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Case Report

Comprehensive management of high-grade knee injuries: a case report and surgical technique on patellar tendon rupture with multi ligament injury following self reduced posterior dislocation of knee

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ABSTRACT

Knee dislocations and patellar tendon ruptures are rare but complex injuries. Incidence of patellar tendon rupture is approximately 0.5% of the general population each year. These injuries are often present with a wide range of symptoms, depending on the structures involved. Significant soft tissue damage is almost always present, frequently accompanied by multi-ligamentous injuries and bony involvement. The potential for neurovascular compromise, particularly injury to the popliteal artery, adds to the urgency of prompt diagnosis and management and are considered as surgical emergencies. Delayed diagnosis or inadequate treatment can lead to devastating complications. A 42-year-old male presented with a high-grade knee injury diagnosed with a complete patellar tendon rupture, complete anterior cruciate ligament (ACL) disruption, and partial posterior cruciate ligament (PCL) tear, along with complex tears in both the medial, lateral menisci and osteochondral fractures, posing challenges for surgical planning. Single stage surgical intervention was planned. ACL reconstruction with peroneus longus tendon graft, medial meniscal balancing, lateral meniscal root repair and semitendinosus graft was harvested with an open stripper with insertion kept intact for patellar tendon repair with augmentation. PCL and collateral ligaments were managed conservatively since they found stable. A tailored rehabilitation protocol focused on early mobilization and progressive strengthening was implemented postoperatively. This case highlights the complexity of high-grade knee injuries involving multiple structures and the importance of thorough evaluation and surgical intervention. The tailored rehabilitation protocol facilitated recovery, leading to significant improvements in range of motion (ROM) and functionality. Individualized management strategies are crucial for addressing these complexities, ultimately enhancing patient outcomes and minimizing complications.

Keywords: Knee dislocation, Patellar tendon rupture, Multiligament injury, Complex knee injuries, Surgical management, Patellar tendon reconstruction

INTRODUCTION

Knee dislocations are uncommon but serious injuries, usually resulting from high-impact trauma such as motor vehicle accidents, falls from significant heights, or sports-related collisions.[1] These injuries are complex and often present with a broad spectrum of symptoms depending on the structures involved. Almost always, there is significant soft tissue damage, including injuries to multiple ligaments. Bony involvement is also common, and the presence of neurovascular damage can make the situation even more critical. The risk of vascular compromise, such as injury to the popliteal artery, adds another layer of urgency to the management of these injuries. Due to the severity of knee dislocations, they are often considered surgical emergencies. If left untreated or if diagnosis is

delayed, the risk of severe complications such as amputation significantly increases, especially when vascular injuries go unrecognized. Even in cases where the knee spontaneously reduces prior to medical evaluation, there remains a high risk of serious neurovascular damage that can lead to long-term functional deficits. Prompt recognition and treatment are essential to avoid complications like arthrofibrosis (joint stiffness) and chronic instability, both of which can significantly impact a patient's quality of life. Early intervention, particularly surgical reconstruction of damaged ligaments and repair of vascular injuries, is often necessary to optimize outcomes. Accurate early diagnosis and swift, comprehensive treatment are critical in managing this complex and potentially life-altering injury.

CASE REPORT

A 42 year old male presented to emergency department with alleged history of skid and fall from bike, sustained injury to right knee. Patient complains of pain and swelling over right knee with inability to walk. Patient is diabetic and not on regular treatment.

On clinical examination there was no signs of head injury and other injuries. On examining the right knee there was a lacerated wound of 1×1 cm over tibial tuberosity, tenderness and swelling were noted on the right knee with knee ROM restricted to 0-30 degrees. Lachman's test was elicited and found to be positive. Anterior drawer test, pivot-shift test and Mc-Murrays test could not be done due to pain. Active SLR was not possible with a high riding patella was noted. His distal pulses were palpable and comparable with contralateral side and there were no neurological deficits. All polytrauma evaluation has been done. Radiology of affected knee showed a high riding patella with tibial tuberosity avulsion injury with multiple loose osteo-cartilaginous fragments in the notch and anterior aspect of knee joint

Figure 1 (A and B): X-ray right knee ap and lateral view.

Due to severity of trauma and findings from x ray patient was worked up for CT and MRI scan to rule out other bone and soft tissue involvement. CT scan of knee revealed depressed fracture of postero-lateral tibial plateau with displacement and bony fragments are found to be in joint space. There was also associated inferior avulsion of patellar tendon.MRI of right knee with contrast showed high grade injury with complete tear of patellar tendon. There was also associated complete disruption with high grade tear of ACL with partial PCL injury. Medial and lateral meniscus appears to show complex tear in body and posterior horn. Sprain of LCL and MCL was noted. Popliteal artery showed preserved luminal opacification. A osteochondral defect was noted in lateral tibial condyle with osteochondral fragments in inter-condylar region.

