

Bicruciate ligament avulsions, lateral meniscus dual root avulsions - “Tibial Avulsion Tetrad”- with menisco- capsular injury - Floating meniscus in innocuous looking proximal tibia fracture

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Learning Point of the Article:

Combination of bicruciate and meniscus osseous root avulsions extremely rare.

Abstract

Introduction: Bicruciate bony avulsion fracture with osseous avulsions of dual root LM in combination with posterior horn LM meniscocapsular injury causing floating meniscus in lateral tibial plateau depressed fracture is a very rare complex injury which was managed carefully with a proper work up and surgical planning to get excellent functional outcome. Few times innocuous looking tibial plateau fractures can reveal severe hidden injuries which have potentials of disastrous complications later in the life and therefore high degree of suspicion is required for accurate diagnosis.

Case Report 22 year old female patient injured her knee while playing kabaddi due to severe hyperextension injury. Based on clinoradiological and intraoperative findings, she was diagnosed as having both ACL and PCL avulsion fractures with LM anterior and posterior root avulsion which we coined new term as “Terrible Avulsion Tetrad” alongwith posterior horn of LM menisco-capsular tear with depressed lateral tibial plateau. Patient was operated next day of the injury with both arthroscopic and open procedures. Arthroscopically, ACL and both root tear of LM were fixed with tunnel pull out suture technique using No. 2 fibrewires and fixing with endobutton and suture disc. Posterior horn LM menisco-capsular junction tear was repaired with two all-inside meniscal sutures. Lateral tibial plateau was fixed with two CC screws after elevating depressed fragments. Posteriorly PCL avulsion fragment was fixed with open procedure with inverted L incision and two cannulated cancellous screws. Patient was put on knee brace for 6 weeks and was allowed knee range of movements at 3 weeks. Patient was kept on non-weight bearing for 3 months. At 24 months follow up, radiology showed complete union of fractures. Functional assessment using Lysholm knee score showed excellent outcome with score of 96 and she was back to her routine activities.

Conclusion: Combination of bicruciate and meniscus osseous root avulsions extremely rare. Further rare injury combination can include floating meniscus as a result meniscocapsular junction tear alongwith osseous root avulsion of meniscus. All these injuries can be accompanied in subtle looking proximal tibia plateau fracture which needs be properly worked up.

Keywords: osteoarthritis, effusion, deformity, gastrocnemius, debridement

Introduction

Anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) midsubstance tear are commonly torn ligaments

seen in orthopedic practice though ACL injuries are more common than PCL. Combined injuries of ACL and PCL are rare again which are ideally seen high energy trauma like knee

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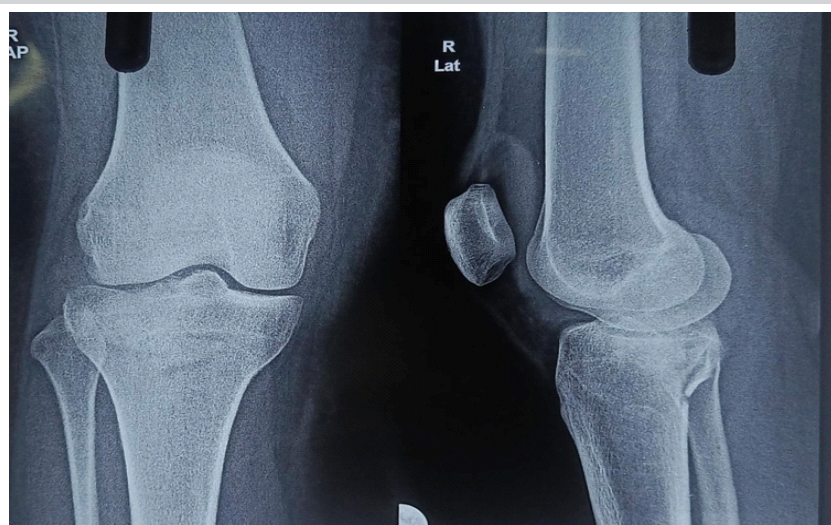


Figure 1: Plain radiograph of knee R showing depressed lateral and posterolateral tibial plateau fracture with large PCL avulsion fragment

dislocations. Avulsion fractures of cruciate ligaments are relatively uncommon category compared to mid-substance injuries. ACL avulsion fractures are seen around 2 % of ACL injuries whereas PCL avulsion injuries are seen in 4 % of PCL injuries [1,2]. Similar injury pattern applies for meniscal injuries as well. Root avulsion of medial meniscus (MM) are generally seen in elderly patient as degenerative tears accompanied by trivial trauma whereas avulsions of lateral meniscus (LM) are generally associated with traumatic ACL tears [3]. On the other hand bony avulsions of meniscus are extremely rare[4]. They are generally seen in high velocity trauma and more seen in posterior horn than anterior horn of both menisci.

