Case report

# Complex multiligament knee reconstruction following high-impact trauma with primary repair and internal bracing: a case report

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## Abstract

Open fracture-dislocations of the knee are high-impact injuries often associated with extensive ligamentous damage, presenting significant challenges in orthopaedic trauma care. The rarity of such injuries makes the pre-operative planning and post-operative rehabilitation especially challenging. Standardized treatment consists of either early - <3weeks, or late - >3weeks reconstruction with autografts. This case report discusses the surgical management of a complex knee trauma with early repair of all ligaments using modern fixation methods. Our case presents a 33-year-old male sustained a complex open fracture-dislocation of the left knee. The injury included a posterolateral tibial plateau fracture, comminuted patellar fracture, avulsion of the lateral femoral condyle, and complete ruptures of the ACL, PCL, MCL, and LCL. Initial emergency surgery involved wound debridement and external fixation. Subsequent surgeries addressed ligament repair, using modern fixation techniques, like Internal Brace. The patient achieved excellent recovery, returning to daily activities within 18 weeks without complications. This case underscores the potential benefits of primary ligament repair over traditional reconstruction in managing complex knee injuries. The successful outcome highlights the importance of early intervention, and modern fixation techniques in optimizing recovery.

## Keywords

Multiligament knee reconstruction; primary ligament repair; internal bracing

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## Introduction

Knee open fracture-dislocation is a high impact trauma that involves extensive ligamentous damage. These types of injuries present formidable challenges in orthopaedic trauma care as they often associate with neurovascular complications and future instability of the joint. The reconstruction of multiple torn ligaments, particularly in the context of open fractures and dislocations, requires careful pre-operative planning and fast surgical intervention in order to ensure optimal patient outcomes.[1] Traditional methods of ligament's reconstruction often rely on autografts or allografts; however, the repairment of torn ligaments has garnered attention for its potential benefits in promoting biological integration and reducing immunogenic complications. Due to the rarity of this type of trauma, there are no standardized protocols on how to treat these injuries and therefore the question regarding the type of graft and the approach (open or arthroscopic) is still open.[2] The acute character of the injury gives the possibility to repair the affected ligament with anchor and enhancing the fixation with the Internal brace system.

By documenting this case, we aim to illustrate the efficacy of repairing techniques in multi-ligament knee repair, discuss the surgical nuances, and review the postoperative outcomes. This contributes to the broader discourse on optimizing treatment protocols for complex orthopaedic injuries, highlighting the evolving practices in ligament repair and the promising role of ligament repair in achieving successful long-term results.

## Case report

A 33-year-old male was brought to the emergency department via ambulance after a severe motorcycle accident. The patient was presented with a complex open fracture-dislocation of his left knee joint (Figure 1). The injury included a posterolateral tibial plateau fracture, a comminuted patellar fracture, an avulsion fracture of the lateral femoral condyle, and complete ruptures of the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL). The patient's medical history was unremarkable, with no chronic medical conditions, surgical interventions or known allergies. Upon arrival to the emergency department, the patient presented with a severely deformed left knee with visible open trauma, including bone fragments protruding through the wound. Despite the high energy of the injury and extensive soft tissue damage, the patient maintained intact neurovascular function in the affected limb.