Figure 2 (A and B): CT sagittal section showing the patellar tendon rupture and osteochondral fragment inside the joint.

Figure 3 (A and B): CT and MRI images showing osteochondral fragment inside the joint.

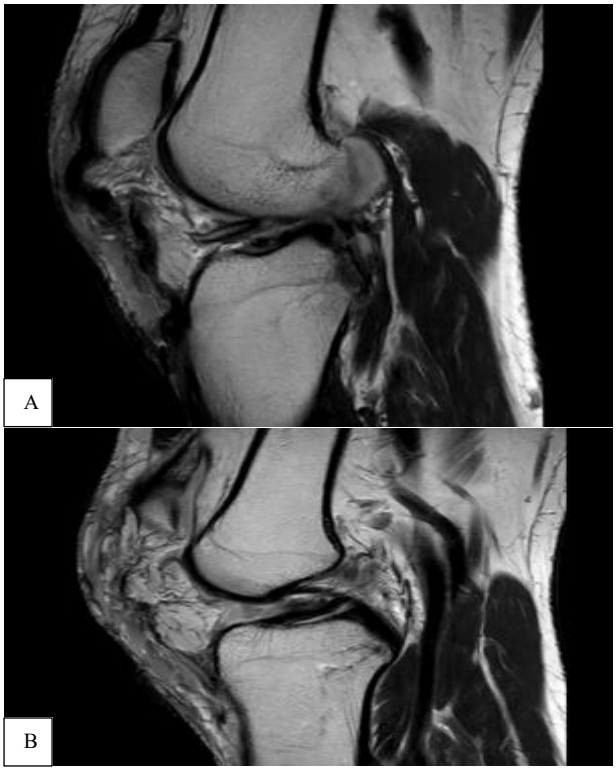

Figure 4 (A and B): Sagittal section of knee showing tendon rupture with osteochondral fragment with meniscal injury.

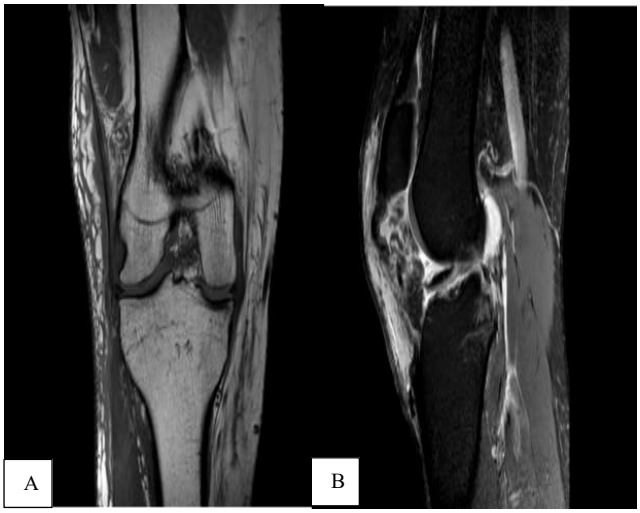

Figure 5 (A and B): Significant marrow edema of postero-lateral tibial condyle with bone loss in sagittal cuts and empty notch sign respectively in coronal cuts.

Based on history and pattern of injury it was deduced that patient suffered 'a self-reduced posterior dislocation of right knee'.

Final diagnosis

Right knee posterior dislocation (self-reduced) with multi-ligament injury and patellar tendon injury without any neurovascular injury

Decision on surgery

Even though there is no consensus on the best surgical technique to use, surgical management deemed necessary.

Table 1: Structures damaged and management planned.

Structures damaged	Management planned
ACL	Open ACL reconstruction
Patellar tendon injury	Patellar tendon fixation with augmentation
Medial and lateral meniscus	Repair/balancing
Osteochondral fragment	Fixation

Surgical procedure

After necessary pre-op investigations and planning, patient was admitted with knee stabilized using a knee immobilizer. Vascular status was assessed for 24 hours to rule out popliteal artery intimal injury. Patient was then taken to operating table

A midline vertical incision is taken over right knee. Full thickness flaps were raised. Full thickness mid substance patellar tendon tear was noted. Upon opening up the joint severe haemarthrosis was noticed and thorough lavage was done for the same. Two loose osteocartilaginous bone fragments are noted inside knee joint of size 2×1 cm and 3×2 cm respectively. Chondral damage of grade 3-4 was noted in patella, lateral and medial tibial condyle and medial and lateral femoral condyle.

