Review Article

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Complications of Multiple Ligament Knee Injury Surgery : Prevention and Salvage

Dinshaw N. Pardiwala[1], Kushalappa Subbiah[1], Nandan Rao, Vicky Jain[1]

Abstract

Multiple ligament injuries of the knee are a complex group of injuries with diverse presentations, varying treatment options, and the potential for an array of significant complications. These include iatrogenic neurovascular injuries, fluid extravasation with compartment syndrome, intraoperative technical complications related to tunnel placement and graft tensioning, tourniquet complications, wound problems and infection, venous thromboembolic events, arthrofibrosis with loss of motion, residual knee instability, heterotopic ossification, and missed postoperative knee dislocations. Prevention of these complications is based on a comprehensive knowledge of knee ligament anatomy and biomechanics, understanding the unique and complex nature of these uncommon injuries, detailed preoperative clinico-radiological evaluation, astute surgical planning, careful operative execution, close postoperative monitoring, and a proper rehabilitation program. Early recognition of complications with appropriate and immediate management is critical for satisfactory functional outcomes.

Keywords: Multiple ligament knee injury, Knee dislocation, Complications, Prevention, Salvage, Surgical reconstruction

Introduction

Treatment of the multiple ligament knee injury (MLKI) remains a challenge. A detailed patient evaluation, individualized management plan, finesse of surgical technique, and supervised rehabilitation program are required in order to obtain good functional outcomes. The complexity of presentation and spectrum of treatment options makes these injuries unique and extremely demanding to even the most experienced knee surgeons [1]. As a result, complications can arise not only from the injury itself, but also from its treatment (Table 1). This article focuses on the prevention and management of complications that may result from surgical treatment of the multiple ligament injured knee.

Table 1 : Complications associated with multiple ligament knee injuries.

INJURY RELATED	TREATMENT RELATED
Vascular injury	Iatrogenic vascular injury
Neurologic injury	Iatrogenic nerve injury
Compartment syndrome	Fluid extravasation & compartment syndrome
Compromised soft tissue envelope	Wound complications & infection
Open knee dislocations	Tourniquet complications
Associated fractures	Complex regional pain syndrome
Arthrofibrosis	Arthrofibrosis & loss of motion
Proximal tibiofibular joint dislocation	Residual laxity
Unique complications in morbid obesity	Heterotopic ossification
	Deep vein thrombosis
	Fractures and avascular necrosis
	Postoperative missed knee dislocations

Vascular Complications

Missed popliteal artery injury at presentation

A subclinical popliteal artery injury that was not identified at presentation can manifest itself after surgery on a multiple ligament injured knee. Such patients often have post-traumatic intimal tears and pseudoaneurysms of the popliteal artery with palpable distal pulses (Fig.1). Use of a thigh tourniquet during surgery is postulated to result in a postoperative pulse-less limb. Patients requiring postoperative emergency revascularisation procedures under such circumstances are described [2-4]. The surgeon should be aware of this potential risk and should conduct repeated and meticulous examination of the distal pulses before and after surgery.

A palpable dorsalis pedis and posterior tibial pulse with an ABI >0.9 has been reported to have a sensitivity of 100% to rule out vascular injury. However even these patients need to be monitored for at least 48 hours to rule out delayed thrombosis and vascular insult. There has been a long standing debate between the proponents of routine angiography (in all patients with MLKI) and selective angiography (performed only when patients have either asymmetric pulsations or ABI< 0.9) with the former arguing that small intimal tears leading to delayed thrombosis may be missed; leading to disastrous complications [5]. Hence, our approach has been to perform a routine preoperative vascular study on all acute MLKI injuries.

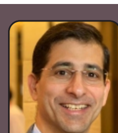
In the surgery itself, tourniquet use is with precautions. The tourniquet should be placed as proximal on the patient's thigh as possible, so as to be away from the zone of injury. A pneumatic tourniquet with adequate padding should be inflated to an appropriate pressure for as brief a duration as possible. All-in-one exsanguination devices should be avoided. Often these surgeries are prolonged, and it is recommended to deflate the tourniquet after 90 minutes for approximately 15 minutes to allow reperfusion before reinflation. The use of a tourniquet is not recommended after vascular repair.

Iatrogenic vascular injury

Posterior cruciate ligament (PCL) reconstruction during MLKI surgery presents a risk for iatrogenic intraoperative popliteal artery injury. The popliteal artery is 9 mm from

[1]Department of Orthopaedics, okilaben Dhirubhai Ambani Hospital, Mumbai, India.