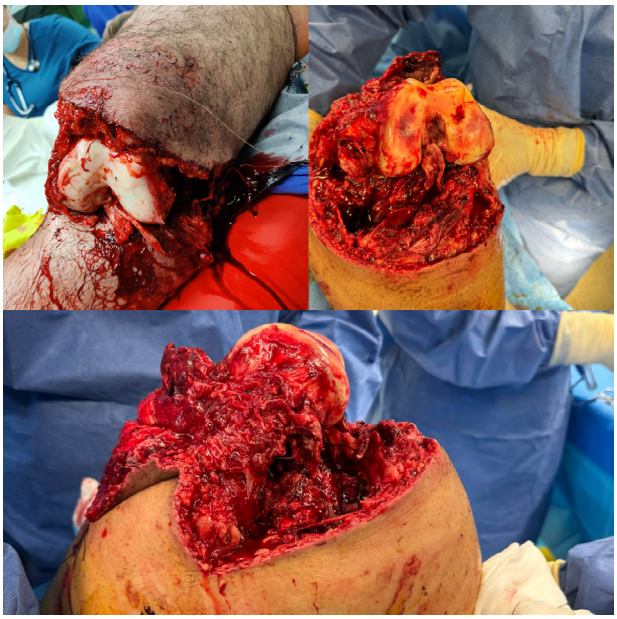

***Figure 1**. Patient's left limb upon arrival to the hospital. Open dislocation-fracture of left knee can be seen along with the PCL tendon and femoral condyles*

A thorough diagnostic evaluation was conducted. A full body computed tomography (CT) scan revealed no evidence of intracranial hemorrhage, skull fractures, or cervical spine injuries. Bilateral first rib fractures were noted in the chest though there was no associated pneumothorax or hemothorax. Abdominal CT imaging showed no internal injuries. Focused imaging of the left lower extremity confirmed a complex fracture of the posterior column of the tibial plateau, a comminuted patella fracture, an avulsion fracture of the lateral femoral condyle, and complete tears of all major knee ligaments, including the ACL, PCL, MCL, and LCL. An additional X-ray of the

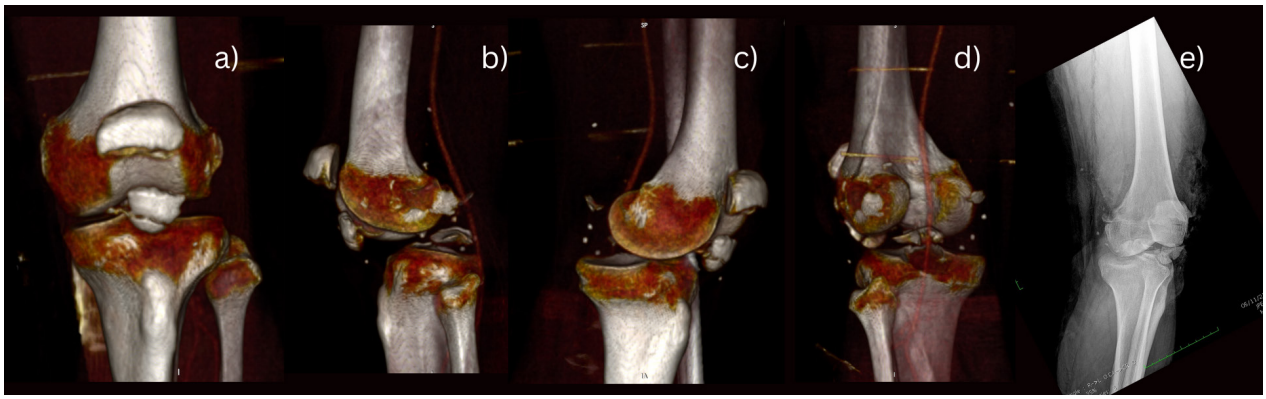


***Figure 2.*** *– a) AP view of CT of the patient's knee pre-operatively b) Lateral view of CT of the patient's knee pre-operatively c)Medial view of CT of the patient's knee pre-operatively d)Posterior view of CT of the patient's knee pre-operatively e) AP X-ray of the patient's left limb pre-operatively*

left limb further corroborated these findings (Figure 2) The case was classified as a KDV injury under Schenck's classification system, indicating a periarticular fracture-dislocation involving the femoral and tibial condyles with associated ligamentous disruption.[3,10] The prognosis indicated a complex and lengthy recovery process due to the severity of the trauma and the need for multiple surgical interventions.

