J Orthop Spine Trauma. 2020 December; 6(4): 104-7. DOI: http://dx.doi.org/10.18502/jost.v6i4.5567

Case Report

Multi-Ligament Knee Injury with Concomitant Tibial Tubercle Fracture: A Challenging Case Report and Review of the Pertinent Literature

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Received: 21 May 2020; **Revised:** 19 August 2020; **Accepted:** 08 October 2020

Abstract

Background: Multi-ligament knee injury (MLKI) combined with a comminuted tibial tubercle avulsion fracture in the literature has been reported as a very rare condition. To the best of our knowledge, there was no case report of this condition associated with open proximal tibia fractures.
Case Report: A 32-year-old man was referred to our center, with a comminuted tibial tubercle fracture, patella alta, fracture of the tibia at the proximal meta-diaphyseal junction, a Segond fracture, and proximal tibiofibular dislocation on X-ray images. Further assessment of intra-articular pathologies was performed during the operation and complete tear of anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) tear were identified. Radial tear of the body and anterior root avulsion of medial meniscus were also noted. All of the extra-articular and intra-articular injuries were addressed surgically, except ACL and PCL tear, which were postponed to a second stage. Proximal tibiofibular dislocation was not approached surgically. The rehabilitation protocol included 6 weeks of non-weight-bearing followed by 6 weeks of crutch-assisted partial weight-bearing ambulation, and forbidden active knee extension during the first 6 weeks and allowing the patient to perform passive flexion of the knee to 90 degrees starting from the second week. Following the rehabilitation program, the patient achieved near-full range of motion (ROM) by the end of 6 months of clinical follow-up.
Conclusion: By means of our specific surgical technique and post-operative rehabilitation protocol, we led the patient with this specific condition to have fracture union and near-normal ROM by the end of 6 months.

Keywords: Ligament; Knee; Fracture; Tibia

Citation: Tahami M, Sharafat Vaziri A, Tahmasebi MN, Vosoughi F, Khalilizad M, Safari R. **Multi-Ligament Knee Injury with Concomitant Tibial Tubercle Fracture: A Challenging Case Report and Review of the Pertinent Literature.** *J Orthop Spine Trauma* 2020; 6(4): 104-7.

Background

Multi-ligamentous knee injury (MLKI), a rare orthopedic condition with a prevalence of about 0.02% among all musculoskeletal injuries, is defined as disruption of two or more out of the four major knee ligaments. These disastrous complex injuries are frequently associated with knee dislocations that have been reduced spontaneously in more than 50% of the events (1, 2).

Tibial tubercle avulsion fractures are uncommon orthopedic injuries accounting for 0.4% to 2.7% of epiphyseal injuries, mostly seen in adolescent male patients and are extremely rare in adult patients. There are only a few case reports of the latter scenario (3-6).

MLKI with concomitant tibial tubercle fracture is an extremely rare condition, reported by just a few case reports (2, 7).

This lesion combined with an open proximal tibia fracture has not been reported in the literature so far to the best of our knowledge. Therefore, we present an adult patient with this type of injury. The authors have obtained written informed consent from the patient for the purpose of publication.

Case Report

A 32-year-old man was referred to our center with severe left knee and leg pain and inability to move his left leg following a motor vehicle accident (bus turnover). The patient was hospitalized and soon after that, regarding our routine experience, anticoagulant (low-molecular-weight heparin: 60 mg subcutaneously per day) and antibiotic agents (Cefazolin: 1 g every 8 hours) were started. On physical exam, two lacerations were noted on the anterior proximal aspect of his left leg. Deformity of the leg was obvious.

Foot drop was pointed out and it was due to traumatic peroneal nerve palsy. Vascular status of the left leg was documented as acceptable. Further physical evaluation of the knee, including anterior and posterior drawer, varus and valgus stress, and Lachman tests were limited due to the severe pain and deformity of proximal of the leg.