Address of Correspondence:
Dr. Dinshaw Pardiwala,
Kokilaben Dhirubhai Ambani Hospital
Four Bungalows, Andheri (W), Mumbai 400053, India.
E-mail: pardiwala@outlook.com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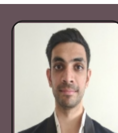
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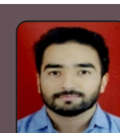
Dr. Nandan Rao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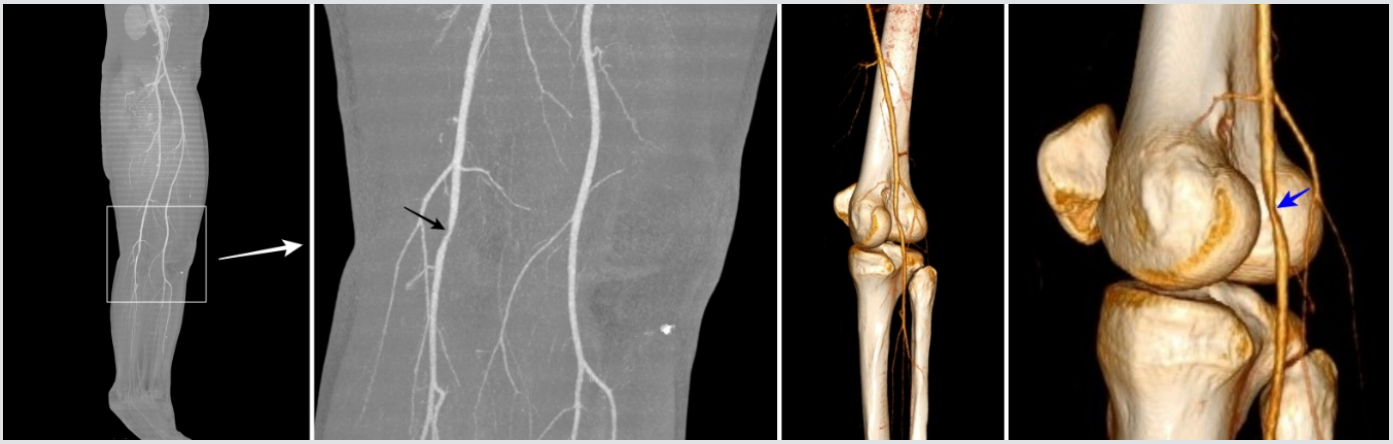

Figure 1: Subclinical popliteal artery injury in a rugby player who sustained a KDIIIM sports knee dislocation. His distal pulses were palpable and ABI was 0.95. A routine preoperative CT angiogram detected the intimal injury to popliteal artery. His multiple ligament surgery in the acute phase was differed and he underwent non-operative treatment for the vascular injury.

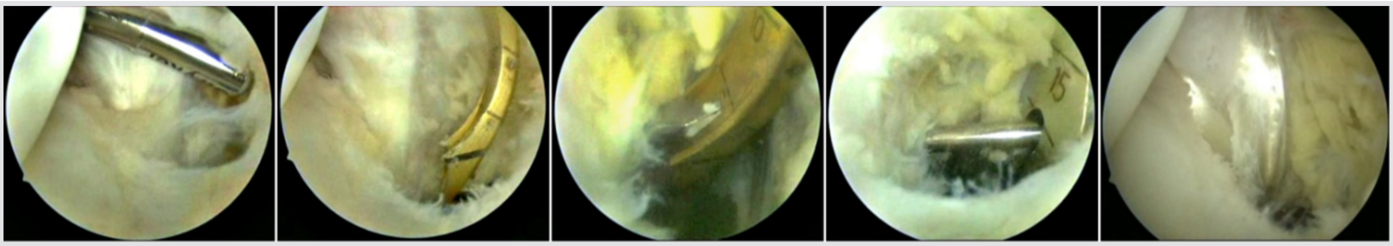

Figure 2: Iatrogenic popliteal artery injury can be prevented by direct visualisation of the posterior compartment via a posteromedial viewing portal. Use of a reliable PCL tibial guide and pin protecting retractor ensures that the guide pin or reamer does not penetrate the posterior capsule during tibial tunnel creation.

the tibial attachment of the PCL in the sagittal plane with knee flexion of 90^0 [6]. Hence, the popliteal artery is most at risk of injury during transtibial drilling and reaming of the tibial tunnel. This can be prevented by direct visualisation of the posterior compartment during tibial reaming via a posteromedial viewing portal, use of a reliable PCL tibial guide designed to prevent guide pin penetration into the posterior capsule, controlled penetration of the posterior cortex with the guide pin, prevention of inadvertent guide pin progression during reaming via a pin protecting retractor, controlled reaming of the posterior tibial cortex in the presence of a protecting retractor (Fig.2), and in special circumstances use of fluoroscopic imaging (Fig.3). In patients who have already undergone a first stage popliteal vascular repair (Fig.4), the surgeon should be familiar with the site of vascular anastomosis including its distance from the PCL, and ensure no undue tension is placed on the graft.

Having a vascular surgeon available is paramount in preoperative planning, and intraoperative and postoperative vascular monitoring is essential. In the event that a patient demonstrates definite signs of ischaemia postoperatively (absent distal pulsations of the dorsalis pedis or posterior tibial artery), immediate angiography is performed (if possible, intra-operative prior to anaesthesia reversal) and treated accordingly. Arterial repair for short segment injuries, and interpositional grafts (usually contralateral saphenous vein graft) for long segment injuries is often needed.

