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Functional Outcomes of Multiligament Reconstruction in Traumatic Knee Injuries: A Case Report

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HIGHLIGHTS

- Triple ligament knee injury
- Combined surgical reconstruction
- Early anatomical restoration
- Structured rehabilitation protocol
- Excellent functional recovery

Key Words:
Multiligament knee injury
ACL reconstruction
PCL avulsion
MCL reconstruction
Arthroscopy
Functional outcome

ABSTRACT

Introduction: Multiligament knee injuries (MLKIs) are uncommon but severe traumatic injuries involving the disruption of two or more major knee ligaments. These injuries are associated with significant instability, impaired knee function, and poor long-term outcomes if inadequately treated. Advances in arthroscopic reconstruction techniques and structured rehabilitation have improved functional recovery. **Aim & Objective:** To evaluate the functional outcome of a traumatic multiligament knee injury managed with multiligament knee injury involving the ACL, PCL, and MCL. **Materials & Methods:** A 39-year-old male presented after a road traffic accident with severe knee pain and inability to bear weight. Clinical examinations revealed positive anterior drawer, posterior drawer, and valgus stress tests. MRI confirmed complete ACL, PCL, and MCL tears with PCL femoral avulsion. The patient underwent arthroscopic ACL reconstruction using an ipsilateral peroneus longus tendon autograft, PCL avulsion repair, and open MCL reconstruction with a hamstring tendon graft, followed by a standardized rehabilitation protocol. **Results:** At the nine-month follow-up, the patient demonstrated excellent functional recovery. He was able to walk independently without pain or instability, had no episodes of knee giving way or clicking, comfortably performed cross-legged sitting and squatting, and achieved a knee range of motion from 0° to 130°. **Conclusion:** Early anatomical reconstruction combined with a structured rehabilitation program can result in excellent functional outcomes following multiligament knee injuries. Individualized surgical planning based on the pattern of ligament injury and patient-specific functional demands is essential for restoring knee stability and achieving optimal recovery.

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INTRODUCTION

Multiligament knee injuries (MLKIs) represent one of the most complex and devastating forms of ligamentous trauma involving the knee joint. They are characterized by the simultaneous disruption of two or more of the major stabilizing ligaments of the knee, including the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), lateral collateral ligament (LCL), and the structures of the posterolateral corner (PLC) [1,2]. These injuries most commonly occur following high-energy trauma such as road traffic accidents, falls from height, sports-related injuries, or industrial accidents [2,3]. Due to the substantial force required to produce these injuries, MLKIs are frequently associated with concomitant meniscal tears, osteochondral lesions, fractures, vascular injuries, and peroneal nerve injuries, making them one of the most challenging conditions encountered in orthopedic trauma [3,4]. The reported incidence of vascular injury ranges from 7% to 32%, while common peroneal nerve injuries have been reported in approximately 10–40% of cases, emphasizing the importance of meticulous clinical evaluation and prompt diagnosis [3,5].

The knee joint relies on the coordinated function of static and dynamic stabilizers to maintain normal biomechanics and functional stability during movement. Simultaneous injury to multiple ligamentous structures disrupts these stabilizing mechanisms, resulting in gross instability in both sagittal and coronal planes, impaired proprioception, pain, recurrent episodes of giving way, restricted range of motion, and inability to perform routine daily activities [2,6]. If diagnosis is delayed or treatment is inadequate, patients are at increased risk of developing chronic instability, arthrofibrosis, persistent pain, muscle weakness, recurrent falls, and progressive post-traumatic osteoarthritis, all of which significantly compromise long-term functional outcomes and quality of life [4,7]. Therefore, early recognition and comprehensive assessment of these injuries are essential to optimize patient outcomes.

Accurate diagnosis of MLKIs requires a systematic clinical examination supplemented by appropriate imaging modalities. Physical examination should include assessment of ligamentous stability using specialized tests such as the anterior and posterior drawer tests, Lachman test, valgus and varus stress tests, dial test, and posterolateral drawer test [2,8]. However, acute pain, swelling, and muscle spasm may limit the reliability of clinical examination immediately after injury. Plain radiographs are useful for identifying associated fractures, joint alignment abnormalities, and avulsion injuries, whereas magnetic resonance imaging (MRI) remains the gold standard for evaluating the extent of ligamentous disruption, meniscal injuries, cartilage damage, and associated soft-tissue pathology [8,9]. In cases of knee dislocation or suspected vascular compromise, vascular assessment with Doppler ultrasonography or computed tomography angiography (CTA) should be performed promptly to prevent limb-threatening complications [3,5].