Initial radiographs showed a comminuted tibial tubercle fracture (Ogden type IIB) with a resultant patella alta, fracture of the tibia at the proximal meta-diaphyseal junction, a Segond fracture, and proximal tibiofibular joint dislocation (Figure 1A and B).

Figure 1. Anteroposterior (A) and lateral (B) views, showing proximal tibia fracture, comminuted tibial tubercle fracture, high riding patella, proximal tibiofibular joint dislocation, and Segond fracture

Moreover, computed tomography (CT) scans were used to elucidate more details of the fracture patterns (Figure 2A, B, and C). Complete assessment of ligaments and meniscal injuries was not fulfilled preoperatively due to the lack of magnetic resonance imaging (MRI).

On day 2 of hospital stay, and after performing clinical and paraclinical workups entirely, the operation was performed under general anesthesia.

The tourniquet was applied at the most proximal site of the left thigh and the surgical field was prepared with alcohol-based antiseptic solutions and applying sterile draping. Thereafter, through a straight longitudinal midline incision, skin and subcutaneous layers were dissected meticulously.

Figure 2. Computed tomography (CT) scan images, including coronal (A), sagittal (B), and 3D (C) views, showing detailed pattern of proximal tibia and tibial tubercle fractures

The fracture site of the proximal tibia as well as the tibial tubercle comminuted fracture, which was substantially rotated and displaced superiorly, were exposed (Figure 3).

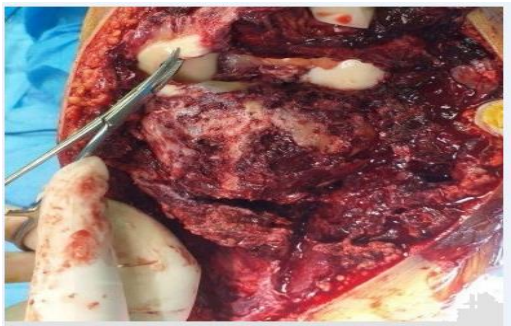

Figure 3. Intraoperative findings showing proximal tibia fracture and comminuted tibial tubercle avulsion fracture

Intra-articular pathologies were investigated and complete tears of anterior cruciate ligament (ACL), and posterior cruciate ligament tear (PCL) were identified (Figure 4 A and B).

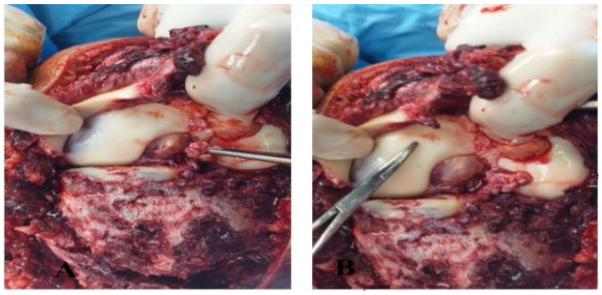

Figure 4. Intraoperative findings showing complete anterior cruciate ligament (ACL) rupture (A) and complete posterior cruciate ligament tear (PCL) rupture (B)

Radial tear of the body and anterior root avulsion of medial meniscus were also noted (Figure 5 A and B). Meniscocapsular separation of anterolateral aspect of lateral meniscus was detected.

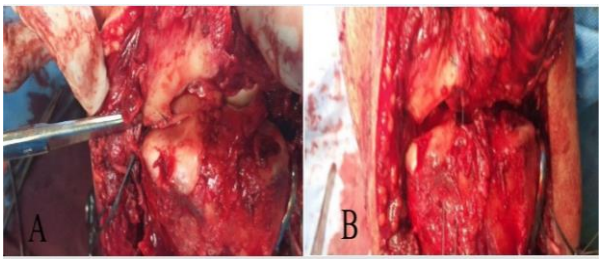

Figure 5. Intraoperative images showing repair of the radial tear in the medial meniscal body (A) and avulsion of the medial meniscus anterior root (B)