Figure 3: Use of fluoroscopy during tibial tunnel creation in paediatric PCL reconstruction can prevent iatrogenic popliteal artery injury. The PCL tibial guide is designed for adults and often does not abut the exit point at the posterior tibial metaphyseal cortex. Drilling and reaming under fluoroscopic control not only ensures that the proximal tibial physis is spared, but also ensures that there is no progression of the guide pin or reamer into the popliteal region.

Iatrogenic nerve injury

Iatrogenic peroneal nerve injury

The peroneal nerve is at risk of injury while performing repair or reconstruction of the posterolateral corner (PLC) of the knee. The peroneal nerve lies behind the fibular head in close proximity to the biceps tendon. The nerve is at greatest risk during fibular tunnel drilling during reconstruction of the lateral collateral ligament, or when performing a biceps femoris repair [7]. Another potential risk is the prolonged use of tourniquets during surgery. Iatrogenic peroneal nerve injury can be prevented by identifying the nerve early in the surgical dissection and protecting it thereafter (Fig.5). The nerve is best identified in the distal thigh posterior to the biceps femoris tendon. In delayed cases of PLC injury surgery, perineural fibrosis may prevent identification of the nerve in its normal anatomical site. In this situation, it is best to identify the nerve proximal to the zone of injury and trace it to the fibular region and beyond. During closure, the fascial plane

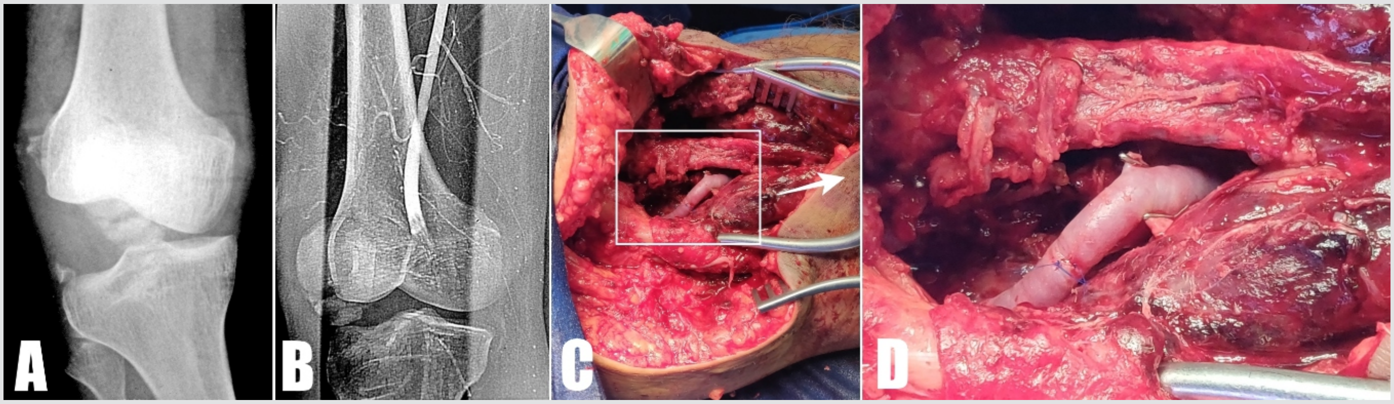

Figure 4: Multiple ligament knee injury (A) with popliteal artery long-segment disruption (B). The patient underwent emergency vascular anastomosis (C). During the subsequent ligament reconstructive surgery, the surgeon should be familiar with the exact site of vascular anastomosis (D) and its distance from the PCL so as to ensure no iatrogenic vascular injury.

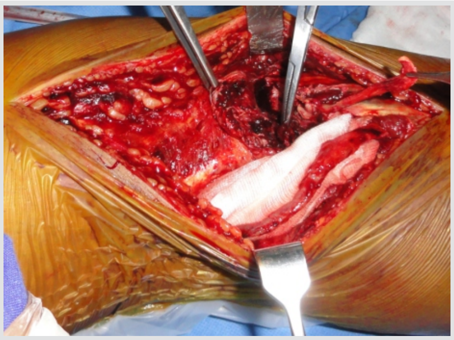

Figure 5: During PLC repair or reconstruction, iatrogenic peroneal nerve injury can be prevented by identifying the nerve early in the surgical dissection and protecting it thereafter.

posterior to the biceps femoris should be left open to prevent potential nerve compression owing to postoperative hematoma or swelling. In patients who reveal an unexpected immediate postoperative peroneal nerve palsy, the approach is based on whether the neurological palsy is complete or partial. 87.3% patients with incomplete palsy have been found to have functional recovery of MRC grade 3 or more, and these patients with neuropraxia may be observed for progressive improvement [8]. A neurolysis may be indicated if there is no progressive improvement and EMG-NC studies performed three weeks post-surgery indicate a more severe injury than anticipated. In patients with a complete injury, the recovery rates are poor, and hence a more aggressive approach is necessitated. Re-exploration with a microvascular surgeon should be performed. If the nerve is found in continuity, a neurolysis is performed. Complete short-segment transections of the nerve may undergo primary repair, whereas long-segment injuries caused by reamer entanglement need nerve grafting. Postoperatively, all patients are rehabilitated initially with a dynamic ankle-foot orthotic support and physiotherapy. Complete nerve injuries have a poor prognosis, and may subsequently warrant tendon transfer, nerve transfer, and combined nerve/tendon transfer as salvage procedures [9].