Over the past two decades, the management of multiligament knee injuries has undergone a substantial transformation.

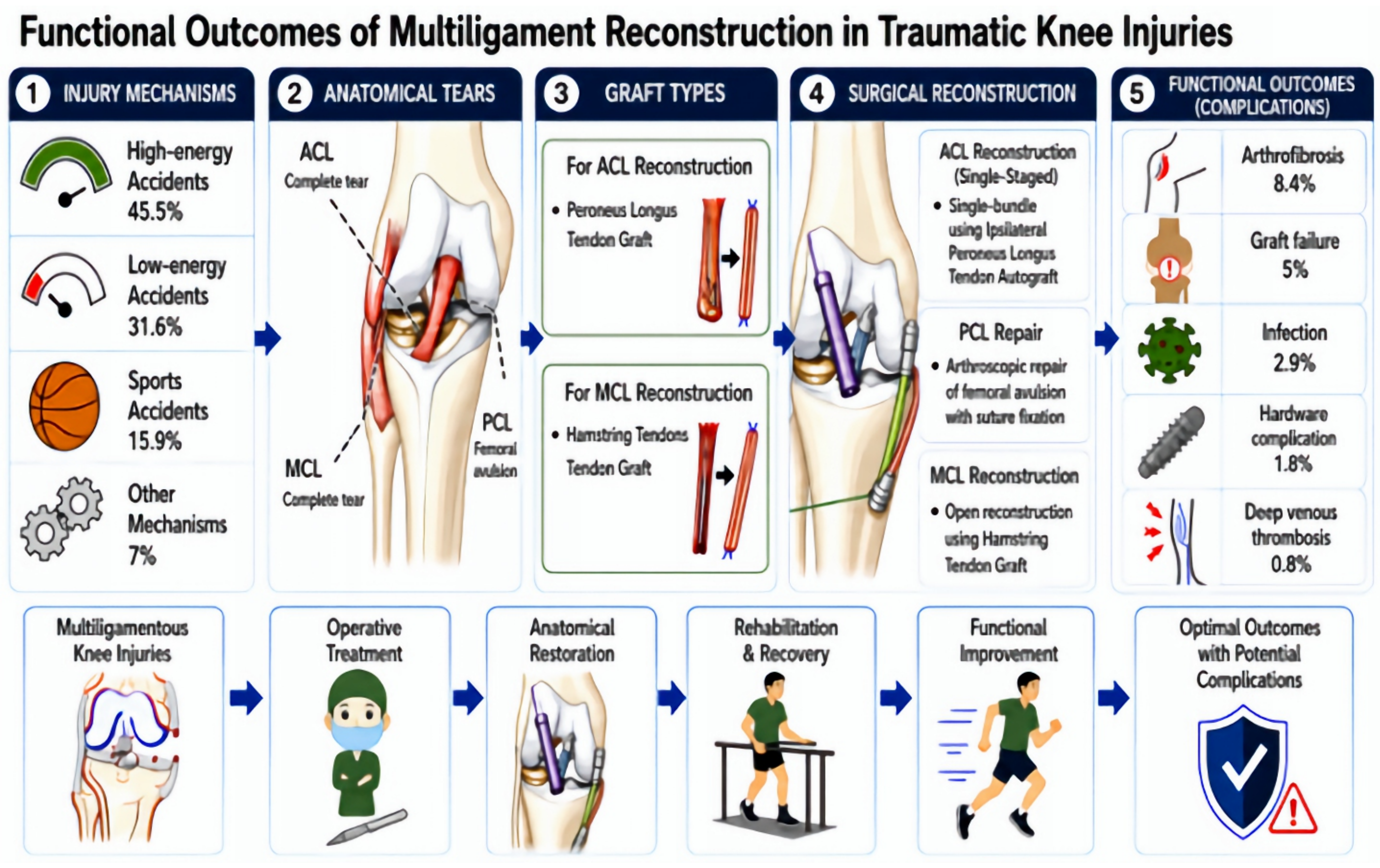

Figure 1: Functional outcomes of single-stage multiligament knee reconstruction in traumatic knee injuries.