Proximal tibia fractures are many times innocuous-looking and often a subtle avulsion of ligaments or menisci are missed out. In this case, we highlight on what initially appeared to be a manageable depressed fracture of lateral tibial plateau showed multiple injuries of bony avulsion contributing to catastrophic global instability, that is a simultaneous ACL and PCL avulsion

fractures, dual root avulsion of LM with meniscocapsular disruption leading to floating lateral meniscus.

Case Report

22 year old professional kabaddi player presented to our casualty with injury to right knee while playing kabaddi. She sustained twisting injury to right knee and presented to us with complaints of pain, swelling and deformity over knee. Players from opponent team fell on her in a group when the patient landed on her knee in hyperextension while kabaddi riding causing severe injury. No other obvious injuries were seen. Patient was conscious, oriented and haemodynamically stable at the time of presentation. On clinical examination, there was severe tenderness, swelling and deformity over right knee with

massive knee effusion. No external wounds were seen. There was significant tenderness over knee and proximal tibia. Both Lachman's and posterior drawer's tests were positive. There was no varus or valgus laxity over knee. There were no distal neurovascular deficits. There was no stretch pain over toes.

Plain radiography showed displaced proximal tibia fracture with minimal depression over lateral and posterolateral tibial plateau with posterior cruciate ligament (PCL) avulsed fragment with displacement [Fig. 1]. Though radiography showed innocuous looking fracture we decided to work-up further with computed tomography (CT) scan and magnetic resonance imaging (MRI) scan in view of significant anterior and posterior knee laxity. CT and MRI scan showed anterior cruciate ligament (ACL) avulsion injury at tibial side, PCL avulsion injury with large bony fragment and lateral meniscus (LM) anterior with posterior root avulsion injuries [Fig. 2]. There were severe fluid signals due to significant haemarthrosis. Meniscocapsular junction of LM was not



Figure 2: CT (a,b) and MRI (c,d) showing ACL avulsion injury at tibial side, PCL avulsion injury with large bony fragment and LM anterior and posterior root avulsion injuries with severe haemarthrosis suggested by large fluid signals.

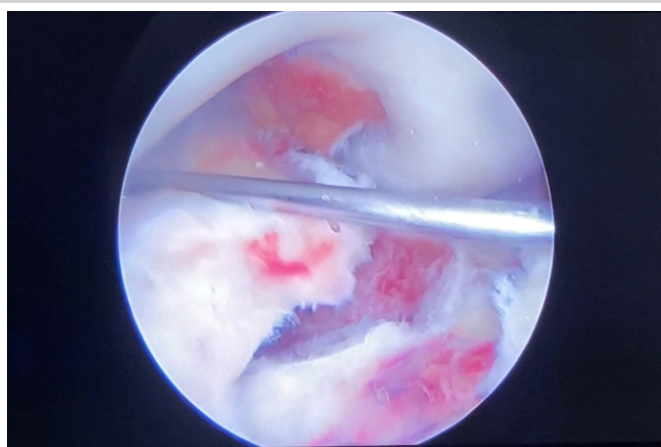


Figure 3: Intraoperative arthroscopic picture showing large avulsed ACL fragment

visualized clearly due to excessive fluid signals.

Treatment considered was arthroscopic management of knee injury. First we decided for initial diagnostic approach with knee arthroscopy to confirm MRI/CT findings and to look for other injuries which were missed on radiology. With knee in 90 degree flexion and under tourniquet, 30 degree arthroscope was used and initial diagnostic examination of knee was made using anterolateral (AL) and anteromedial (AM) working portal. Thorough joint lavage, debridement and haematoma evacuation was done. Avulsed ACL fragment was noted [Fig. 3]. In the lateral compartment, both anterior and posterior LM root avulsions were noted [Fig. 4]. Additionally we noticed there was complete tear of menisco-capsular junction of posterior horn of LM which was not seen on imaging [Fig. 5]. Also depression in lateral tibial plateau was noted. Posteriorly avulsion of PCL fragment was noted. After assessing all the injuries we planned for systemic approach to address each injuries step wise. First we passed two fibre wire No. 2 with scorpion wire passer through ACL avulsion at ligament bone junction from AM portal through cannula. With knee in lazy figure of four position, cinch

