infection. KD3L is associated with the maximum incidence of vascular injury (32%).[5] Patients with an open injury and increased BMI have a higher association with a vascular injury.[10] In general, sports dislocations have a lower rate of vascular injury as compared to the high velocity injuries.[11]

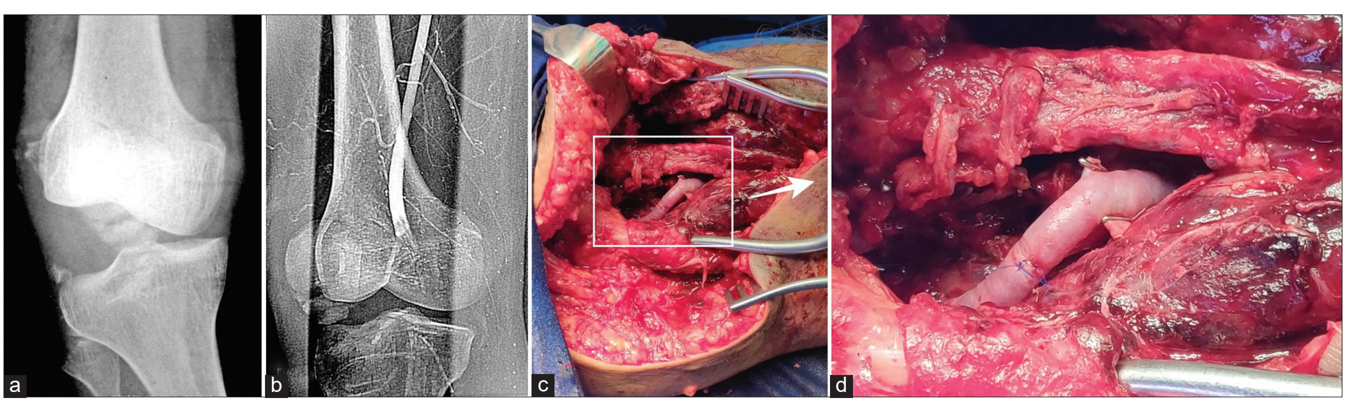

Figure 3: (a) Acute multiple ligament knee injury following a vehicular accident with absent distal pulsations. (b) Emergency intra-operative arteriogram confirmed popliteal artery injury. (c) The patient immediately underwent vascular surgery with (d) popliteal artery anastomosis. The arrow denotes that (d) is the magnified view of the central marked part of (c).

Figure 4: Irreducible knee dislocation. (a and b) Prereduction AP and lateral radiographs reveal a posterolateral knee dislocation. A reduction under GA was then attempted. The clinical image following reduction (c) reveals a persistent prominent medial femoral condyle with classical transverse furrow (arrow). (d) The post-reduction radiograph confirms incomplete reduction of the knee joint. This is a complex dislocation in which the MCL invaginates into the knee joint (e) (arrow), and the medial femoral condyle button-holes through the medial capsule (f), preventing closed reduction (g).

The most common vascular injury involves the popliteal artery. This is due to the popliteal artery being tethered proximally at the adductor hiatus and distally at the soleus arch. Early detection and treatment of vascular insult are critical as the rate of amputation following intervention within 8 h is 11%, and a delay beyond 8 h results in an amputation rate of 86%.[12] Despite early vascular intervention, residual amputation rates after surgery are 10%.[13] Patients with palpable dorsalis pedis and posterior tibial pulse with ABI of 0.9 or greater are found to have a sensitivity of 100% to rule out vascular injury. However, even these patients need to monitor for at least 72 h to rule out delayed thrombosis and vascular insult. Some authors propose routine angiography for all MLKI to prevent missing small intimal tears that may lead to delayed thrombosis and disastrous complications. However, angiography is an invasive procedure with its associated risks, and studies have shown that selective angiography is adequate,[14] and only patients with either asymmetric pulsations or ABI <0.9 need further vascular evaluation. CT angiography is 100% sensitive and specific[6] while being less invasive and involves lesser radiation than a conventional arteriogram.[15] MR angiography is also equally accurate[16] without the risks of radiation and can be performed in the same sitting as the knee MRI.

A patient with traumatic popliteal artery injury should undergo limb revascularization on an emergency basis. Arterial repair for short segment injuries and interpositional grafts for long segment injuries are often needed.