Iatrogenic saphenous nerve injury

Repair and reconstruction of the medial knee ligaments presents a risk of iatrogenic incisional injury to the saphenous nerve and its branches. The saphenous nerve lies beneath the sartorius muscle and gracilis tendon. The sartorial branch courses distally to supply sensation to the medial aspect of the calf and leg. The risk of such injury to this branch is increased when using a posteromedial portal for PCL reconstruction, harvesting the medial hamstring tendons with an open-ended tendon stripper, or performing medial collateral ligament reconstruction or repair. Injury to the sartorial branch results in numbness or paraesthesia in it's distribution along with a painful neuroma at the site of injury. The infrapatellar branch of the saphenous nerve travels anteriorly towards the tibial tubercle and is at risk of injury when establishing a medial arthroscopic portal or when performing anteromedial incisions around the knee [10]. Injury to this branch leads to hypersensitivity and dysthesia over the anterolateral aspect of the knee, and sometimes a painful infrapatellar neuroma if it is stretched or heals in scar tissue. Trauma to the cutaneous nerves may also result in vasomotor abnormalities and reflex sympathetic dystrophy (complex regional pain syndrome) [11]. This nerve injury is prevented by taking a horizontal parapatellar incision for the medial portal above the joint line after transillumination so as to avoid visible nerve branches and the vein that runs along the joint line. Flexing the knee during pes tendon harvesting may put the nerves at a lesser risk of injury [12]. During open procedures, iatrogenic cutaneous nerves injury can be prevented by using blunt dissection between skin and joint capsule, sufficiently identifying the nerve so that it can be gently retracted from the area of instrumentation, avoiding drying out of nerve tissue, and avoiding the nerve during wound closure [13]. Mild saphenous neuralgia, nerve entrapment, or early onset neurogenic pain are treated with ultrasound guided saphenous nerve block, whereas persistently painful cutaneous nerve neuromas warrant open excision and perineural fat grafting.

Fluid extravasation & compartment syndrome

Knee dislocations are associated with significant capsular tears and fascial disruption. Any arthroscopic surgery performed within two weeks of the injury has the potential to cause irrigation fluid extravasation and compartment syndrome [14,15]. This limb threatening complication is best prevented by avoiding arthroscopy in acute knee injuries in which capsular tears are anticipated. When reconstruction is performed early, an open approach or gravity inflow arthroscopy is preferred over a pump for fluid inflow. During the arthroscopic procedure, constant clinical assessment of the calf for tense swelling, or compartment pressure monitoring [16] is mandatory, and if necessary, arthroscopy should be abandoned in favor of an open approach. In the rare event of a compartment syndrome being identified in the immediate postoperative period, emergency compartment release is warranted.

Intraoperative technical complications

Tunnel placement and convergence :

Tunnel placement in cruciate and collateral

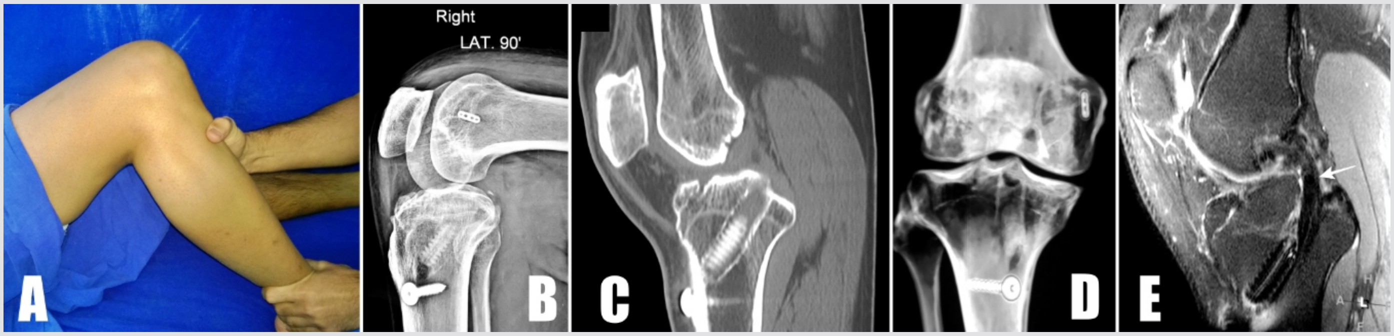

Figure 6: Tunnel malposition leading to graft impingement is the most common reason for failure in MLKI surgery (A). In this patient of failed PCL reconstruction, a high tunnel aperture on the posterior tibia leads to a non-anatomic PCL reconstruction (B,C), suboptimal lever arm, and residual grade 3 posterior laxity despite an intact graft on MRI (E).