The patient underwent a series of three surgeries as part of his comprehensive treatment plan. The first surgery was an emergency procedure performed immediately upon hospital arrival. It involved surgical cleaning and debridement of the wound, meticulous assessment of neurovascular integrity and application of external fixation to the left femur and tibia. This initial intervention aimed to stabilize the injury and prevent infection.

Three days post-injury, the patient underwent planned reconstructive surgery under general anesthesia. Positioned supine on a radiolucent flat table. After initial surgical cleaning, the external fixation was removed, and the existing wound was open again provided optimal exposure of the distal femur and proximal tibia. Initially a comminuted fracture of posterior column of tibial plateau was reduced and fixed using intraosseous sutures. The lateral meniscus was sutured next, restoring its integrity. (Figure 3)

For the PCL repair, a PCL guide was placed to the anteromedial side of tibia and centered in the tibial PCL footprint. A tunnel was drilled after the correct positioning of the guide. Then, the PCL was sutured, and the sutures were passed through the canal and fixed to the tibia using Smith & Nephew XTendobutton, attaching the PCL to its position.

For the ACL repair, an ACL guide was centered in the femoral ACL footprint ensuring the anatomical placement of the ligament. The tunnel was drilled from the footprint until the lateral wall of femoral condyle. ACL was sutured and the sutures were passed through the tunnel and fixed with the same technique as PCL.

For the MCL repair, a transverse tunnel from medial to lateral side of the tibial shaft was created. The ligament was sutured, and the sutures were passed through the tunnel and fixed with XTendobutton on the lateral side of tibial shaft attaching the MCL to its position. After, the MCL was enhanced proximally and distally with Internal Brace Swive Lock Anchor - Arthrex system.

For the LCL repair, a tunnel from posterolateral to anteromedial side of the tibial shaft was created. The ligament was sutured, and the sutures were passed through the tunnel and fixed and enhanced with the same technique as the MCL.

The lateral femoral condyle was reduced and fixed with two semi-threaded cannulated screws with washers. The comminuted patella fracture was reduced and fixed with intraosseous sutures and a tension band. After closing the wound, external fixation was reapplied to the femur and

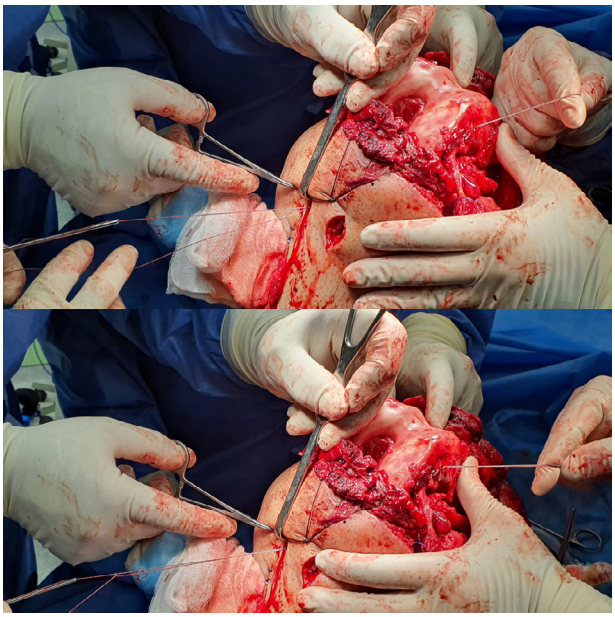

***Figure 3**. Intraoperative photo of the ligament's repair. The positioning of the patient is demonstrated along with the open approach to the knee joint*


***Figure 4**. a) Post-operative AP X-Ray of the patient's left knee joint b)Post-operative lateral X-Ray of the patient's left knee joint*

tibia, with the knee positioned in neutral position to ensure continued stabilization. Postoperative imaging confirmed an adequate anatomical reduction of the fractures. (Figure 4) This approach is consistent with the comprehensive treatment strategies for complex knee injuries detailed in the literature.