Approach in acute MLKI associated with nerve injuries

The common peroneal nerve is the most commonly injured nerve in knee dislocations [Figure 5], with a general incidence of 14–25%, and as high as 41% in MLKI with PLC injuries.[17] Unlike vascular injuries which are rare in sports knee dislocations, peroneal nerve injuries attributed to sports specific knee dislocation are reported, with skiing and football being the most common sports.[18] Approximately 30% of cases have a complete neurological palsy, and the rest have a partial peroneal nerve palsy.[19] Functional recovery is noted in only 38.4% patients with a complete palsy, and 87.3% patients with incomplete palsy.[20] Treatment options include ankle-foot orthotic support, neurolysis, tendon transfer, nerve transfer, and combined nerve/tendon transfer.[21]

Elective surgical intervention in the acute phase after MLKI

In patients with an acute knee dislocation that has been reduced and observed, or patients who present after 72 h of injury with a spontaneously reduced knee, concerns over vascular injury are diminished. Patient evaluation is now concentrated over the ligaments injured, the soft tissue condition, and to rule out deep vein thrombosis and neurological injury. A detailed radiological evaluation including radiographs, MRI, and if necessary a CT scan is indicated if not already performed.

The principles of the treatment of MLKI include identification and treatment of all torn ligaments with surgical repair or reconstruction, followed by a supervised rehabilitation program. A high incidence of concomitant meniscal and focal cartilage injuries are noted in MLKI, and early repair of these is critical to ensure a good long-term outcome. [Figure 6] describes the different approaches commonly used to treat an acute MLKI in an elective manner. A single stage surgery with repair or reconstruction of all torn collateral and cruciate ligaments may be appropriate for an acute high grade injury in a young patient capable of extensive supervised rehabilitation [Figure 7]. In all others, it may be safer to consider staged treatment – either initial non-operative treatment followed by subsequent reconstruction of all residual ligament deficiencies, or acute stage open repair of collaterals and extensor apparatus followed by second stage arthroscopic bicruciate reconstruction.

The complex anatomy of the knee with wide variation in severity and extent of injury, coupled with various treatment protocols, and multiple outcomes scores reported in literature, has resulted in controversies in treatment in MLKI.

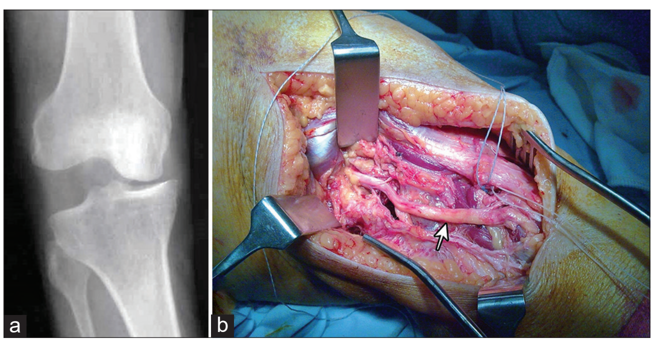

Figure 5: Acute multiple ligament knee injury with PLC tears (a) are commonly associated with peroneal nerve injury. While performing PLC ligament reconstructive surgery (b), the peroneal nerve (arrow) is dissected and a neurolysis is performed if nerve continuity is noted.

Operative versus non-operative

Systematic reviews and meta-analyses[22,23] reveal that surgical treatment results in better functional outcomes as compared to non-operative treatment with IKDC excellent and good results being 58% versus 20%, respectively. However, the mean range of motion (126° vs. 123°) and flexion loss (4° vs. 3°) is comparable in both the groups.