After sufficient irrigation and debridement, open reduction and internal fixation of the proximal tibia fracture was performed using a 4.5 mm locking plate on the lateral side of the tibia. Then, the radial tear on the body of the medial meniscus and the medial root avulsion were repaired by pull-out technique and inside-out horizontal mattress stitches via number 2-0 Ethibond sutures (Figure 5). After repair of the periphery of the lateral meniscus, tibial tubercle avulsion fracture was reduced and fixed in its anatomic position with a pre-bent one-third tubular plate. To augment the fixation construct, a 3.5 mm reconstruction plate was applied on the medial proximal side of the tibia (Figure 6 A, B, and C). ACL and PCL were not addressed in this session and their reconstruction was postponed for a second stage. Nonsurgical management was selected for the proximal tibiofibular joint dislocation. With the closure of the wound, the operation was finished and the knee became relatively stable. Hence, we decided not to apply the external fixator, and a long leg splint was enough for the patient.

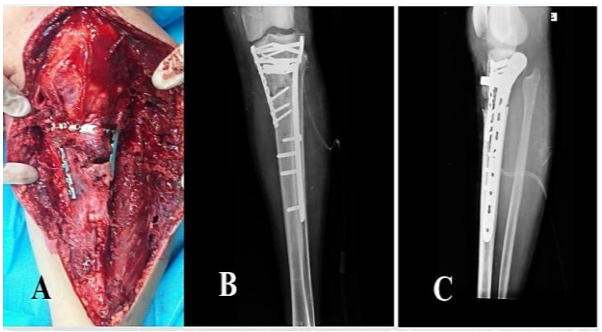

Figure 6. Intraoperative photography of the final construct (A). Early anteroposterior (AP) (B) and lateral (C) postoperative radiographs

The patient was discharged from the hospital on the second post-operative day with a hinged knee brace and ankle foot orthosis (AFO). The patient was educated well enough to perform the daily post-operative physiotherapy and rehabilitation protocol. The protocol was as follows: 6 weeks of non-weight-bearing followed by 6 weeks of crutch-assisted partial weight-bearing ambulation. Meanwhile, active knee extension during the first 6 weeks was forbidden, allowing the patient to perform passive flexion of the knee to 90 degrees starting from the second week. On the other hand, regarding foot drop, passive ROM of the ankle was emphasized during the postoperative rehabilitation program. After 6 months of follow-up and observation, the patient was evaluated at the clinic and interestingly, he was able to perform full knee extension with no extension lag and flexion of 110 degrees (Figure 7 A and B). At this time in follow-up, there were signs and symptoms of peroneal nerve recovery, which resulted in full recovery of this nerve at 1 year follow-up without surgical intervention. Therefore, by that time, the patient was able to perform full, active ankle dorsiflexion and extension of the big toe.

Figure 7. Clinical follow up of the patient at 6 months depicting the final range of motion (ROM): full extension (A) and at least 110 degrees flexion (B)

Discussion

To date, there has been sufficient evidence demonstrating ACL tear with concomitant patellar tendon injury (8-10). However, scarce data exists about MLKI and associated extensor mechanism disruption (2, 11). As far as we know, only one case report presented MLKI with concomitant patellar tendon injury combined with a tibia plateau fracture (12). Therefore, the current study is probably the first case report in the literature that exhibited a state of MLKI with concomitant tibial tubercle fracture associated with an open proximal tibia fracture in an adult patient. Hence, there is no established evidence regarding the optimal method of diagnosis, treatment, and postoperative rehabilitation protocol of such an injury.

