Review Article | Asian Journal of Arthroscopy | 2020 January-April ; 5(1): 14-19.

Primary repair in acute multiligament knee injury

Anshu Shekhar[1], Siddharth Reddy[1], Sachin Tapasvi[1]

Abstract

Acute multilagment knee injuries (MLKI) are those in which more than two ligaments are injured and which present within a period of three weeks. Treatment of life threatening conditions, neurovascular injuries, peri-articular fractures and irreducible dislocations take precedence over ligaments in setting of an acute MLKI associated with or without knee dislocations. There is no consensus or well defined guidelines regarding management of these complex injuries. For medial sided injuries, early repair for avulsions with good tissue quality and reconstruction for mid substance tears or poor tissue quality is a reasonable approach. Early repairs of posterolateral corner structures have had good functional outcomes but failure rates of such repairs are higher compared to a reconstruction. Better stability and better knee range of motion have been reported in knees with cruciate reconstructions than repairs in an acute setting. Primary suture repair in indicated low demand patients has shown promising outcomes. However, the risks of arthrofibrosis and revision surgery must be explained to the patients undergoing and arthrotomy for cruciate repairs. Use of synthetic augmentation seems reasonable although there is no strong science to support this presumption. A comparative study between homogenous injury groups would perhaps shed more light on the relevance of repair or reconstruction in acute surgery for MLKI.

Keywords: Knee dislocation, Multiligament knee injury, Acute, Ligament repair, Ligament reconstruction.

Introduction

The spectrum of knee dislocation (KD) can involve injury to the ligaments, cartilage, bone and soft tissue envelope of the knee or vital structures like the popliteal artery and common peroneal nerve. If the patient has concomitant injuries of other vital organs like a head or chest trauma, the management of such potentially life-threatening conditions take precedence over the knee. However, the presence of a vascular injury or nerve injury very often necessitates surgical intervention in the acute phase to salvage the limb. Similarly, an irreducible knee dislocation also requires early surgery to reduce the joint and perform an external fixation as part of early stabilization, with or without ligament surgery. Peri-articular fractures in association with knee dislocation also need to be treated on an emergent basis. Another unusual injury which always requires surgery on an urgent basis is a disruption of the extensor apparatus of the knee- either a patella tendon rupture or a quadriceps tear. (Fig. 1) Surgery for treatment of ligament injuries comes next in the sequence when planning early surgical intervention.

Surgery for the ligaments, whether repair or reconstruction, in the acute period has been a subject of much debate and discussion. In fact, there is no consensus on the time point for classifying a surgery or injury as acute or chronic [1]. It has been proposed that 3 weeks be the cut-off to label a surgery as acute, because beyond this time, the tissue planes become less defined due to scarring and this can impact the outcome [2, 3]. However, Geeslin et al., in their case series of "acute" management of grade 3 posterolateral corner injuries, included patients who had trauma in the preceding 6 weeks [4]. Therefore, an "acute" case of knee dislocation is somewhere up to 3 to 6 weeks after injury. It has been reported that early surgery within 2 weeks of injury yields better outcomes in terms of overall return of knee function, activity level and anterior stability [5]. Further, the superior clinical results of acute one stage surgery for all injured ligaments does not depend on which collateral structure (medial or lateral) is injured [6].

This narrative review explores the current status of ligament surgery in the acute or early stage. The injured structures can either be repaired end to end or to the bony attachments with sutures; or they may be reconstructed with grafts of any kind. We shall discuss what the published literature recommends with regards repairing the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), Posterolateral corner (PLC) and Posteromedial Corner (PMC) in a multiligament knee injury (MLKI) setting.

Indications and Technique of Repairs

There are several described techniques to reconstruct the ACL, PCL, PLC and PMC (including the medial collateral ligament), with autograft, allograft and/or synthetic materials. The methods of repairing these torn ligaments with sutures are even more variable. There is general agreement that bony avulsions of any of these ligaments are amenable to fixation/repair. Rarer still is the presence of scientific data evaluating the outcomes of such suture repairs, especially in the presence of MLKI of a homogenous type.