Figure 7: Dedicated aiming jigs for extra-articular ligament reconstruction reduce the risk of tunnel convergence in MLKI surgery. These are also useful to accurately plan collateral ligament tunnel trajectories so as to avoid co-existing cruciate ligament tunnels.

ligament reconstructive surgery is critical for anatomical restoration since this allows adequate stability and full range of motion. Tunnel malposition and graft impingement is the most common reason for failure in MLKI surgery (Fig.6). 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 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. Multiple tunnels also potentially weaken the metaphyseal bone and in the presence of multiple hardware pose the risk of fractures [17] and avascular necrosis [18].

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 [19,20]. There are also special aiming jigs available for extra-articular ligament reconstruction that can plan tunnel trajectories that avoid co-existing tunnels (Fig.7). In cases of doubt, and especially in revision situations, intraoperative fluoroscopy can be helpful for correct tunnel placement.

Graft tensioning

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 (endobutton femoral fixation)(3) PCL double-bundle grafts fixed (4) PLC grafts passed and fixed (5) ACL tensioning and tibial fixation (6) MCL and posterior oblique ligament (POL) grafts passed and fixed. The PCL is always tensioned and fixed first. This is the central pillar and fixing this reduces the knee and achieves the basis for anatomical reduction of subsequent ligaments. If in doubt (with a very unstable knee), we confirm anatomical reduction with a C-arm if necessary. If a single-bundle graft is used, we tension the graft at 90°. If adouble-bundle graft is used, we first tension the AL bundle at 90° and the PM at 0°. The PLC (anatomical) is fixed next since integrity of PLC is a critical prerequisite for tibiofemoral orientation when an ACL graft is tensioned. We normally fix both the femoral sockets first and the tibial tunnel last (I often don't use a fibular screw). The knee is kept in 30° of flexion with valgus force during tightening and fixation. The pre-passed ACL (with endobutton) is fixed on the tibianext. This achieves the 4-bar cruciate linkage system. The graft is tensioned at 30° of kneeflexion in neutral rotation. The MCL-POL is tensioned and fixed last. The MCL 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.

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 for the multiple ligament injured knee. Tensioning and fixation of an ACL graft in flexion prior to PCL tensioning and fixation will result in a fixed posterior subluxation and is a catastrophic error.

Tourniquet complications

MLKI surgery is often prolonged and complex and at risk of tourniquet ischaemia. Tourniquet complications are time dependent, and directly related to the duration of compression, excessive pressure, and local vascular supply of the injured extremity. Younger patients tolerate tourniquet ischaemia better than do older patients [21]. Although the "safe" time and pressure varies with each patient, a pressure of 250 mm Hg for 90 minutes is deemed safe for most adult patients. On the other hand, insufficient pressure that allows passive congestion of the extremity may produce hemorrhagic infiltration of the nerves and should be avoided [21].

Tourniquet complications can be avoided by use of properly functioning and calibrated equipment, proper application and padding of the tourniquet cuff, pre-inflation limb exsanguination, checking the pressure level after inflation, and limiting tourniquet time.

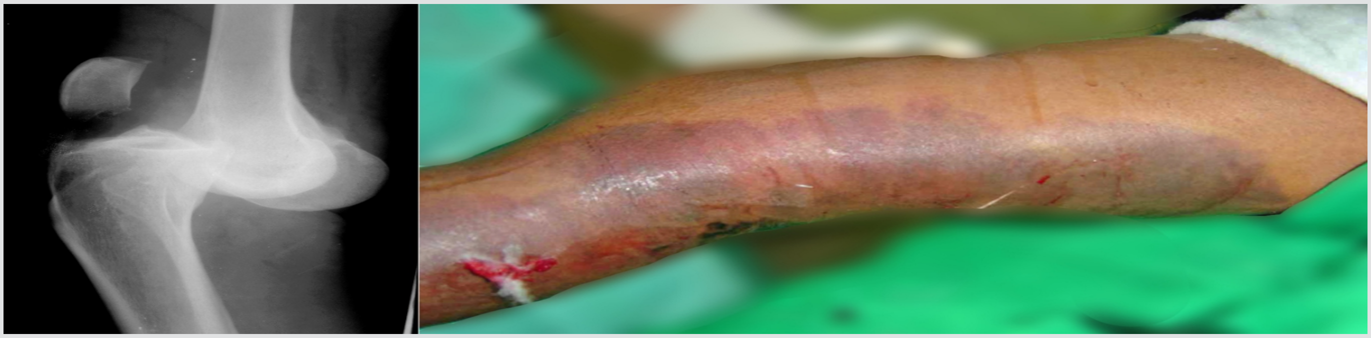

Figure 8: Knee dislocations often have severely traumatised superficial and deep soft tissues around the knee causing wound complications and infection. Non-emergency surgical intervention should be performed only once swelling and ecchymosis are regressing, wounds around the knee have healed, and there are no signs of infection.