Lateral meniscus posterior horn and root tear was found for which meniscal balancing is done with repair of root with pull-out sutures is done Medial meniscus tear is noted in the posterior horn was balanced up to the margins.

Postero-lateral tibial condyle showed full thickness osteo-cartilaginous bone loss corresponding with the larger loose bony osteocartilaginous fragments which were retrieved and fixed with tissue glue.

Figure 6: On midline approach exposing the torn patellar tendon.

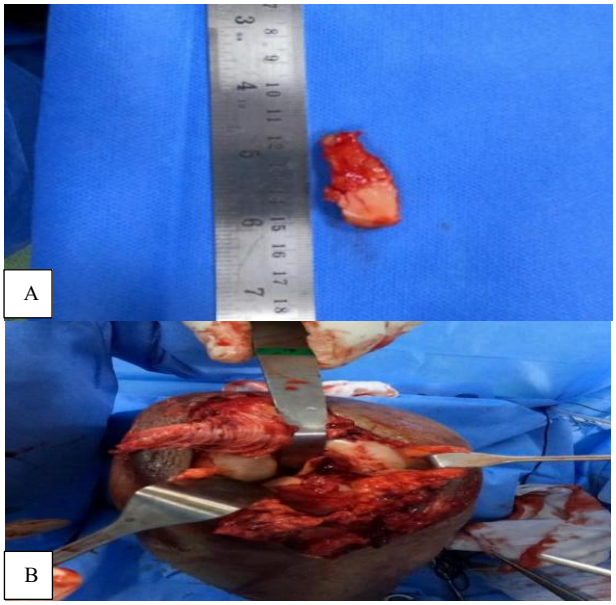

Figure 7 (A and B): Postero-lateral tibial condyle osteochondral fracture fragment and patellar tendon rupture with postero-lateral fragment loss with ACL tear noted.

ACL showed complete mid substance tear for which peroneus longus tendon is harvested from ipsilateral leg, prepared and tripled. Graft is then passed through the tunnel prepared at the footprint and fixed on femoral side with adjustable loop and endobutton and tibial side with bio interference screws with adequate tension. PCL showed partial tear which was stable on probing.

Semitendinosus graft is harvested with open stripper without detaching the attachment from insertion and tendon end prepared, whipstitches applied. Horizontal tunnel is prepared in the middle of patella. ST graft is looped through patellar tunnel medial to lateral direction. another horizontal tunnel made at level of tibial tuberosity and tendon looped from lateral to medial direction end to end repair of tendinosus tendon is done. Patellar tendon is repaired with 2-0 fiber wire. Post repair, patella found to be tracking normally and stable on movements.

Figure 8: Looped st graft with repair of patellar tendon.

Post-operative protocol

Post operative protocol consists of non-weight bearing mobilization for 3 months. No splints were used for immobilization. Passive ROM of 0-90 degrees was allowed from day 1. ROM increased every 10 degree after 3 weeks. Static quads and hamstring strengthening exercises was advised. Periodic followup was done. Partial weight bearing was started at 6 weeks on wards and full weight bearing at 3rd month.

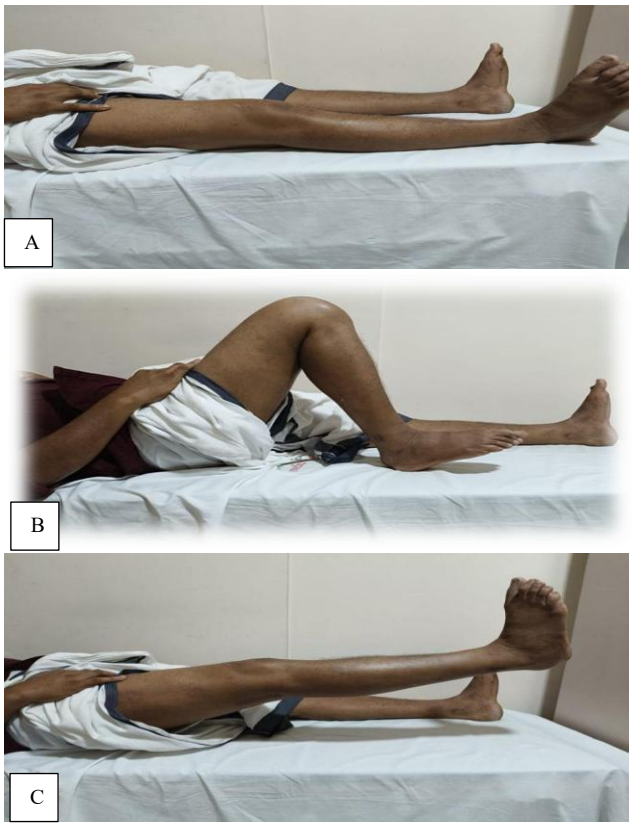

Figure 9 (A-C): Three month follow up of patient with full extension without lag and felxion from 0 to 110 degrees ROM.