1. Medial Side Injuries:

The posteromedial structures of the knee, including medial collateral ligament and posterior oblique ligament, have a propensity towards natural healing. Hence, isolated tears

[1]The Orthopaedic Speciality Clinic, Pune, India

Address of Correspondence:
Dr. Anshu Shekhar,
The Orthopaedic Speciality Clinic, Pune, India
E-mail: dr.anshushekhar@gmail.com


Dr. Anshu Shekhar


Dr. Siddharth Reddy


Dr. Sachin Tapasvi

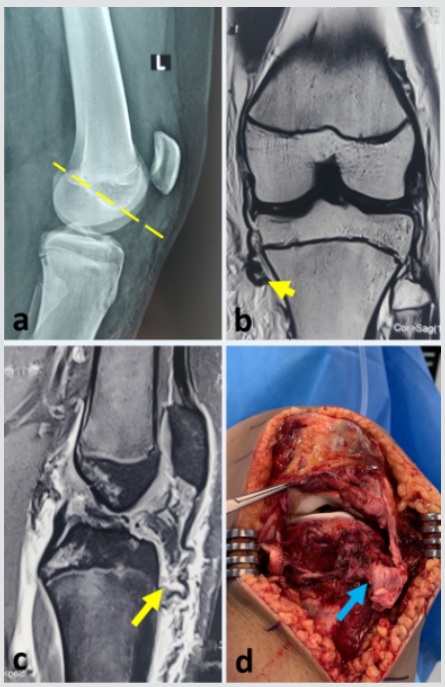

Figure 1: A case of KDIV Injury with Patella Tendon Rupture. (a) Lateral radiograph in 30^0 knee flexion showing the Blumensaat line (yellow). The patella is riding higher, instead of touching the line at its lower pole. This is indicative of patella alta secondary to a patella tendon rupture. (b) MRI scan T2-weighted coronal section showing tibial sided avulsion of MCL (yellow arrow). (c) MRI scan Proton density fat-saturated sagittal section showing disruption of the patella tendon close to the tibial tuberosity (yellow arrow). (d) Intra-operative image of the same patient showing a complete tear of the patella tendon (blue arrow), along with injury to the MCL, medial retinaculum and capsule.

and grade I and II tears can be managed non-surgically in most cases [7]. However, high grade tears of the posteromedial corner which cause valgus opening in extension or grade 3 tears of the meniscotibial component of MCL heal poorly. These may result in residual valgus and/or rotational laxity [8]. A MRI study to assess medial injury patterns in MLKI revealed that at least one structure of PMC was injured in 81% cases, while injury to superficial MCL was seen in 63% cases. Further, those with injuries to posterior horn of medial meniscus always had a tear of the meniscotibial ligament and tear of the posterior oblique ligament [9]. Acute grade 3 tears which co-exist with other ligament(s) and meniscal tears are preferably managed surgically [10]. Females and obese patients who sustain these injuries as a result of ultra low velocity trauma have been reported to have poorer outcomes in one series. In this cohort, medial sided injuries were managed

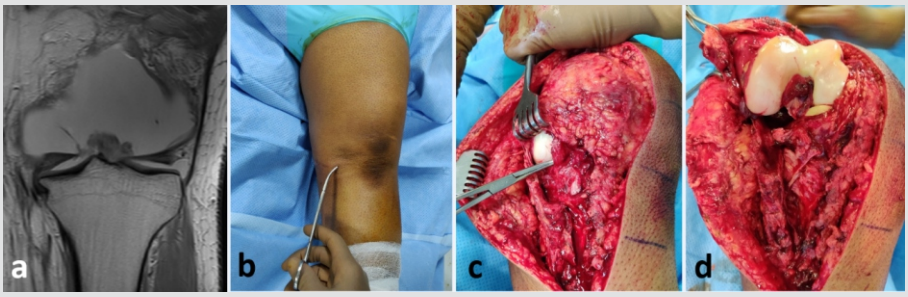

Figure 2: Stener type lesion. (a)MRI scan T2-weighted coronal image showing the distally torn MCL flipped into the joint. (b) Clinical picture of the same patient who did not have a congruent reduction due to the incarcerated tissue seen as a dimple on the medial side. (c) The torn tissue was found stuck between the medial femoral and tibial condyles. (d) Removal of the incarcerated MCL enabled reduction but gaping of the medial joint space is seen.

based on injury pattern and not randomized. Femoral injuries were conserved, mid-substance repaired using semitendinosus tendon by the Bosworth technique and tibial avulsion or Stener lesions were repaired using suture anchor or screw and spiked washer [11].