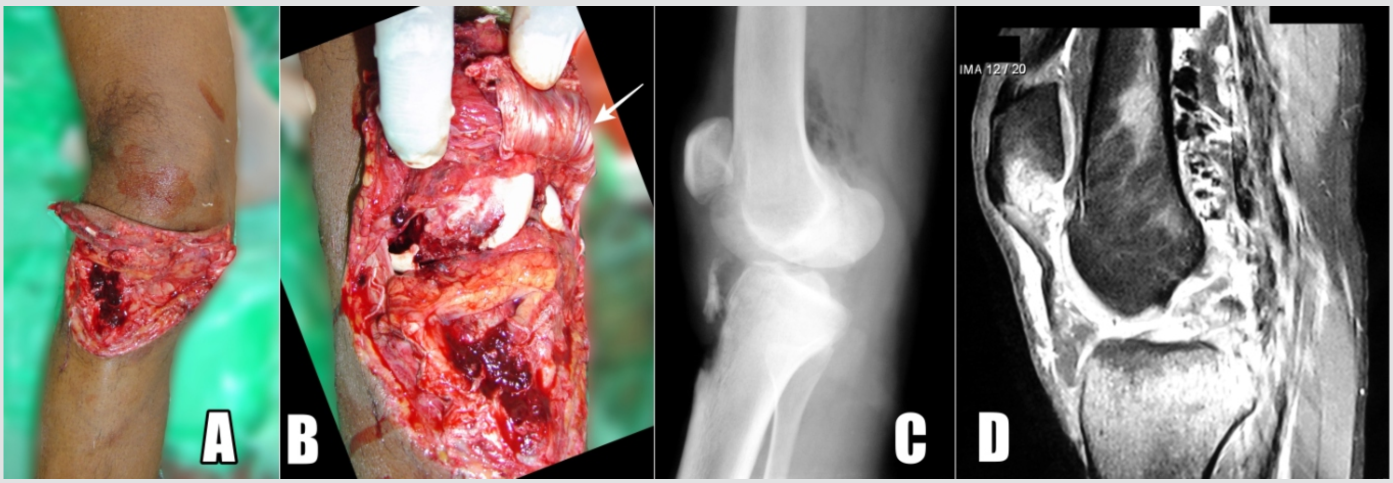

Figure 9: Open anterior knee dislocation following a jump from height in a young male (A). Besides sustaining a KD IV MLKI he had a patellar tendon avulsion (B,C,D). He underwent emergency reduction, lavage with debridement, patellar tendon primary repair with fixation, skin closure under drains, external fixator immobilisation, and antibiotic cover in the first stage. He underwent second stage multiple ligament reconstruction once his wounds had healed and knee range was normal.

Wide cuffs allow lower pneumatic pressures and decrease the risk of muscle and nerve damage [22]. Leg holders can cause a constrictive effect and when applied over a tourniquet must be used with caution.

Wound complications & infection

Knee dislocations often have severely traumatised superficial and deep soft tissues around the knee causing wound complications and infection (Fig. 8). Non-emergency surgical intervention should be performed only once swelling and ecchymosis is regressing, wounds around the knee have healed, and there are no signs of infection. Open knee dislocations (Fig. 9) require emergency reduction, external fixator stabilisation, wound debridement and lavage, followed by antibiotic administration.

Wound problems can be avoided by careful soft tissue handling. This includes avoiding incisions that cross previous scars or wounds, maintaining adequate skin bridges between incisions, creating full-tissue skin flaps, ensuring adequate hemostasis prior to closure, tension-free skin closure, and use of drains to prevent postoperative hematoma formation (7). At-risk wounds should be closely monitored during the first 3 weeks for wound complications. High-energy dislocations are notorious for skin necrosis especially in cases of delayed reduction, and these cases may need a plastic surgeon to collaborate for wound cover.

The incidence of wound infections in open knee reconstructive surgery ranges from 0.3-12.5% [23-25]. Superficial infection may be managed successfully with debridement and antibiotics, whereas deep infection often necessitates hardware removal besides debridement, lavage and antibiotic treatment.