Our case, similar to most MLKIs that are associated with a knee dislocation, was reduced spontaneously at the crash site and attended our center with no apparent knee dislocation (2, 12). Although the exact mechanism of this kind of injury has not been explored yet, we infer that the most relevant and possible mechanism of this injury could be an eccentric quadriceps contraction while the knee is flexed, in addition to the simultaneous direct trauma to the proximal leg. Meanwhile, anterior tibial translation is prior to the aforementioned events due to the rationale that the ACL tear in advance leads to loss of tension in extensor mechanism resulting in a more susceptible state to be injured (13). The associated injuries in the MLKI are chondral damage, menisci lesions, and collateral ligament injuries, the most prevalent of which in the literature has been reported to be the medial collateral ligament (66%) and meniscal injuries (69%) (12, 13). In our case, radial tear and root avulsion of the medial meniscus and meniscocapsular separation of the lateral meniscus were observed. Collateral ligaments were intact and both cruciate ligaments were ruptured completely.

In the current case, proximal tibia fracture, comminuted tibial tubercle avulsion fracture, and both menisci lesions were addressed surgically at a single session. To regain full ROM and quadriceps muscle strength, reconstruction of the ACL and PCL was postponed to a second operation. To limit further chondral and meniscal injury, both meniscal tears were approached and repaired. Fixation of comminuted tibial tubercle to its anatomic position was performed via a pre-contoured one third tubular plate which is a novel method in the literature as far as we know. Most of the other studies used cortical or cancellous screws (3-6, 14, 15). While a study presented a novel trans osseous-equivalent technique using two anchor sutures (16), another one reported the innovative use of wiring tubercle to the applied LCP in the cases of combined tibia plateau fracture and tibial tubercle fracture (17). The only technique which was applicable in the state of severe comminution of tibia tubercle was the wiring technique. Our technique also provided relatively stable fixation of comminuted fragments. Considering the presence of conflicting outcomes of surgical versus nonsurgical treatment of proximal tibiofibular joint dislocation in the literature, which have been manifested as improved knee function by surgical and lower complication rates by nonsurgical methods, we opted for nonoperative treatment of this condition (18).

It is mandatory to manage extensor mechanism injury and periarticular fractures in the MLKI at the first stage, but several conflicting reports exist regarding cruciate ligaments reconstruction time (13). A study performed single stage reconstruction and encountered arthrofibrosis postoperatively, leading to a need for surgical arthrorelease (8). Two studies supported single-stage reconstruction, with the goal of reducing the total time of treatment process and achieving a stable knee instantly. They reported successful results with the near-complete functional outcome with no complications (2, 12). Meanwhile, the majority of evidence showed two-stage reconstruction to result in less post-operative knee stiffness and better functional outcome (9-13).

Rehabilitation guidelines toward patellar tendon repair and ACL reconstruction differ entirely. After extensor mechanism repair, the knee should be immobilized for at least four weeks, while the progressive ROM and closed chain exercise should start immediately after ACL reconstruction (2, 12, 13). Our case had specific characteristics, including proximal tibia fracture and comminuted tibial tubercle fracture, both of which obligate the surgeon to perform more periarticular soft tissue dissection to put three kinds of plates around the knee. Therefore, in spite of extensor mechanism disruption repair, we decided to mobilize the knee with passive ROM from full extension to 90 degrees of flexion from the postoperative week 2, in order to minimize knee stiffness. Nonetheless, active extension was forbidden for the first 6 weeks. Finally, when the patient was visited at six months postoperatively, he could perform full, active extension without extension lag and flex his knee to 110 degrees.

Regarding the limitations of the study, the required longer period of follow-up, assessment of the patients with

specific orthopedic score, and maybe documenting muscle strength measurement were among the limitations.

Conclusion

The present case was an adult with MLKI and concomitant tibial tubercle comminuted avulsion fracture combined with an open proximal tibia fracture. Near-full ROM was achieved at 6 months after surgical treatment with use of meticulous technique and pursing the rehabilitation protocol. It might help orthopedic surgeons in the way of optimal diagnostic and treatment procedures, and rehabilitation protocol toward this kind of injury pattern.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgments

None.

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