There is scant literature directly comparing repair versus reconstruction for PMC in a multiligament injured knee. A nuanced approach to either repair or reconstruct the tear based on the injury pattern has been suggested. Distal based tibial avulsion or presence of a Stener-type lesion with incarceration of MCL within the joint, are amenable to repair [12](Fig. 2). Kovacevich et al performed a systematic review to analyze the operative outcome of surgery for medial injuries in MLKI. It included five studies of MCL repair and three studies of reconstruction and all these were level IV studies. Satisfactory results were reported in patients who were treated by either strategy as assessed by patient reported outcome measures and laxity on stress radiography [13]. However, this systematic review is more than a decade old. Stannard et al. compared the results of repair and reconstruction in 73 dislocated knee with PMC tears in a non-randomized study. Direct repair was performed using suture anchors for patients with femur or tibial avulsions, having good tissue quality and operated within 4 weeks of injury. The failure rate was 20% in the repair group compared to 4% in the reconstruction group and this difference was statistically significant. However, the number of patients who returned to pre-injury activity level was similar in both groups. One-fifth patients in both groups developed arthrofibrosis [14]. Thus, patients with MLKI and grade 3 medial injuries must be treated surgically. Early repair for avulsions with good tissue quality (Fig. 3) and reconstruction for mid-substance tears or poor tissue is a reasonable approach. It is worthwhile to protect the repair from stretching out by augmentation with a tendon graft or synthetic tapes and permit earlier range

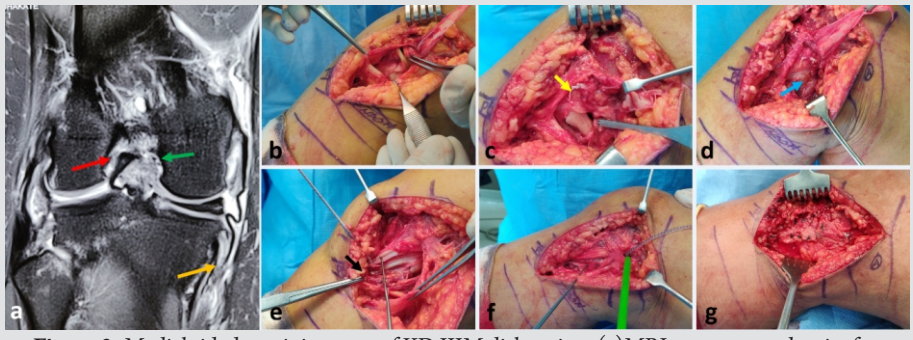

Figure 3: Medial sided repair in a case of KD IIIM dislocation. (a)MRI scan proton density fat-saturated coronal section showing disruption of the ACL (red arrow), PCL (green arrow) and distal MCL (yellow arrow). (b) Complete tear of superficial MCL, deep MCL (meniscotibial fibers) and posterior oblique ligament. (c) The repair proceeds deep to superficial. The deep MCL is repaired first using suture anchors (yellow arrow).(d) The posterior oblique ligament is repaired to its attachment on the tibia using a suture anchor (blue arrow).(e)The superficial MCL is the re-attached 6 mm distal to the joint line using another suture anchor (black arrow). (f)Augmentation the repair in this case has been done using synthetic tape and a knotless suture anchor to protect the repair in early rehab. (g) The Sartorius fascia is finally suture back to complete the repair.

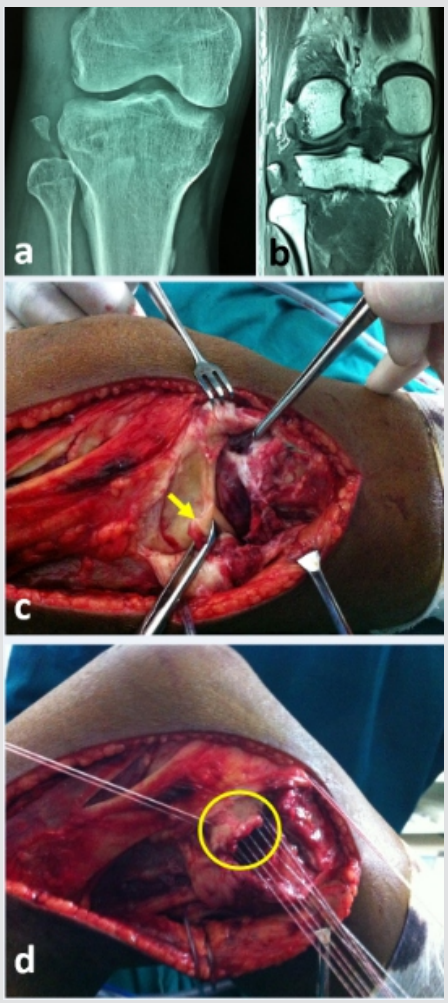

Figure 4: Repair of posterolateral corner structures.(a) Plain anteroposterior radiograph showing an avulsion of fibula head which contains attachments of the fibular collateral ligament (FCL) and biceps tendon. (b)MRI scan T2-weighted coronal image showing the osseous fragment with attached FCL. (c)Lateral exposure showing the avulsed FCL (yellow arrow). (d) En-masse trans-osseous repair (yellow circle) of all bone and ligaments was performed.

of motion. Augmentation of repair with suture tapes for both superficial MCL and posterior oblique ligament has been shown to restore valgus and rotary laxity close to the native state. This technique also reduces strain on the ACL [15]. Primary repair and FiberTape® augmentation by a mini-open technique, using 2 incisions at proximal and distal MCL insertions has also been described. This technique causes lesser surgical trauma and will likely cause lesser stiffness [16].