Historically, conservative treatment or delayed surgical intervention often resulted in poor functional recovery because of persistent instability and prolonged immobilization leading to joint stiffness [2,6]. With the advent of minimally invasive arthroscopic techniques, improved fixation devices, advanced graft options, and standardized rehabilitation protocols, anatomical reconstruction has become the preferred treatment strategy for most active patients [2,10]. Current evidence suggests that early or staged surgical reconstruction of injured ligaments provides superior restoration of knee biomechanics, improved stability, higher patient satisfaction, and better functional outcomes compared with non-operative management [10–12]. Nevertheless, several aspects of treatment remain controversial, including the optimal timing of surgery, single-stage versus staged reconstruction, graft selection, management of associated ligament injuries, and postoperative rehabilitation protocols [11,12]. Consequently, treatment should be individualized according to the patient's age, activity level, injury mechanism, associated injuries, chronicity of the lesion, and functional demands.

Selection of an appropriate graft is another important consideration in multiligament reconstruction. Although hamstring tendon and bone–patellar tendon–bone autografts remain widely used, the ipsilateral peroneus longus tendon has emerged as a reliable alternative because of its favorable biomechanical characteristics, adequate graft diameter and length, and minimal donor-site morbidity [13,14]. Its use is particularly advantageous in multiligament injuries where hamstring tendons may be preserved for collateral ligament reconstruction. Similarly, advancements in arthroscopic techniques have enabled precise anatomical reconstruction of intra-articular ligaments with reduced soft-tissue dissection, less postoperative pain, and earlier initiation of rehabilitation, ultimately contributing to improved functional recovery [10,12]. Equally important to successful surgical management is a structured and individualized rehabilitation program. Rehabilitation following multiligament reconstruction aims to protect the reconstructed ligaments during the healing phase while progressively restoring knee range of motion, muscle strength, proprioception, and functional stability [15]. Early quadriceps exercises, controlled weight-bearing, gradual progression of range-of-motion exercises, and supervised strengthening protocols have been shown to reduce postoperative stiffness and facilitate return to daily activities and sports [15,16]. Thus, the overall outcome of treatment depends not only on meticulous surgical reconstruction but also on patient compliance with rehabilitation and close clinical follow-up. **Figure 1.** The illustration summarizes the mechanism of injury, associated ligament tears (ACL, MCL, and PCL femoral avulsion), graft selection, single-stage surgical reconstruction techniques, postoperative rehabilitation, and functional recovery, along with the incidence of major postoperative complications including arthrofibrosis, graft failure, infection, hardware-related complications, and deep venous thrombosis.

The present case report describes the successful management of a 39-year-old male with a traumatic multiligament knee injury involving complete tears of the anterior cruciate ligament, posterior cruciate ligament, and medial collateral ligament, along with femoral avulsion of the posterior cruciate ligament following a road traffic accident. The patient underwent arthroscopic single-bundle ACL reconstruction using an ipsilateral peroneus longus tendon autograft, arthroscopic repair of the PCL femoral avulsion, and open MCL reconstruction using a hamstring tendon graft, followed by a structured rehabilitation protocol. At nine months of follow-up, the patient achieved excellent functional recovery, with restoration of knee stability, painless independent ambulation, full participation in routine daily activities, and a knee range of motion of 0°–130°. This case highlights the importance of early anatomical reconstruction, appropriate graft selection, and comprehensive postoperative rehabilitation in achieving favorable functional outcomes following complex multiligament knee injuries.