Early versus late surgery

Although the optimum time to perform MLKI surgery is a topic of debate, most surgeons prefer to perform this before 3 weeks to better identify anatomy before scarring and tissue necrosis affect outcomes. This is also essential for bony avulsion of ligaments. Patients undergoing surgery within 3 weeks of injury have been shown to have higher return to sports as compared to those who undergo surgery in the chronic stage (mean 51 weeks). However, the functional outcome scores reported are similar in both the groups.[22]

Repair versus reconstruction

Although a systematic review found no difference between outcomes of repair and reconstruction for MLKI,[22] PLC ligament repair is reported to have a higher failure rate than PLC reconstruction (37% vs. 9%), and return to sports is higher with reconstruction than repair (51% vs. 23%).[24] Similarly, another study demonstrated that while the functional outcome scores were similar in ligament repair and reconstruction, patients who underwent repair had a greater flexion loss, posterior sag, and lower return to pre-injury activity level.[25] However, en masse repair of lateral side structures in multi-ligament injuries has reported a 81% return to sports rate at a mean follow-up of 55 months with excellent functional outcomes.[11] When allografts are available, it may be preferable to choose reconstruction over repair; however, when multiple autograft options are limited especially in acute KD 4 situations, it may be prudent to primarily repair the collateral ligaments and preserve

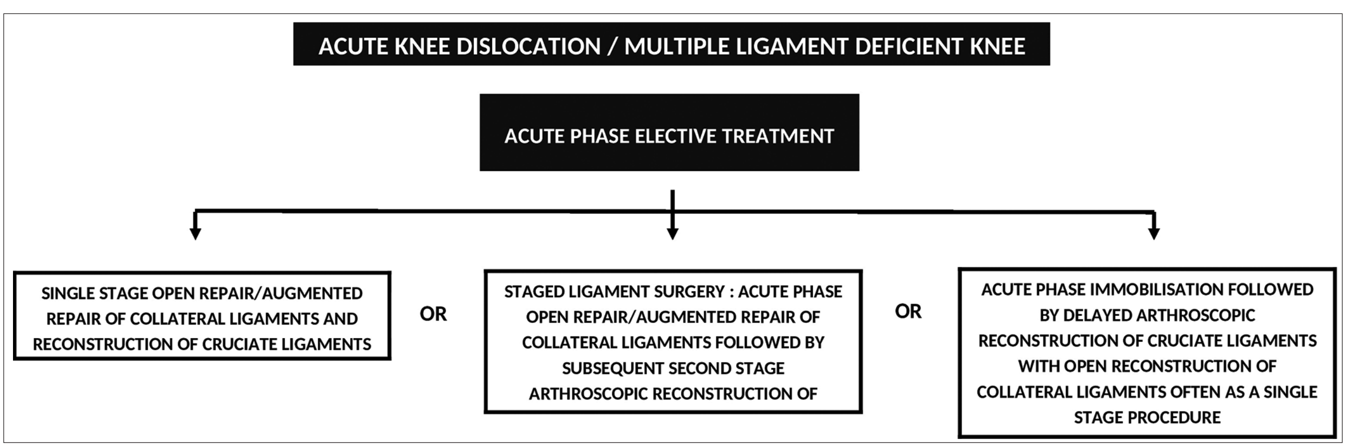

Figure 6: The surgical options for ligament repair and reconstruction in acute multiple ligament knee injury.

Figure 7: (a) A young male cricketer sustained a varus-hyperextension injury (arrow) to his left knee while fielding. (b) Severe ecchymosis is noted along the posterolateral aspect of the left knee and leg. Clinical examination reveals ACL laxity along with (c) grade 3 laxity of the LCL, and (d) posterolateral rotatory instability of the knee on dial test. MRI confirms ACL tear (arrow) (e), normal PCL (f), and avulsion of the LCL and biceps tendon from fibula (arrow) (g, h). (i) EUA with stress radiography prior to surgery confirms grade III laxity of LCL (arrow). The patient underwent a single stage arthroscopic ACL reconstruction (arrow) (j), with open PLC repair (arrow) (k), which constituted primarily suture pull-through fixation of LCL and biceps tendon avulsion (l).

autograft options for same stage or subsequent cruciate reconstruction.