2. Lateral Side Injuries:

The posterolateral corner (PLC) of the knee includes the fibular collateral ligament (FCL), popliteus tendon, popliteofibular ligament and the posterolateral capsule. These structures are injured in 43%-80% of all knee dislocations. The decision to repair or reconstruct the PLC would depend on the timing of surgery and pattern of tear [17]. Early surgery is especially important at this site prior to formation of scar tissue which precludes safe common peroneal nerve isolation, besides making a repair difficult in this "lax" area of the knee. Shelbourne reported the outcomes of "en masse" repair of the lateral structures in their cohort of 21 patients after 5.6 years. The mean IKDC score was 91.3 and modified Noyes score was 93, but the scores were higher for patients operated within 4 weeks of injury. Stress radiography revealed increased lateral opening of 1.1 ± 1.7 mm and MRI demonstrated that the lateral structures were thickened but intact [18]. Geeslin and LaPrade have advocated a hybrid approach to manage grade 3 PLC injuries. They recommended a direct repair with suture anchors or recess technique, if the structures were avulsed from bone and could be reduced to their native insertion with the knee in full extension. However, for all mid-substance tears or if the tissue was stretched, reconstruction with auto or allograft was performed. The subjective outcome scores and laxity on stress radiography significantly improves using this method of treatment in all patients [4]. A bony avulsion of the FCL from the fibula head and soft tissue peel off lesion are amenable to repair with a screw/K-wire or suture anchor (Fig. 4).

There are at least two good quality published studies comparing repair versus reconstruction for acute PLC injuries [19, 20]. Levy et al. performed a retrospective study to compare the outcomes of early PLC repair followed by staged cruciate reconstruction versus only reconstructions for all ligaments in a MLKI cohort. They noted a 40% failure rate of PLC repairs requiring a revision reconstruction. Their regression analysis did not show any co-relation with timing of surgery, severity of injury or location of the FCL/PLC tear [19]. A similar failure rate of 37% for PLC repair has been reported by Stannard, when comparing it with reconstruction. The difference in stability on clinical examination was significantly greater in the reconstruction compared to the repair group [20]. McCarthy et al. have on the other hand, reported no difference between these techniques in terms of patient reported outcome measures or laxity on stress radiography and much lower failure rates. However, almost half of the patients who underwent a repair within 3 weeks of injury, had a distally based avulsion. Repair was recommended for such injuries due to favorable outcome [21]. A recent prospective multicenter study has evaluated the 6 years outcomes of concurrent ACL reconstruction and either PLC repair or reconstruction. PLC repairs were performed after a median 19 days of trauma while reconstruction was done after 121 days. There was no functional difference between the 2 groups. Interestingly patients who had a PLC reconstruction had lower activity scale scores [22].

3. Cruciate Ligament Injuries:

The results of operative treatment of ACL and PCL injuries are reported to be superior to conservative treatment. Surgery is necessary to provide sufficient stability to permit early functional rehabilitation. Trans-osseous repair of avulsion of the cruciates is a viable option to reconstruction, if performed with in the first 2 weeks after trauma [23]. Mariani et al. performed a retrospective comparative study of with three groups- group 1 having direct repair of both cruciates, group 2 having ACL reconstruction with hamstrings and PCL repair, and group 3 having PCL reconstruction with bone-patellar tendon-bone graft and ACL reconstruction with hamstring tendons. The results were reported after an average follow-up of 6.9 years. In terms of stability on a KT-2000 arthrometer and knee ROM, better results were reported after combined ACL and PCL reconstruction than direct suture repair. Based on their results, the authors did not recommend repair of the cruciate ligaments after a knee dislocation to achieve a stable knee and good range of motion [24]. Reconstruction of cruciates with autograft or allograft is the standard of care, especially in isolated injuries. However, in an MLKI scenario which is being operated upon for another indication (medial or lateral collateral surgery), a repair can be reasonable option if the ACL or PCL is avulsed off the femur and the tissue quality is good (Fig. 5).