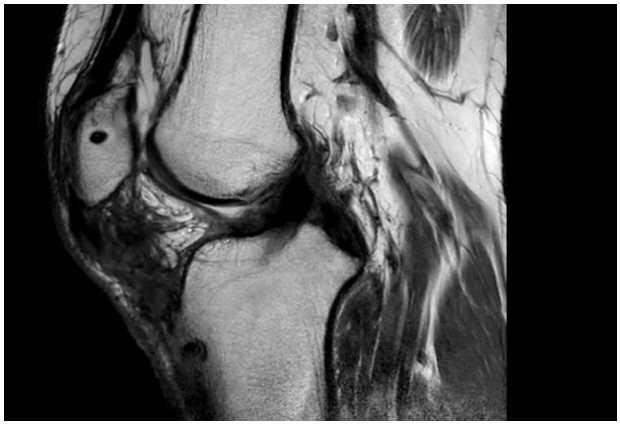

Figure 10: Six month follow up MRI sagittal view showing patellar and tibial tunnels for attaching semitendinosus autograft with intact graft.

DISCUSSION

Knee dislocations are rare, accounting for less than 0.2% of all orthopedic injuries.[1]

Schenck introduced an anatomical classification system for knee dislocations, which Wascher later modified to reflect the structures involved in the injury.[2,3] In this system, knee dislocation I refers to a dislocation where the PCL remains intact. Knee dislocation II involves injury to both cruciate `ligaments, while the corner structures are preserved. Knee Dislocation III includes damage to both cruciate ligaments with either the posteromedial or posterolateral corner intact, but the opposite one is torn. Knee dislocation IV involves injuries to both cruciate ligaments and both corner structures. Lastly, knee dislocation V includes knee dislocations that occur alongside a periarticular fracture. Studies by Taylor et al, Mitchell, and Thomsen et al have supported nonsurgical management of knee dislocations, but more recent research has shown a preference for surgical intervention.[4-6] The current approach leans toward early reconstruction for ligamentous injuries.[7-9] Incidence of patellar tendon rupture is approximately 0.5% of the general population each year.[18] A patellar tendon rupture, characterized by a complete tear of the tendon connecting the patella's inferior pole to the tibial tubercle, commonly occurs in males during their third or fourth decade of life, typically arising from a weakened tendon subjected to excessive tensile forces, and is classified as either acute or chronic based on the duration since the injury, necessitating prompt diagnosis and surgical intervention due to the patellar tendon's integral role in the extensor mechanism.[10] Numerous researchers have described the mechanism of patellar tendon injuries in sports as being primarily due to the rapid deceleration force exerted on a planted foot when the knee is in a flexed position, coupled with an eccentric contraction of the quadriceps muscle, which creates significant stress on the tendon and increases the likelihood of rupture under high-intensity movements or sudden changes in direction.[11] Despite anatomical and biomechanical differences between KD3-M and KD3-L types of multiligamentous knee injuries (MLKIs), single-stage management of all three damaged structures yielded favorable clinical outcomes, reducing the need for staged reconstruction, minimizing morbidity, shortening rehabilitation time, and showing better results when performed within six weeks, particularly with early collateral ligament repair for grade 3 laxity or conservative management for grade 2 laxity after cruciate ligament reconstruction.[12]

Since patellar tendon rupture with multiligament injury is one of the least addressed topics, the efforts of Sundhararajan et al with the Ganga classification shed light on decision-making for operating surgeons. The classification offers a structured approach to managing complex injuries, categorizing them based on severity and associated ligament damage. This system provides clear guidance on whether to pursue single- or multi-stage surgical interventions, including when to incorporate open patellar tendon repair, ligament reconstruction, and fracture fixation, thus facilitating tailored and effective treatment strategies.[13]