MATERIALS & METHODS

The patient was a 39-year-old male who presented to the Department of Orthopaedics following a road traffic accident with complaints of severe pain, swelling, and inability to bear weight on the affected lower limb. A detailed clinical examination was performed, which revealed positive anterior drawer, posterior drawer, and valgus stress tests, suggestive of combined cruciate and medial collateral ligament injury. Distal neurovascular status was intact. Plain radiographs of the knee were obtained to exclude associated fractures or dislocations, followed by magnetic resonance imaging (MRI), which demonstrated complete tears of the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and medial collateral ligament (MCL), along with femoral avulsion of the PCL. Based on the clinical and radiological findings, the patient was diagnosed with a traumatic multiligament knee injury and was planned for operative management after obtaining informed consent. The surgical procedure was performed under appropriate anesthesia using a combined arthroscopic and open approach. Arthroscopic single-bundle ACL reconstruction was carried out using an ipsilateral peroneus longus tendon autograft. Arthroscopic repair of the femoral avulsion of the PCL was subsequently performed to restore its anatomical attachment. Open reconstruction of the MCL was then completed using a hamstring tendon graft. Following graft fixation, appropriate tensioning was confirmed throughout the range of knee motion to ensure satisfactory stability before wound closure. The procedure was completed without any intraoperative complications.

Postoperatively, a sterile compression dressing was applied, and the knee was immobilized in full extension using a hinged knee brace. The patient followed a standardized rehabilitation protocol consisting of protected weight-bearing with crutches during the first four weeks, along with quadriceps strengthening exercises, straight-leg raising, and passive knee flexion up to 90°.

From the fourth to the eighth postoperative week, gradual partial weight-bearing was initiated in conjunction with open-chain quadriceps exercises, progressive knee flexion up to 60°–75°, and closed-chain strengthening exercises. After eight weeks, the brace and crutches were discontinued, and the patient progressed to independent ambulation with continued strengthening, balance training, and functional rehabilitation exercises. The rehabilitation program was designed to achieve gradual restoration of knee range of motion while protecting the reconstructed ligaments and optimizing functional recovery.

RESULT

Preoperative clinical assessment and MRI findings demonstrated injuries to the anterior cruciate ligament, posterior cruciate ligament, and medial collateral ligament **(Table 1).** Details of the surgical procedures performed for anatomical reconstruction of the injured knee ligaments, including the reconstruction technique and graft utilized for each ligament **(Table 2).** Comparison of preoperative clinical status and functional outcomes at the 9-month postoperative follow-up following arthroscopic ACL reconstruction, PCL femoral avulsion repair, and open MCL reconstruction **(Table 3)**.

Figure 2. Preoperative magnetic resonance imaging demonstrated complete tears of the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL) with femoral avulsion, and medial collateral ligament (MCL). **Figure 3.** evaluates an intraoperative arthroscopic image showing single-bundle ACL reconstruction using the ipsilateral peroneus longus tendon autograft and arthroscopic repair of the femoral avulsion of the posterior cruciate ligament. **Figure 4.** shows open medial collateral ligament reconstruction using a hamstring tendon graft. **Figure 5.** shows the AP and lateral postoperative radiographs.

Table 1: Clinical Examination and MRI Findings

Parameter	Findings
Mechanism of injury	Road traffic accident
Anterior drawer test	Positive
Posterior drawer test	Positive
Valgus stress test	Positive
MRI findings	Complete ACL tear, femoral avulsion of the PCL , complete MCL tear
Diagnosis	Multiligament knee injury (ACL + PCL + MCL)

Table 2: Surgical Procedure Performed

Injured Structure	Surgical Technique	Graft/Procedure
ACL	Arthroscopic single -bundle reconstruction	Ipsilateral peroneus longus tendon autograft
PCL	Arthroscopic repair	Femoral avulsion repair
MCL	Open reconstruction	Hamstring tendon graft

Table 3. Functional Outcome at 9-Month Follow-up

Outcome Parameter	Result
Knee range of motion	0°–130°
Knee stability	Stable
Pain	Absent
Walking	Independent
Cross-legged sitting	Achieved
Squatting	Achieved
Clinical outcome	Excellent
IKDC 2000 score	96
Lysholm Knee Score	93
AOFAS (American Orthopaedic Foot & Ankle Society) score	94