A meta-analysis of 9 studies was performed by Frosch et al. to compare the results of repair versus reconstruction for the cruciates in MLKI. They reported poor outcomes when ACL and PCL injuries were managed non-operatively. However, no difference was reported between the suture repair and reconstruction groups in KD III and KD IV injuries. About 77.5% of patients who underwent ACL and PCL repair had good to

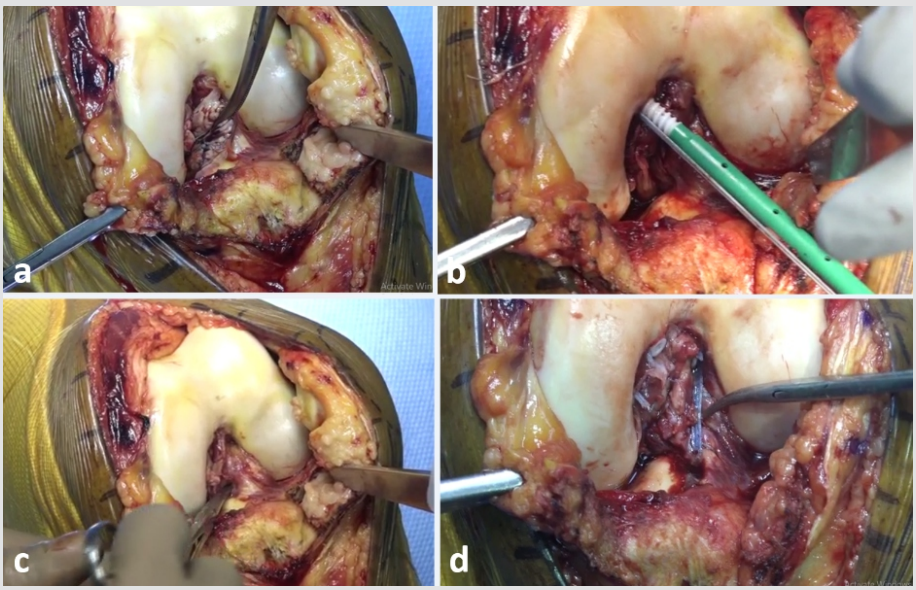

Figure 5: Repair of Femoral avulsion of ACL and PCL in a KD IIIM injury. (a) The avulsed PCL with good tissue quality. (b) Repair of the PCL performed first at it anatomic attachment using a 4.75 mm SwiveLock® anchor (Arthrex, Naples, FL).(c) The femoral ACL avulsion probed for tissue quality.(d) Repair of the ACL and augmentation performed with FiberTape® (Arthrex, Naples, FL). using our previously described technique [23].

excellent outcomes. The severity and pattern of knee injury did effect the outcome, with PLC repair resulting in superior outcome, while MCL repair having no impact on the results [27]. Martinek et al. evaluated the timing of ACL and PCL repair or reconstruction on clinical outcomes in a retrospective study of 28 patients. Twenty two patients had surgery within 30 days of trauma (acute) and 6 were operated beyond this time (chronic). While 16 patients underwent repair for both cruciates, 12 had one ligament repaired and another reconstructed. They found that primary repair of ACL/PCL in the acute period was superior to delayed repair. These patients had satisfactory knee function in spite of some residual ligamentous laxity [27].

There is no universally accepted or "standard" technique of repairing the cruciates in MLKI injuries. We employ a technique previously described by us for arthroscopic femoral avulsion repair of ACL, with minor modifications [28]. A high strength suture like No. 2 FiberWire® (Arthrex, Naples, FL) is used. No special device is needed for suturing since this is done by open surgery and a size 6 Mayo needle is used for passing the free end of FiberWire®. If both are torn, the PCL is repaired first followed by ACL. The suturing is begun in the mid-substance of the ligament. Each end of the suture is passed 2-3 times progressing proximally and ensuring to incorporate both bundles, in a shoe-lace fashion. Both suture ends are retrieved at the avulsed proximal end and passed through a 4.75 mm BioComposite™ SwiveLock® anchor (Arthrex, Naples, FL). The native footprint is identified and a pilot hole created at its center using a SwiveLock® tap at 90^0 knee flexion. The anchor is then inserted while maintaining tension at the suture ends. For the PCL, two anchors are used, one each for the anterolateral and posteromedial bundle. Anterior drawer force is applied when these anchors are being inserted. For the ACL, augmentation of the repair is performed with a FiberTape® inserted in the femur using the same anchor. The FiberTape® is passed through a transtibial 4.5 mm tunnel at the tibial footprint and fixed on the anteromedial tibia using a TightRope® ABS Button in 30^0 knee flexion.