Early simultaneous repair versus staged repair and reconstruction

While early surgery has been shown to give better results, there has been debate whether the procedure should be staged, or whether all ligaments should be repaired and reconstructed initially itself. Patients who undergo early simultaneous repair or reconstruction of three or more ligaments are at higher risk of knee stiffness after surgery. A systematic review has reported that staged repair gives better clinical outcomes (79.1%) than simultaneous ligament surgery in acute cases (58.4%) and chronic cases (45.5%), with no difference between KD3M and KD3L knees.[26] In a study on staged reconstruction of multiligament injuries 70% patients had an IKDC score of A or B.[27]

Staged surgery includes collateral ligament repair and/or reconstruction within 3 weeks of injury, followed by supervised rehabilitation for 4–6 weeks. Once knee range of motion is achieved beyond 120°, second stage arthroscopic bicruciate reconstruction is performed. The advantages of staged surgery include shorter operative time, decreased chances of infection, and decreased chances of arthrofibrosis.[28,29] However, staging the reconstruction can potentially alter joint kinematics, and increase the risk of graft failure.[30,31]

CHRONIC MLKI: CLINICAL PRACTICE GUIDELINES FOR EVALUATION & TREATMENT

Patients may present >6 weeks following the injury with a reduced knee dislocation and multiligament instability, or rarely with a chronic unreduced knee dislocation. The treatment algorithm for these cases of chronic MLKI is elaborated in [Figure 8]. In the chronic multiple ligament deficient knee (with joint reduction), assessment of single-stance limb alignment in both the coronal and sagittal plane is important. For patients in whom limb alignment is normal, a single-stage arthroscopic bicruciate reconstruction with medial-sided and or PLC reconstruction is indicated. Patients with limb malalignment (commonly varus malalignment in a PCL-PLC deficient knee) should undergo corrective osteotomy (usually with slope modification) in the first stage, before any subsequent ligament reconstruction. Reconstructed PLC grafts do not tolerate varus malalignment, and the excessive biomechanical loads tend to stretch the graft and fail with time. Increasing tibial slope reduces tibial sag in a PCL deficient knee, whereas decreasing tibial slope has a protective effect on the ACL-deficient knee.[32] Often limb alignment with slope correction itself is sufficient to afford functional knee stability in low-demand individuals.[33] In patients with residual instability following corrective osteotomy, a second-stage ligament or multiple ligament reconstructive surgery may be warranted.

Chronic unreduced knee dislocations are usually missed injuries in a polytrauma patient and are extremely rare. These cases are challenging since achieving joint mobility with stability warrants complex techniques including open reduction, hinged external fixator application, with or without staged ligament reconstruction, and prolonged rehabilitation. Complete circumferential capsular release and scar tissue excision are required to reduce the chronically dislocated knee. To prevent extensive arthrofibrosis, early mobilization with a hinged external fixator that helps maintain the reduction and reestablish stable anatomic range of motion is mandatory.[34] Moreover, if ligament reconstruction is planned at the same stage, a hinged external fixator is critical to prevent increased stress on the grafts.

SURGICAL PRINCIPLES

A comprehensive knowledge of knee ligament anatomy and biomechanics, astute surgical planning, careful operative execution, close post-operative monitoring, and a phased rehabilitation program are critical for a good surgical outcome.

Surgical technique

Anatomic ligament reconstructions that are biomechanically and clinically validated are performed. The surgical technique uses both autografts and allografts depending on the ligaments injured and graft availability. We prefer arthroscopy prior to the open surgical approach; however, surgical speed and low fluid pressure are important to limit fluid extravasation into the open surgical site. Arthroscopic tibial and femoral tunnels are reamed for anatomic double-bundle PCL and single-bundle ACL reconstructions, and passing sutures are placed. Concomitant meniscal and chondral lesions are then addressed. This is followed by open approaches to the posterolateral and PMC with creation of femoral, tibial, and fibular sockets for anatomical reconstruction of LCL, popliteus tendon, popliteofibular ligament, superficial MCL (sMCL), and posterior oblique ligament (POL). Once all tunnels are created, cruciate ligament followed by collateral ligaments are passed.

Tunnel placement and convergence

Tunnel placement in cruciate and collateral ligament reconstructive surgery is critical for anatomical restoration since this allows adequate stability and full range of motion. Tunnel malposition and graft impingement are the most common reason for failure in MLKI surgery. Surgeons should be aware of the exact anatomical insertion site for each ligament being reconstructed and plan tunnel orientation so as to avoid convergence or hardware. Vertical femoral tunnels in ACL reconstruction provide suboptimal rotational stability, whereas anterior tibial tunnels cause notch