Venous thromboembolic events

Patients after multiple ligament knee surgery are at a higher risk of deep vein thrombosis (DVT) and pulmonary embolism (PE) given the risk factors of a complex injury, lengthy operation, intraoperative use of a tourniquet, venous stasis, possible endothelial injury, and postoperative immobilisation. A high index of uspicion, with regular preoperative and postoperative physical examination including Homan's sign is necessary for the early diagnosis of DVT, and prevention of PE. Despite a reported DVT risk rate of 3.5%, there is no consensus for the use of thromboprophylaxis following knee dislocations [26]. Since some "silent" DVT produce minimal leg symptoms and yet result in catastrophic PE, we perform a preoperative venous color doppler in all cases of MLKI with delayed presentation, and recommend appropriate pharmacological and mechanical thromboembolic prophylaxis, especially in the setting of restricted weight bearing or immobilisation.

Arthrofibrosis & loss of motion

Although arthrofibrosis was a commonly encountered complication in the past when knee dislocations were treated definitively with prolonged cast immobilisation, even in recent times with knees treated surgically, the mean incidence of this complication has been upto 29% [27]. The factors influencing the risk

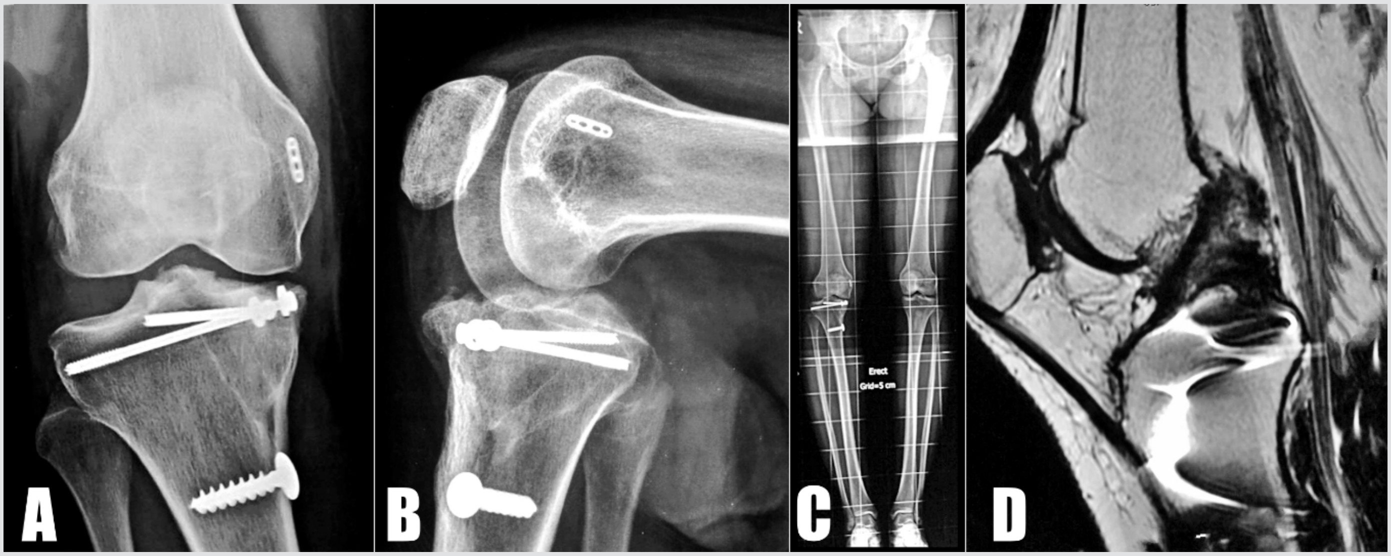

Figure 10: Failed MLKI surgery in a young female who presented with pain, instability, limp, and varus thrust. She had undergone two prior procedures following her injury for fracture fixation and PCL reconstruction (A,B). Clinically she had a chronic PCL-PLC deficient knee. Her scanogram confirmed varus malalignment (C), and MRI revealed PCL deficiency with an intact ACL (D). She underwent a medial open wedge high tibial osteotomy with slope correction in first stage followed by revision PCL reconstruction and PLC reconstruction in second stage.

of arthrofibrosis include the severity of trauma, preoperative range of motion, heterotopic ossification, infection, rehabilitation, and genetic predisposition. The role of early surgical intervention in promoting arthrofibrosis is controversial, with some authors suggesting this, whereas others have found improved outcomes with early surgical intervention [28-33].

Arthrofibrosis may be prevented by careful soft-tissue handling, arthroscopic techniques where possible, minimization of ipsilateral autografts, postoperative protocols to limit swelling and inflammation, and early progressive rehabilitation.

When arthrofibrosis is detected early, it may be managed successfully with intensive and controlled physiotherapy accompanied with appropriate pain and inflammation management. A gentle manipulation under anaesthesia may be attempted with great care in patients with moderate stiffness not responding to physiotherapy. Patients with severe and chronic arthrofibrosis will warrant arthroscopic adhesiolysis and fat pad contracture excision for the debridement of excessive intra-articular and suprapatellar scar tissue.