Outcomes of Acute Ligament Repair

There is sparse literature comparing ligament repair and reconstructions for MLKI. Owens et al. reported the outcomes of 25 patients with 28 knee dislocations who had undergone primary ligament repairs and an early rehabilitation program, in a retrospective series with a mean follow-up of 48 months. The cruciates were approached through an anterior arthrotomy while posterolateral structures were repaired via a separate lateral approach. The patients had a mean extension loss of 1.9^0, mean flexion loss of 10.2^0 and the functional outcome was comparable to the then published literature (2007) for ligament reconstruction in MLKI. All but 2 patients with bilateral dislocations were able to get back to their pre-injury occupation. The commonest complication seen in this series was arthrofibrosis in 5 patients (17.8%), all requiring arthroscopic adhesiolysis. The authors did mention that this treatment may not allow a high level athlete to return to competitive sports but allows adequate function for occupational or leisure activities [29]. Another retrospective series published almost a decade later (2016) included 17 patients (18 knees) and had a mean follow up of 4.8 years. In this series also, an open repair was performed for all torn ligaments within 5-10 days of injury. The authors used a high strength suture (Cobraid™) and a running baseball suturing technique for the repairs to allow early rehab. The patients had fairly good outcome on patient reported outcome measures but there was significant loss of range of motion compared to the contralateral knee. The commonest complaint in this series was also arthrofibrosis (16.6%) in 3 patients, where 1 underwent manipulation while 2 required arthroscopic adhesiolysis. Twelve patients returned to their previous occupation with no or little modification, four could return to light duty only while one patient with bilateral dislocations did not return to work [30].

A more recent multicenter case series of 69 knees undergoing open acute ligament repairs for KD III and KD IV used #2 FiberWire® for augmentation of the repairs. This ligament internal bracing was done to improve maximum load to failure of the repair construct. At a mean follow up was 14 months, the median loss of activity on the Tegner scale was 1. Re-operations were performed in 10 patients; 4 patients required arthroscopic adhesiolysis for stiffness (5.8%) while six underwent ligament reconstructions for symptomatic instability (8.7%). The authors did not recommend this technique be performed in obese patients with ultra-low velocity injuries or those with common peroneal nerve injuries due to poor outcomes [31]. Ranger et al. reported mean 6 year outcomes of acute repair of collateral and cruciates with LARS augmentation for MLKI in 111 patients. More 90% patients had good anterior stability while only 60% patients had good posterior stability on stress radiography using Telos. About 25-30% collateral repairs which did not have augmentation (avulsions or peel-offs) had residual laxity. Those with body mass index of >30 Kg/m^2 had worse outcomes and knee ROM. The commonest

complication in this series was heterotrophic ossification (21.6%) followed by arthrofibrosis in 18 patients (16.2%). All these patients underwent open arthrolysis. Two revision were performed for re-tear of ACL grafts [32].A technique of dynamic intraligamentary stabilization with primary repair has been described by Kohl et al. as a "biological concept". They reported good functional results and patient satisfaction in the short-term in 35 patients (26- KD III, 9-KD IV). Two patients (5.7%) underwent arthroscopic adhesiolysis for arthrofibrosis while two patients (5.7%) had revision surgery by PLC reconstruction for persistent lateral laxity [33].

Table 1: Authors' decision making approach in acute MLKI Surgery

Anterior Cruciate Ligament	Posterior Cruciate Ligament	Medial Ligament Complex	Posterolateral Corner
- Repair for femoral avulsions having good tissue quality using suture anchors.	- Repair for femoral avulsions having good tissue quality. Two anchors for anterolateral and posteromedial bundle.	- Repair for grade 3 tibial avulsions using suture anchors	- Repair only for fibula sided bony avulsions or soft tissue peel offs.
- Early reconstruction (open or arthroscopic) for low velocity injuries with minimal bone marrow edema and good range of motion	- Early reconstruction (arthroscopic) for low velocity injuries with minimal bone marrow edema and capsular injury.	- Suture repair and augmentation with synthetic tapes or hamstrings tendon for mid-substance tears	- Isolated popliteus avulsion from femur can be repaired with a suture anchor
- Delayed or Staged reconstruction for mid-substance tears and high velocity injuries	- Bony avulsions can be repaired by arthroscopic or open surgery with screw fixation or transosseous pull-through technique.	- Femoral sided tears almost always conserved due to their propensity to heal.	- All other injuries undergo anatomic reconstruction by either the Modified Larson or LaPrade techniques in the early stage.
- Bony avulsions can be repaired by arthroscopic or open surgery with screw fixation or transosseous pull-through technique.	- Delayed or Staged reconstruction for high velocity injuries (Double bundle if associated with posterolateral corner instability)	- Residual laxity managed by reconstruction or InternalBrace™ during second stage surgery.	