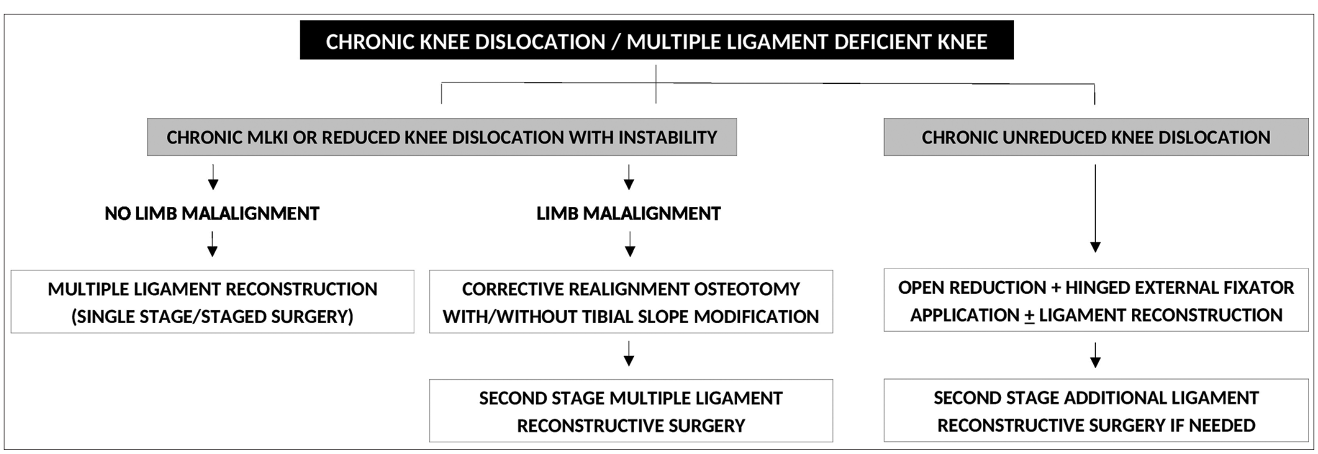

Figure 8: The surgical algorithm for chronic knee dislocations and multiple ligament knee injuries.

impingement and loss of extension. In PCL reconstruction, a high tunnel aperture on the posterior tibia will lead to suboptimal lever arm and potential graft failure.

Drilling multiple tunnels, especially in the distal femur, raises the potential risk of tunnel convergence which may result in graft damage, fixation impairment, and reconstruction failure. This is most often encountered in the lateral femoral condyle when performing ACL and PLC combined ligament reconstruction, in the medial femoral condyle when performing combined PCL and MCL ligament reconstruction, and in the tibia when performing combined bicruciate and collateral reconstruction. To prevent such complications, surgeons should be well versed with published data providing recommendations for reducing the risk of convergence in the multiple ligament reconstructed knee.[35,36] In combined PCL-MCL reconstruction, the POL tunnel should be aimed to a point 15 mm medial to Gerdy's tubercle to reduce risk of convergence with the PCL, and the sMCL tunnel should be aimed 30° distally to avoid convergence with the PCL. In combined ACL-PLC reconstructions, a 40° angulation in the axial plane and 0° in the coronal plane while performing the LCL and popliteus tunnels avoids tunnel convergence with the ACL tunnel. There are special aiming jigs available for extra-articular ligament reconstruction that can plan tunnel trajectories that avoid co-existing tunnels. In cases of doubt, and especially in revision situations, intraoperative fluoroscopy can be helpful for correct tunnel placement.