sutures were placed on both LM meniscal roots with one fibre wire No. 2 on each root avulsion. Using ACL tibial jig, first tibial tunnel was made at footprint of posterior horn of LM root with arthroscope in AM portal and jig holding from AL portal with exit at lateral tibial cortex. 2.9 mm guide pin was used and it was overreamed with 4 mm cannulated drillbit. Another tibial tunnel was made for ACL avulsion fragment with

arthroscope from AL portal and holding jig from AM portal with exit at medial tibial cortex using 2.9 mm guide pin. It was overreamed with 4 mm cannulated drill bit. No. 2 fibre wire for LM posterior horn avulsion fracture were pulled through tunnel at lateral tibial cortex using crescent shaped small hook. Fibre wires holding ACL avulsion fragment and anterior horn of LM avulsion fragment were pulled through same single tibial tunnel made at medial tibial cortex using crescent hook. Holding all the sutures under tension, menisco-capsular junction of posterior horn of LM was repaired with two all inside meniscal repair devices (Sironix SureStich). Now focus is shifted to depressed lateral tibial plateau fracture. Under arthroscopic guidance and fluoroscopic guidance bone impactor inserted through small window made over lateral tibial cortex away from lateral tibial plateau. Once satisfactory reduction achieved and to maintain the reduction, two 4 mm cannulated cancellous screws with washer (4mm x 45mm, 4 mm x 50 mm) were passed from lateral side of tibial plateau directing slightly posteriorly in subchondral bone. Cannulated drill bits were placed in already existing tibial tunnels for LM posterior root and ACL avulsion to prevent the cannulated screws entering the tunnels. Once plateau was fixed, LM posterior horn avulsion suture was fixed with endobutton on outer surface of lateral tibial cortex and stability was checked in arthroscopic view. ACL avulsion and LM anterior horn sutures were fixed with suture disc on tibial surface of medial tibial cortex and again stability assessed arthroscopically [Fig. 6]. Now focus shifted to PCL avulsion fragment. Patient was turned to prone position. Inverted L shaped incision was made over posteromedial corner of knee with vertical limb along the medial edge of gastrocnemius muscle and horizontal limb on just distal to joint line. Plane between semimembranosus and gastrocnemius was made and avulsed fracture fragment was isolated after making vertical incision on posterior capsule. Fracture fixation was done with two 4 mm cannulated cancellous screws (4mm x 30 mm and 4mm x 35 mm) directing away from lateral tibial plateau screws

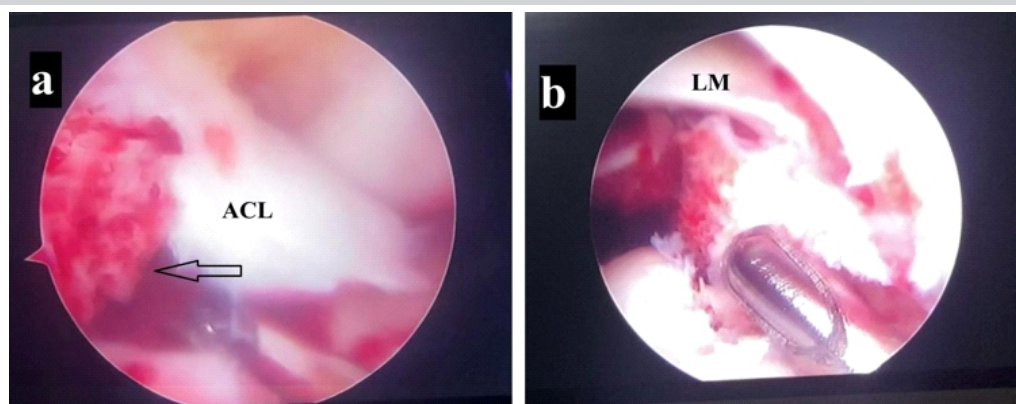


Figure 4: Intraoperative arthroscopic picture showing osseous avulsion of anterior horn of LM, (a with arrow) and osseous avulsion of posterior horn of LM (b).