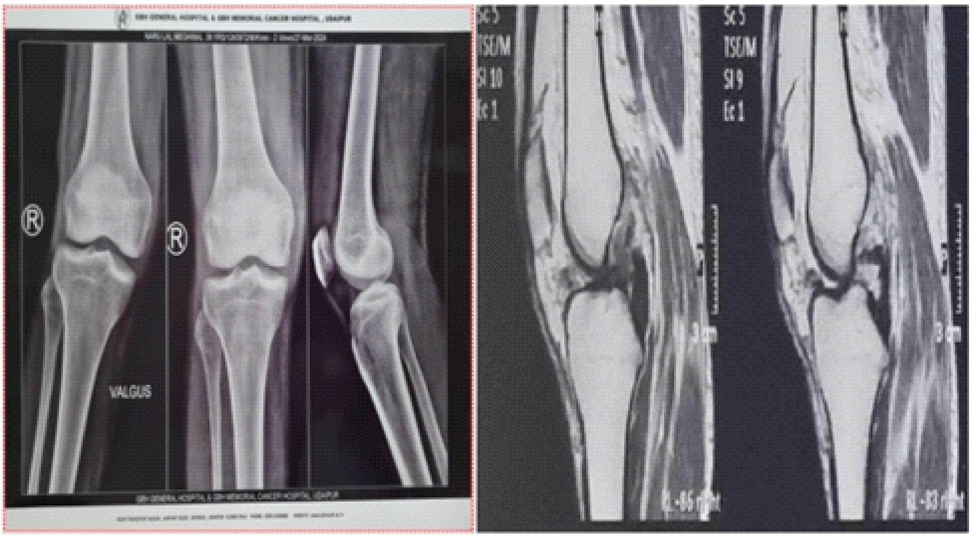

Figure 2: Preoperative MRI Demonstrating Complete ACL Tear, PCL Femoral Avulsion, and Complete MCL Tear

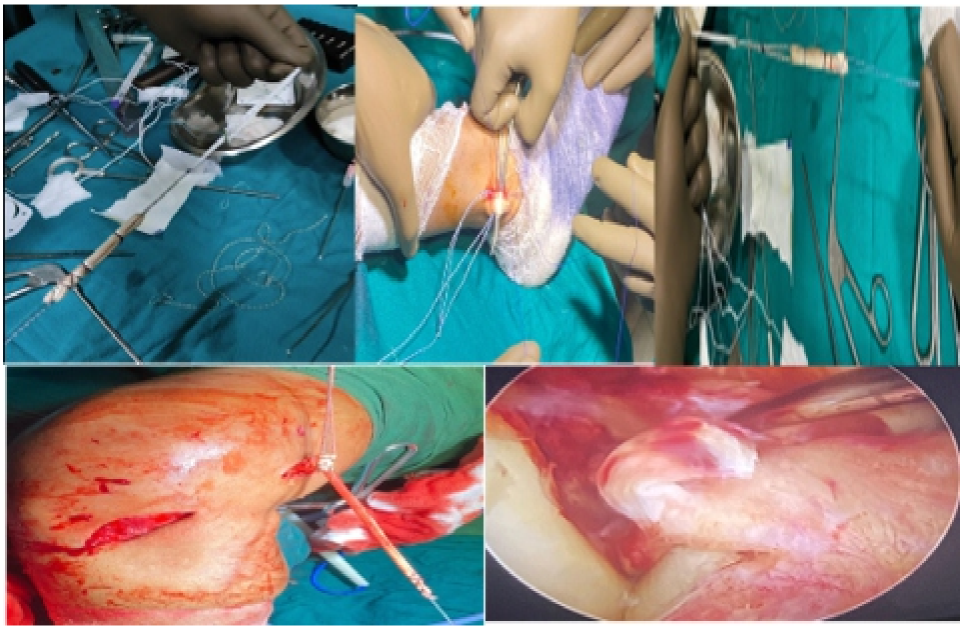

Figure 3: Intraoperative Arthroscopic View of ACL Reconstruction and PCL Femoral Avulsion Repair