Graft tensioning sequence

The position of the knee and sequence in which each graft is tensioned and fixed is critical to achieve good stability and full range of motion in MLKI surgery. The tensioning sequence is a topic of debate, and different sequences have been reported in the literature. The sequence we normally follow in tensioning and fixing grafts for multiple ligaments reconstruction, and the rationale for the same is: (1) PCL double bundle graft passed, (2) ACL single-bundle graft passed with suspensory femoral fixation, (3) PCL double-bundle grafts fixed on femur and tibia, (4) PLC grafts passed and fixed, and (5) ACL tensioning and tibial fixation (6) sMCL and POL grafts passed and fixed.[37] The PCL is tensioned and fixed first, since this is the central pillar of the knee, and fixing this reduces the knee, restores the central pivot with tibial step-off, and achieves the basis for anatomical reduction of subsequent ligaments. If a single-bundle graft is used, tension the graft at 90°, whereas if a double-bundle graft is used, tension the AL bundle at 90°, and the PM at 0°. With a very unstable knee, or especially with anterior knee dislocations, anatomical reduction should be confirmed with a C-arm image prior to PCL graft fixation. The PLC is fixed next, since integrity of PLC is a critical prerequisite for tibiofemoral rotational orientation when an ACL graft is tensioned. In a PLC deficient knee, tension during fixation of the ACL graft increases external tibial rotation of the tibia.[38] We normally fix both the femoral LCL and femoral popliteus first, and the tibial tunnel last. The knee is kept in 30° of flexion with valgus force during tightening and fixation. The already passed ACL with femoral suspensory fixation is fixed on the tibia next. The graft is tensioned at 30° of knee flexion in neutral rotation. This achieves the 4-bar cruciate linkage system. The sMCL and POL are tensioned and fixed last. The sMCL is tensioned in 30° of flexion with varus corrective force to close knee joint of any possible medial opening. The POL is tensioned and fixed in full extension because this is when the POL is tightest in a normal knee. Although there is a lack of scientific data to back this exact sequence, to us, this is the most logical and scientific way to go about it.

Rehabilitation

MLKI are complex and challenging pathologies to rehabilitate due to the extensive soft tissue damage and the different injury patterns that can occur. An appropriate diagnosis and treatment of all the damaged structures is vital for a successful outcome. Reconstruction of all injured ligaments and repair of soft-tissue structures such as the meniscus or cartilage are recommended to aid in early mobilization and to avoid joint stiffness or graft failure. A well-crafted rehabilitation plan after a MLKI reconstruction should focus on graft protection and functional outcomes including regaining motion, strength and function. Post-operative recovery after MLKI surgery typically requires 9–12 months of rehabilitation before returning to full activities. This allows proper time for the grafts to incorporate and to heal in order to prevent reconstruction graft failure. Use of a dynamic PCL brace in the rehabilitation period and in the 1st year of returning to activities is recommended to protect the reconstruction.

OUTCOMES FOLLOWING MLKI TREATMENT

Nonsurgical management of MLKI has poor outcomes, whereas good functional outcomes are reported in short to medium follow-up after surgical treatment of MLKI.[1,39] In a follow-up of 85 patients with knee dislocations at 2–9 years, improved patient reported outcomes with a mean Lysholm of 83, median Tegner Activity score of 5, and mean IKDC 2000 subjective score of 64 have been reported.[39] However, 87% of the patients in the cohort had radiological osteoarthritis in the injured knee. Another study reported a mean Lysholm score of 84, Tegner score of 4, and subjective IKDC 73 in a follow-up of 65 patients with multiligament knee injuries at a minimum follow-up of 10 years.[40] About 42% of the cohort had radiological osteoarthritis in the injured knee compared with only 6% in the uninjured knee. Good functional outcomes have also been reported by other authors.[41-45] Despite good functional scores, several studies report relatively high prevalence of radiographic osteoarthritis ranging from 23% to 87%.[39,43,45] Certain factors have been reported to correlate with poor outcomes including high-energy trauma,[39] repair of medial side injury,[46] age >30 years,[47] concomitant cartilage injury,[48] combined medial, and lateral meniscal tears.[48]

CONCLUSION

The management of multiple ligament knee injuries is challenging and should not be undertaken without an astute appreciation of all the factors concerned. The principles of treatment of MLKI include identification and treatment of all torn ligaments with accurate tunnel placement at anatomic graft insertion sites, utilization of strong graft material, secure graft fixation, and supervised rehabilitation. Failure to identify and treat all injured structures appropriately can lead to alterations in knee kinematics, poor functional outcomes, increased risk of graft failure, and post-traumatic osteoarthritis. Although it would be ideal to treat all the injured structures in a single-surgery in the sub-acute phase, to facilitate early rehabilitation and better restoration of knee function, this may not be possible in every situation. A thorough understanding of the clinical practice guidelines, along with proper application of the treatment algorithms presented, should facilitate an individualized approach necessary to treat these heterogenous injuries. Good functional outcomes with normal knee stability and range can be achieved after surgical treatment of these injuries; however, attention to operative details and compliance during rehabilitation is paramount.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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