In our case scenario, we faced a high-grade knee injury characterized by a complete tear of the patellar tendon, alongside a complete disruption of the ACL and a partial tear of the PCL. Additional injuries included complex tears in both the medial and lateral menisci, as well as sprains of the lateral collateral ligament (LCL) and medial collateral ligament (MCL). The presence of osteochondral fractures added further complexity to the situation, leading to uncertainty about whether to proceed with a single-stage or multi-stage surgical procedure. Notably, this injury pattern did not conform to any existing classification systems, presenting a significant challenge in surgical planning. Upon opening the joint, we observed severe hemarthrosis, which was addressed with thorough lavage. Two loose osteocartilaginous bone fragments were identified along with chondral damage was noted at a grade 3-4 level on the patella, lateral and medial tibial condyles, and medial and lateral femoral condyles, indicating extensive articular surface involvement. A significant finding was the posterior horn and root tear of the lateral meniscus, which necessitated meniscal balancing and repair using pull-out sutures. The medial meniscus tear in the posterior horn, which was also balanced. Postero-lateral tibial condyle had a full-thickness osteo-cartilaginous bone loss, which corresponded with the larger loose bony fragments that were subsequently retrieved and fixed using tissue glue. The ACL showed a complete midsubstance tear, prompting the harvesting of the peroneus longus tendon from the ipsilateral leg. This tendon was prepared and tripled before being passed through a tunnel prepared at the ACL footprint. The graft was securely fixed on the femoral side using an adjustable loop and endobutton, and on the tibial side with bio-interference screws. Although the PCL demonstrated a partial tear, it remained stable upon probing, suggesting that extensive reconstruction may not have been necessary. We proceeded to harvest the semitendinosus graft using an open stripper technique, preserving its insertion. This tendon was prepared with whipstitches, and a horizontal tunnel was created through the middle of the patella to facilitate graft passage in a medial-to-lateral direction. Another horizontal tunnel was made at the level of the tibial tuberosity, allowing for an end-to-end repair of the tendinous tissue.

The patellar tendon was repaired with 2-0 fiber wire, and post-repair examination revealed that the patella tracked normally and exhibited stability during movement.

After surgical intervention, another crucial hurdle is postoperative rehabilitation. Since there are no established rehabilitation protocols available for such a case scenario, a detailed literature review required which encompassing both recent and historical studies.

Conflicting evidence exists regarding the effectiveness of functional braces in adequately controlling knee forces to prevent re-injury following ligament reconstruction, with most studies focusing on the ACL and providing some support for their use in managing anterior tibial translation after ACL injuries; however, the reliability of these findings is often challenged due to small sample sizes and inadequate study designs.[14-16] A study evaluating 11 patients with a mean age of 42 years, followed for an average of 26 months after suture repair of the patellar tendon and retinacula protected by cerclage wire, demonstrated that postoperative immobilization in a cast is unnecessary, with excellent functional outcomes including a mean Lysholm knee score of 97, an average Insall-Salvati ratio of 1.0, no fixed flexion deformities or extensor lag, and an average ROM of 0-137, along with a minimal power loss of 6% in concentric extension and 7% in concentric flexion between the operated and control knee.[17]

A tailored rehabilitation protocol was developed for this patient, focusing on a progressive approach to recovery. The postoperative protocol included a period of non-weight bearing mobilization for the first three months, with no splints utilized for immobilization. From day 1 post-surgery, the patient was allowed passive ROM from 0 to 90 degrees. This range was systematically increased by 10 degrees every three weeks to promote flexibility and joint health. Additionally, the patient was advised to perform static quadriceps and hamstring strengthening exercises to enhance muscle support around the knee.

Periodic follow-ups were conducted to monitor the patient's progress and adjust the rehabilitation protocol as necessary. At six weeks, partial weight bearing was started, allowing the patient to gradually regain confidence and mobility. Full weight bearing was permitted starting in the third month, facilitating a more active lifestyle.

At the three-month postoperative follow-up, he achieved full extension of the knee without any lag and exhibited a flexion range from 0 to 110 degrees.

The significant ROM achieved by the patient demonstrates the success of the tailored rehabilitation protocol in promoting recovery and restoring function.

CONCLUSION

This case underscores the complexities of managing high-grade knee injuries involving multiple structures, emphasizing the importance of a comprehensive evaluation and meticulous repair to optimize functional outcomes, minimize complications, and enhance the likelihood of successful rehabilitation through early intervention. With this attempt, we aimed to contribute data on high-grade knee injuries to the scientific community, where such information is scarce. We advocate for more comprehensive classification systems and surgical guidelines for these complex injuries, which may assist operating surgeons in selecting appropriate surgical interventions and validated rehabilitation protocols.

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