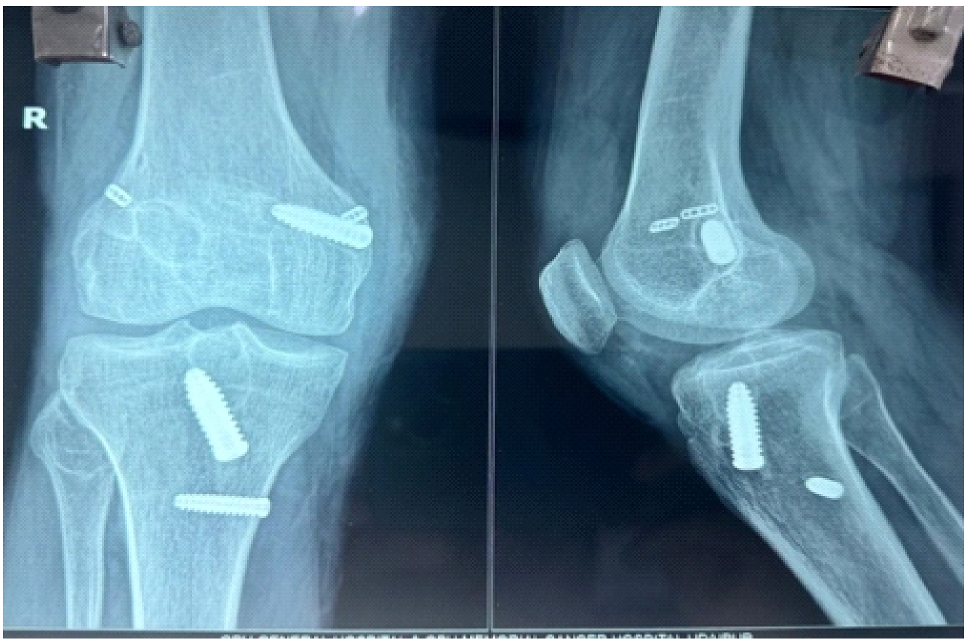

Figure 4: Open MCL Reconstruction Using Hamstring Tendon Graft

Figure 5: Postoperative Radiographs Demonstrating Satisfactory Graft Fixation and Tunnel Placement

DISCUSSION

Multiligament knee injuries (MLKIs) are among the most complex and challenging injuries encountered in orthopedic trauma because they involve disruption of two or more of the primary stabilizing structures of the knee [1,2]. These injuries are typically associated with high-energy trauma, particularly road traffic accidents. They are often accompanied by extensive soft tissue damage, meniscal injuries, chondral lesions, vascular compromise, or neurological deficits [2–5]. Failure to recognize and appropriately manage these injuries may result in chronic instability, persistent pain, reduced range of motion, stiffness, early osteoarthritis, and significant functional disability [4,6]. Consequently, early diagnosis through a comprehensive clinical examination and advanced imaging modalities, particularly magnetic resonance imaging (MRI), plays a crucial role in defining the pattern of ligament injury and planning appropriate surgical intervention [8,9].

The management of MLKIs has evolved considerably over the past two decades. Earlier treatment strategies frequently involved prolonged immobilization or delayed reconstruction, often leading to poor functional outcomes due to joint stiffness and persistent instability [6,10]. With advances in arthroscopic techniques, improved fixation devices, and a better understanding of knee biomechanics, anatomical reconstruction of injured ligaments has become the preferred treatment option for active individuals [10–12].Current evidence suggests that surgical reconstruction provides superior restoration of knee stability, improved functional outcomes, and a greater likelihood of returning to pre-injury activity levels compared with non-operative management [10–12]. However, the optimal surgical strategy remains controversial because treatment must be individualized according to the specific injury pattern, associated soft tissue damage, timing of surgery, patient age, activity level, and surgeon expertise [11,12].