Conclusions

Based on current literature, the approach adopted in our practice is as described in Table 1. We can safely deduce from the currently available literature that suture repair does have a role in acute management of MLKIs in selected, low demand patients. However, the risks of arthrofibrosis and revision surgery for a reconstructions must be explained to the patients undergoing an arthrotomy for cruciate repairs. Some form of synthetic augmentation seems reasonable although there is no strong science to support this presumption. A comparative study between homogenous injury groups would perhaps shed more light on the relevance of repair or reconstruction in acute surgery for MLKI.

References

1. *Moatshe G, Chahla J, LaPrade RF, et al Diagnosis and treatment of multiligament knee injury: state of the art Journal of ISAKOS: Joint Disorders & Orthopaedic Sports Medicine 2017;2:152-161.*
2. *Harner CD, Waltrip RL, Bennett CH, et al. Surgical management of knee dislocations. J Bone Joint Surg Am 2004;86-A:262–73.*
3. *Mariani PP, Santoriello P, Iannone S, et al. Comparison of surgical treatments for knee dislocation. Am J Knee Surg 1999;12:214–21.*
4. *Geeslin AG, LaPrade RF. Outcomes of treatment of acute grade-III isolated and combined posterolateral knee injuries: a prospective case series and surgical technique. J Bone Joint Surg Am 2011;93:1672–83.*
5. *Liow RY, McNicholas MJ, Keating JF, Nutton RW. Ligament repair and reconstruction in traumatic dislocation of the knee. J Bone Joint Surg Br. 2003;85(6):845–851.*
6. *Tardy N, Boisrenoult P, Teissier P, Steltzlen C, Beaufils P, Pujol N. Clinical outcomes after multiligament injured knees: medial versus lateral reconstructions. Knee Surg Sports Traumatol Arthrosc. 2017;25(2):524–531. doi:10.1007/s00167-016-4067-4*
7. *Wijdicks CA, Griffith CJ, Johansen S, Engebretsen L, LaPrade RF. Injuries to the medial collateral ligament and associated medial structures of the knee. J Bone Joint Surg Am. 2010 May;92(5):1266-80. doi: 10.2106/JBJS.I.01229.*
8. *Cinque ME, Chahla J, Kruckeberg BM, DePhillipo NN, Moatshe G, LaPrade RF. Posteromedial Corner Knee Injuries: Diagnosis, Management, and Outcomes: A Critical Analysis Review. JBJS Rev. 2017 Nov;5(11):e4. doi: 10.2106/JBJS.RVW.17.00004.*
9. *Chahal J, Al-Taki M, Pearce D, Leibenberg A, Whelan DB. Injury patterns to the posteromedial corner of the knee in high-grade multiligament knee injuries: a MRI study. Knee Surg Sports Traumatol Arthrosc. 2010;18(8):1098–1104. doi:10.1007/s00167-009-1011-x*
10. *Andrews K, Lu A, McKean L, Ebraheim N. Review: Medial collateral ligament injuries. Journal of Orthopaedics. 2017;14(4):550-554.*
11. *Werner BC, Hadeed MM, Gwathmey FW Jr, Gaskin CM, Hart JM, Miller MD. Medial injury in knee dislocations: what are the common injury patterns and surgical outcomes?. Clin Orthop Relat Res. 2014;472(9):2658–2666. doi:10.1007/s11999-014-3483-3*
12. *Dold AP, Swensen S, Strauss E, Alaia M. The Posteromedial Corner of the Knee: Anatomy, Pathology, and Management Strategies. J Am Acad Orthop Surg. 2017;25(11):752–761. doi:10.5435/JAAOS-D-16-00020*
13. *Kovachevich R, Shah JP, Arens AM, Stuart MJ, Dahm DL, Levy BA. Operative management of the medial collateral ligament in the multi-ligament injured knee: an evidence-based systematic review. Knee Surg Sports Traumatol Arthrosc. 2009;17(7):823–829. doi:10.1007/s00167-009-0810-4*
14. *Stannard JP, Black BS, Azbell C, Volgas DA. Posteromedial corner injury in knee dislocations. J Knee Surg. 2012;25(5):429–434. doi:10.1055/s-0032-1322605*
15. *Mehl JT, Kia C, Murphy M, et al. Posteromedial Ligament Repair of the Knee With Suture Tape Augmentation: A Biomechanical Study. Am J Sports Med. 2019;47(12):2952–2959. doi:10.1177/0363546519868961*