Pain management was provided with morphine 3mg PRN. The patient was closely monitored in the orthopaedic ward for 20 days post-operatively, with no signs of infection and stable vitals throughout. Due to the fragility of the trauma, physical therapy was not initiated. However, the patient was allowed to move in bed and flex and extend his ankle joint to avoid stiffness and muscle atrophy.

The third surgery was performed 20 days after the second and involved the removal of the external fixation and application of a functional knee brace. The patient was discharged the following day with instructions on partial weight-bearing using a functional knee brace locked at 0-90 degrees.

The patient attended bi-weekly outpatient visits initially, which were reduced to monthly after one month. Regular X-rays demonstrated proper fracture healing and joint stability. Four months postoperatively, an MRI (Figure 5) indicated that the reattached ligaments were not loose and remained securely attached to the bone, providing excellent stability and functionality. The patient reported no pain during movement or rest and had achieved an adequate range of motion with normal neurovascular signs. During follow-up visits, the stability of the knee joint was assessed with specific tests: ACL stability with Lachman test and Anterior drawer test, PCL with posterior drawer test, LCL with varus stress test, and MCL with valgus stress test. The patient adhered well to the prescribed rehabilitation protocol, including the use of the functional knee brace and partial weight-bearing instructions. No adverse or unanticipated events were reported. He returned to his daily activities, and to his job as a delivery man 6 months post injury.

At nine months post injury, the patient demonstrates full extension and 90 degrees of flexion in the left knee (Figure 5), with no pain during rest