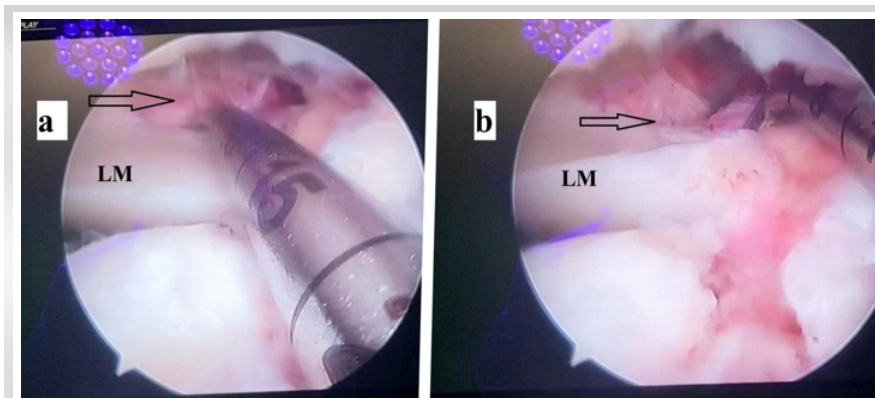


Figure 5: Intraoperative arthroscopic picture (a,b) showing tear at menisco-capsular junction of posterior horn of LM (arrows).

and making sure not to pass through tunnels made for ACL and LM. Fluoroscopy showed satisfactory reduction of all the fractures.

Patient was advised on knee brace for 6 weeks with isometric quadriceps exercises started on day 1. Knee range of movements (ROM) until 90 degree were started at 3 weeks with complete ROM at 6 weeks. She was kept on non-weight bearing for 12 weeks and was allowed full weight bearing at 16 weeks.

Patient was followed up for 24 months postoperatively and at latest follow up she was back to her regular activities of running and playing her professional sports of kabaddi. She had excellent functional score (Lysholm Knee Score -96) [Fig. 7]. Plain radiography of knee complete radiological union of ACL, PCL avulsion with complete union of tibial plateau fracture [Fig. 8].

Discussion

This is probably the first case in our knowledge reporting extensive avulsion fractures of ACL, PCL, dual root of LM with menisco-capsular junction of posterior horn of LM leading to floating meniscus in a lateral tibial depressed fracture. Previously many case reports on avulsion injuries of ligaments and meniscus have been reported in various permutation and combination. Mariani et. al reported complete ACL rupture with both MM and LM avulsion injuries in a professional football player [5]. Dartus et.al in their arthroscopic technique described an injury naming “Tibial Avulsion Triad” which involved ACL tear of posterolateral bundle, PCL avulsion fracture with LM posterior horn root avulsion seen in dashboard injury [6]. Therefore we too named an injury in our patient as “Tibial Avulsion Tetrad” comprising avulsion fractures of ACL, PCL and dual roots of LM. In another interesting case report of similar complex injury, White et.al described ACL, PCL avulsion fractures with

posterior horn MM root avulsion injury in a sleepwalking patient by unknown injury mechanism [7]. However, closest to our case report was reported by Van der list et.al [8]. In their case report injury described was ACL, PCL avulsion with posterior root osseous avulsions of both meniscus. Therefore described in our patient is slightly different from all the injuries described above making it unique in addition to the depressed lateral tibial plateau fracture.

PCL avulsion injuries are commonly associated with other intra articular injuries and therefore we need to keep an close look into

concurrent injuries ideally with the direct visualization through arthroscopy since MRI too can miss out in the first place due to existing fluid signals secondary to trauma. Pardiwala et.al showed nearly 28 % of coexistent pathologies in PCL avulsion fractures in their comparative study of arthroscopic and open fixation of PCL avulsion injuries [9]. PCL avulsions too are commonly associated with bony avulsions injuries of MM posterior root due to anatomical close relation to PCL tibial facet [10].

Avulsion injuries of these cruciate ligament are classically seen in dashboard injuries wherein posteriorly directed force applied on proximal tibia with knee in flexed position which is seen in high energy road traffic accident. Other mechanism include hyperextension injury which are ideally seen in sports injuries which may have concomitant meniscal injuries or other ligamentous injuries [11]. In our patient to hyperextension could be the mechanism of injury since patient will on the ground with knee in hyperextension followed by group of players from opposite team falling on the knee causing