In the present case, a combined arthroscopic and open surgical approach was adopted to restore the normal biomechanics of the knee. Arthroscopic single-bundle reconstruction of the ACL using an ipsilateral peroneus longus tendon autograft provided excellent graft strength and adequate graft diameter while minimizing donor-site morbidity [13,14]. Repair of the femoral avulsion of the PCL was performed arthroscopically to achieve anatomical restoration of the posterior stabilizing mechanism, whereas open reconstruction of the MCL using a hamstring tendon graft effectively restored medial stability. The combination of these procedures allowed simultaneous reconstruction of the major injured ligaments while preserving surrounding soft tissues and facilitating early postoperative rehabilitation. The successful outcome observed in this patient supports the concept that anatomical restoration of each injured ligament contributes significantly to overall knee stability and functional recovery [10,12]. The selection of the ipsilateral peroneus longus tendon as the graft for ACL reconstruction deserves consideration. Recent biomechanical and clinical studies have demonstrated that the peroneus longus tendon possesses tensile strength comparable to conventional hamstring tendon grafts while offering adequate graft diameter and minimal donor-site morbidity [13,14]. Furthermore, preservation of the hamstring tendons for collateral ligament reconstruction represents a significant advantage in patients with multiligament injuries. In the present case, utilization of the peroneus longus tendon enabled simultaneous reconstruction without compromising graft quality or post-operative ankle function. Equally important to the surgical procedure was the structured post-operative rehabilitation protocol. Rehabilitation following multiligament reconstruction requires a careful balance between protecting the reconstructed ligaments and preventing post-operative stiffness [15,16]. Early quadriceps exercises, controlled range-of-motion exercises, gradual progression of weight-bearing, and supervised strengthening exercises are essential for restoring joint mobility, muscle strength, and proprioception while minimizing the risk of graft failure [15]. In this case, adherence to a standardized rehabilitation protocol allowed gradual improvement in knee function without compromising ligament healing. The patient achieved independent ambulation, painless knee motion, and satisfactory functional activities, including cross-legged sitting and squatting, by the end of the nine-month follow-up period.

At the final follow-up, the patient demonstrated excellent clinical and functional outcomes, with no evidence of instability, pain, or mechanical symptoms. A knee range of motion of 0°–130°, combined with the ability to perform routine daily activities independently, indicated successful restoration of knee bio-mechanics and function. These findings are consistent with previous studies demonstrating that early anatomical reconstruction combined with comprehensive rehabilitation provides favorable medium and long-term outcomes in patients with multiligament knee injuries [10–12,15].

Although the present report describes a single case, it highlights the importance of individualized treatment planning, meticulous surgical technique, appropriate graft selection, and structured rehabilitation in achieving successful outcomes following complex multiligament knee injuries. Larger prospective studies with longer follow-up periods and standardized functional outcome measures such as the International Knee Documentation Committee (IKDC), Lysholm Knee Score, and AOFAS (American Orthopaedic foot & ankle society score) are warranted further to establish the long-term efficacy of this combined reconstructive approach. Nevertheless, this case demonstrates that timely anatomical reconstruction of multiple injured ligaments can restore knee stability, improve functional performance, and facilitate return to normal daily activities with excellent short-term clinical outcomes.

CONCLUSION

Multiligament knee injuries require prompt diagnosis, careful surgical planning, and a comprehensive rehabilitation strategy to achieve satisfactory functional outcomes. This case demonstrates that combined arthroscopic ACL reconstruction, arthroscopic repair of PCL femoral avulsion, and open MCL reconstruction can effectively restore knee stability and function in patients with complex ligament injuries. Individualizing the surgical approach according to the pattern of ligament injury and implementing a structured rehabilitation protocol are essential for achieving optimal recovery and improving long-term functional outcomes.

LIMITATIONS & FUTURE PERSPECTIVES

The study's limitations include a single-centre setting, a relatively small sample size, and a short study duration, which may limit the broader applicability of the results. Future studies should incorporate multicentre designs with larger populations to enhance validity, assess long-term outcomes, and investigate advanced diagnostic & management approaches. Such efforts will improve overall patient care & help minimize complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical health-.care, diagnosis, and treatment outcomes. By highlighting real-world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

MLKI: Multiligament Knee Injury
ACL: Anterior Cruciate Ligament
PCL: Posterior Cruciate Ligament
MCL: Medial Collateral Ligament
RTA: Road Traffic Accident
ROM: Range of Motion
PLT: Peroneus Longus Tendon
IKDC: International Knee Documentation Committee
Lysholm Score (LKS): Lysholm Knee Score
AOFAS: American Orthopaedic foot & ankle society score

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a re-asonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research diretions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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