16. van der List JP, DiFelice GS. Primary Repair of the Medial Collateral Ligament With Internal Bracing. Arthrosc Tech. 2017;6(4):e933–e937. Published 2017 Jul 3. doi:10.1016/j.eats.2017.03.003

17. Vicenti G, Solarino G, Carrozzo M, et al. Major concern in the multiligament-injured knee treatment: A systematic review. Injury. 2019;50 Suppl 2:S89–S94. doi:10.1016/j.injury.2019.01.052

18. Shelbourne KD, Haro MS, Gray T. Knee dislocation with lateral side injury: results of an en masse surgical repair technique of the lateral side. Am J Sports Med. 2007;35(7):1105–1116. doi:10.1177/0363546507299444

19. Levy BA, Dajani KA, Morgan JA, Shah JP, Dahm DL, Stuart MJ. Repair versus reconstruction of the fibular collateral ligament and posterolateral corner in the multiligament-injured knee. Am J Sports Med 2010;38:804–9, doi:http://dx.doi.org/10.1177/0363546509352459.

20. Stannard JP. The posterolateral corner of the knee: repair versus reconstruction. Am J Sports Med 2005;33:881–8, doi:http://dx.doi.org/ 10.1177/0363546504271208.

21. McCarthy M, Ridley TJ, Bollier M, Cook S, Wolf B, Amendola A. Posterolateral Knee Reconstruction Versus Repair. Iowa Orthop J. 2015;35:20–25.

22. Westermann RW, Marx RG, Spindler KP, et al. No Difference Between Posterolateral Corner Repair and Reconstruction With Concurrent ACL Surgery: Results From a Prospective Multicenter Cohort. Orthop J Sports Med. 2019;7(7):2325967119861062. Published 2019 Jul 30. doi:10.1177/2325967119861062

23. 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(S):718–727. doi:10.1177/03635465020300051601

24. Mariani PP, Santoriello P, Iannone S, Condello V, Adriani E. Comparison of surgical treatments for knee dislocation. Am J Knee Surg. 1999;12(4):214–221.

25. Tapasvi SR, Shekhar A, Patil SS. Primary Anterior Cruciate Ligament Repair With Augmentation. Arthrosc Tech. 2018;7(2):e139–e145. Published 2018 Jan 22. doi:10.1016/j.eats.2017.08.063

26. Frosch KH, Preiss A, Heider S, et al. Primary ligament sutures as a treatment option of knee dislocations: a meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2013;21(7):1502–1509. doi:10.1007/s00167-012-2154-8

27. Martinek V, Steinbacher G, Friederich NF, Müller WE. Operative treatment of combined anterior and posterior cruciate ligament injuries in complex knee trauma: can the cruciate ligaments be preserved?. Am J Knee Surg. 2000;13(2):74–82.

28. Tapasvi SR, Shekhar A, Patil SS. Primary Anterior Cruciate Ligament Repair With Augmentation. Arthrosc Tech. 2018;7(2):e139–e145. Published 2018 Jan 22. doi:10.1016/j.eats.2017.08.063

29. Owens BD, Neault M, Benson E, Busconi BD. Primary repair of knee dislocations: results in 25 patients (28 knees) at a mean follow-up of four years. J Orthop Trauma. 2007;21(2):92–96. doi:10.1097/BOT.0b013e3180321318

30. Hua X, Tao H, Fang W, Tang J. Single-stage in situ suture repair of multiple-ligament knee injury: a retrospective study of 17 patients (18 knees). BMC Musculoskelet Disord. 2016;17:41. Published 2016 Jan 22. doi:10.1186/s12891-016-0894-1

31. Heitmann M, Akoto R, Krause M, et al. Management of acute knee dislocations: anatomic repair and ligament bracing as a new treatment option-results of a multicentre study. Knee Surg Sports Traumatol Arthrosc. 2019;27(8):2710–2718. doi:10.1007/s00167-018-5317-4

32. Ranger P, Senay A, Gratton GR, Lacelle M, Delisle J. LARS synthetic ligaments for the acute management of 111 acute knee dislocations: effective surgical treatment for most ligaments. Knee Surg Sports Traumatol Arthrosc. 2018;26(12):3673–3681. doi:10.1007/s00167-018-4940-4

33. Kohl S, Stock A, Ahmad SS, et al. Dynamic intraligamentary stabilization and primary repair: a new concept for the treatment of knee dislocation. Injury. 2015;46(4):724–728. doi:10.1016/j.injury.2014.10.012

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Shekhar A, Reddy S, Tapasvi S | Primary repair in acute multiligament knee injury | Asian Journal of Arthroscopy | January-April 2020; 5(1): 14-19.