Besides arthrofibrosis, patients may have loss of motion (loss of extension greater than 10 degrees or loss of flexion beyond 125 degrees, or both) secondary to a non-anatomic reconstruction [34]. Loss of knee extension is disabling to the patient because of its effects on the normal gait pattern. MCL repair and reconstruction have the highest rates of stiffness with flexion and extension equally involved. ACL reconstruction more often results in loss of extension, whereas patients who undergo PCL reconstruction sometimes lose terminal flexion. PLC reconstruction is not associated with loss of motion and is more commonly complicated by residual laxity. A thorough understanding of ligament anatomy and insertion sites, finesse of surgical technique, and compliance of rehabilitation can prevent postoperative loss of motion.

Residual laxity

The causes of recurrent instability after MLKI surgery include nonanatomic placement of ligament grafts, weak or ruptured grafts, loss of fixation, and inappropriate rehabilitation. The most common instability noted is posterior secondary to failed PCL reconstruction and posterolateral secondary to PLC surgery [35,36]. Defining and addressing all the ligamentous insufficiencies, associated pathologies, and limb alignment at the time of reconstructive surgery helps minimise postoperative laxity [29](Fig.10). The concept that grade III MCL tears heal spontaneously does not apply in knee dislocations and repair with or without augmentation must be performed in acute MLKI when collateral ligament disruption is present [21]. Unrecognised PLC injury will also lead to laxity in the reconstructed knee if it is ignored [21].

Heterotopic Ossification

Heterotopic ossification (HO) around the knee following a multiple ligament injury has a reported incidence of 26% to 43% [37-38]. Patients initially develop pain and limited range of motion, with a few cases presenting as ankylosis. The timing of surgery or number of ligaments reconstructed does not seem to affect the development of HO. Although PCL reconstruction is reported to be the only independent predictor of HO in knee dislocations [39], we have noted its presence more in medial sided knee ligament injuries and surgery.

The standard preventive modalities for HO such as prophylactic indomethacin or low-dose radiation have not been investigated in the dislocated knee. Intensive controlled physiotherapy remains the main modality of treatment for mild cases, whereas surgical excision with arthrolysis is the ultimate intervention for severe and complicated cases. Range of motion limitations secondary to HO do not respond to manipulation [39].

Postoperative missed knee dislocations

Chronic unreduced knee dislocations following MLKI surgery are a rare but grave complication and these occur when the complexity of the primary injury is underestimated. We have seen 6 such cases referred to our service over the past 20 years, and although each case was unique, all had undergone prolonged postoperative knee immobilisation in an inadvertent dislocated position following primary surgery.

These were often obese patients where the postoperative dislocation was probably not clinically overt and hence was missed. In each of our cases, the extent of knee instability was probably underdiagnosed and undertreated. The primary surgeries the patients had undergone ranged from a popliteal artery repair with no ligament reconstructive surgery (Fig.11), to a first stage isolated PLC repair in an acute highly unstable MLKI injury (Fig.12A), to a bicruciate reconstruction in an acute posterior knee dislocation (Fig.12B). The spontaneously reduced dislocated knee is notorious for being missed and an inexperienced surgeon may underestimate the extent of instability. Most of these primary surgeries were probably planned as staged procedures, and the knee instability was not completely addressed in the first stage. Early recognition with adequate physical examination, and serial postoperative radiographs are critical to avoid overlooking this complication.

Treatment of a chronic fixed irreducible knee dislocation is challenging since achieving stability and range of motion warrants complex management techniques including open reduction, hinged external fixator application, with or without staged ligament reconstruction, and prolonged rehabilitation [40]. When associated with prior failed knee ligament surgery this is an extreme task and each case requires an individualized approach. To reduce the chronically dislocated knee, complete circumferential capsular release and scar tissue excision are required (Fig.13). To prevent extensive arthrofibrosis, early mobilization is mandatory and this is possible only with a hinged external fixator that helps maintain the reduction and reestablish stable anatomic range of motion [1]. Moreover, if ligament reconstruction is planned at the same stage, a hinged external fixator is critical to prevent increased stress on the grafts.

Figure 12: Postoperative missed knee dislocations are rare complications that are best prevented. They occur when the complexity of the primary injury is under diagnosed or under treated, and when knee reduction during the postoperative period is not monitored with radiographs. These usually occur in obese individuals where overt clinical signs of dislocation are masked. The treatment of these complications is particularly challenging since patients present late with a chronic fixed posterior subluxation (A) or dislocation (B).

Figure 11: Postoperative missed knee dislocation presenting 4 months following knee dislocation. He had already undergone a vascular repair. Incomplete reduction in a position of knee flexion during post-surgical immobilisation resulted in a fixed posterior subluxation.

Conclusions

A high incidence of complications in MLKI surgery is noted because of the nature and extreme severity of these uncommon traumatic knee injuries. Surgeons should be vigilant and pre-empt these preoperatively, intraoperatively, and postoperatively. The major complications that cause significant morbidity, including amputation and death are now relatively infrequent. Preventing complications, and immediate recognition and treatment if they occur, is critical to ensure limb viability and a good functional outcome.

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