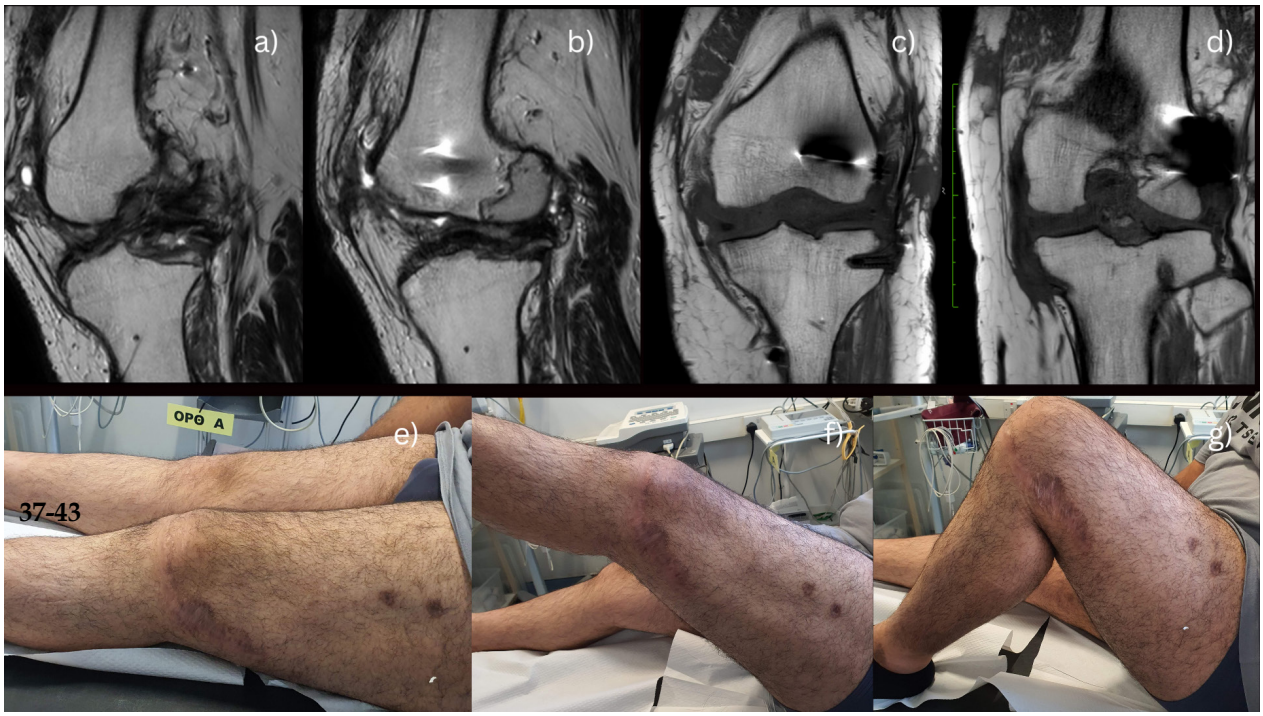


***Figure 5**. a) Post-operative MRI of the left ACL b)Post-operative MRI of the left PCL c)Post-operative MRI of the left LCL d)Post-operative MRI of the left MCL e,f) 9 months post-operatively patient is able to fully extend his left knee g) 9 months post-operatively patient is able to achieve a 90 degree flexion in his left knee*

or movement. His knee joint remains stable, and the patient has no complaints. He has returned to work as a delivery man, performing all his daily activities without difficulty, and is able to fully bear weight on his left limb. His gait is completely normal [video], indicating a successful recovery. The patient's status shows excellent recovery, reflecting a full return to his daily activities and occupational responsibilities.

## Discussion

The case report presented an effective management of a KD-V[3] multiligamentous knee injury using acute open single-stage repair with Internal Brace augmentation. This approach aligns with contemporary trends favoring early surgical intervention and repair of damaged ligaments to enhance outcomes and facilitate rapid return to pre-injury activity levels.[4] Our results add to the growing body of evidence supporting the feasibility and benefits of primary ligament repair in multi ligamentous knee injuries (MLIK).

Schenck's KD classification system, particularly the KD-V subtype, underscores the complexity of injuries involving both ligamentous and bony elements, which are typically associated with high-energy trauma.[3,10] The successful outcome of our patient, who returned to normal activities within 18 weeks post-surgery and resumed work within 6 months, highlights the effectiveness of primary ligament repair, even in such severe cases. The application of Schenck's classification in this context not only facilitated a structured approach to treatment but also supported decision-making in the management of complex periarticular injuries.

The high incidence of repairable ligaments underscores the potential of repair strategies over reconstruction. Specifically, the repair rates for the ACL, PCL, MCL and LCL are notably high, suggesting that many ligaments, even in complex injuries, can be effectively repaired rather than reconstructed[5]. This approach offers several advantages, including reduced surgical morbidity,

preservation of native tissue and avoidance of complications associated with graft harvesting. The successful result in our patient demonstrates that primary ligament repair can restore function efficiently, allowing for a quicker recovery and return to daily activities.

However some factors such as age and BMI may influence the repairability of ligaments, that's why each case must be examined differently to achieve the best result possible for each patient.[6,8] These factors highlight the importance of patient selection in optimizing outcomes for ligament repair and suggest that specific patient demographics may benefit more from repair techniques.

The timing of surgical intervention is crucial for achieving optimal outcomes. Literature supports that early intervention within the period of three weeks tends to yield better outcomes due to superior tissue quality and the ability to distinguish ligaments separately.[7] However, the ideal timeframe remains debated, and further research is needed to determine the optimal window for repair to balance the benefits of early intervention with the risks of postoperative stiffness.

Finally, the application of modern techniques such as suture augmentation in ligament repair has shown promising results in enhancing stability and facilitating early rehabilitation.[9] Our patient's excellent recovery and absence of complications or reinjury attest to the potential of these techniques in managing complex knee injuries. Despite the limitations of our case report, including the fact that it is a sole case, the findings provide a strong basis for further research into the efficacy of primary ligament repair. Continued investigation into patient selection criteria, surgical techniques, and long-term outcomes will be essential to fully realize the benefits of primary repair in the treatment of Multiligamentous knee injuries.

**Acknowledgment**

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**Conflict of Interest**

The authors declared no conflicts of interest.

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