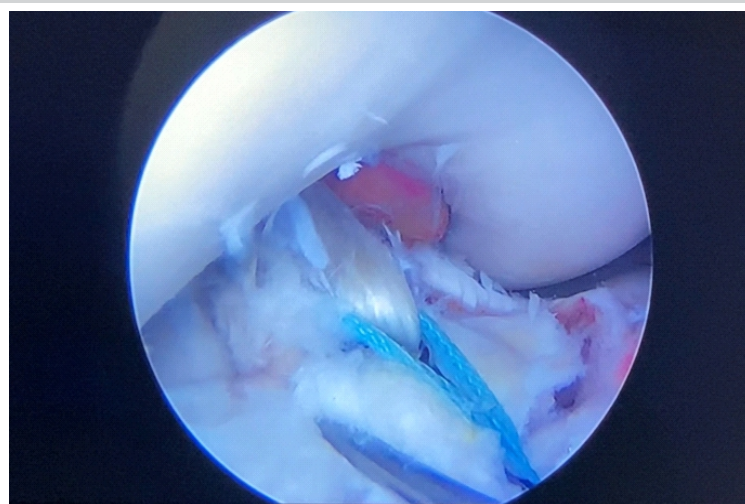


Figure 6: Intraoperative arthroscopic picture showing stable fixation of osseous avulsion of posterior horn of LM with No. 2 fibre wire.



Figure 7: Clinical images of functional outcome at 2 year follow up

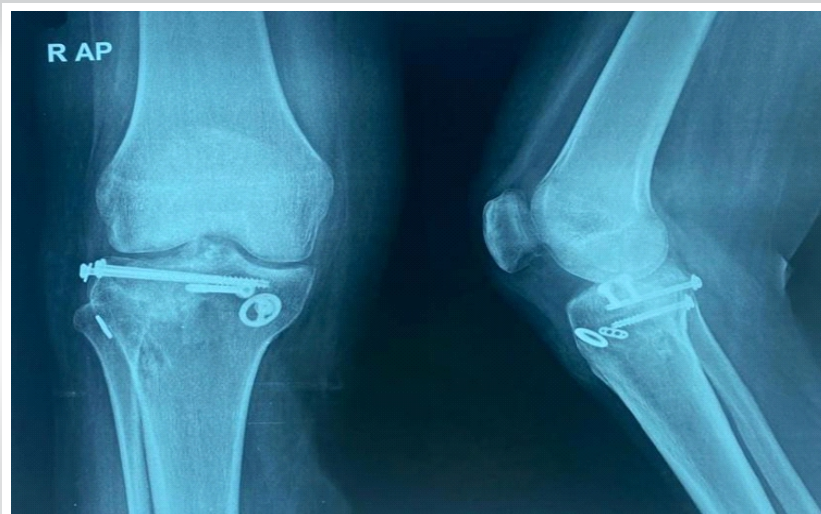


Figure 8: Knee radiograph at two year showing complete union of fracture with well maintained articular congruity.

translation of tibia following operative management either open or arthroscopic compared to conservative management [14]. Bony avulsion injuries of MM are far lesser variants of degenerative root tears offer greater functions following arthroscopic repair than non operative or following meniscectomy [15]. Among all these avulsions, LM bony avulsions are rarest avulsion injuries and again operative management helps in achieving anterolateral rotational stabilities and prevents long term complications like osteoarthritis [16].

Conclusion

Bicruciate bony avulsion fracture with osseous avulsions of dual root LM in combination with posterior horn LM meniscocapsular injury causing 'floating meniscus' in lateral tibial plateau depressed fracture is a very rare complex injury. Such complex injury needs careful proper work up and surgical planning to get excellent functional outcome. Few times innocuous looking tibial plateau fractures can reveal severe hidden injuries which have potentials of disastrous complications later in the life and therefore high degree of suspicion is required for accurate diagnosis.

Clinical Message

Bicruciate avulsion fractures with meniscal dual root avulsion injuries are extremely rare and never been reported in the literature and therefore we coined a new terminology- "terrible avulsion tetrad" for such injury. 'Floating meniscus' due to both root injuries and meniscocapsular tear can also happen making it even rarer injuries. All such complex injuries can happen in innocuous looking proximal tibia fracture. Therefore even in such fractures, we should work up accordingly with proper investigations like CT or MRI to look out for missed out injuries when in doubt. Arthroscopy too is a great tool in finding out missed injuries like disrupt meniscocapsular junction as in this case which was missed in MRI due to excessive fluid signals. Early and aggressive treatment approach including arthroscopic and open approaches helps in excellent functional outcome. This case report highlights on such rare complex injury of knee which was managed both arthroscopically as well as with open procedure yielding excellent outcome in a young active patient.

significant injury.

Floating meniscus is interesting entity generally seen in high impact injuries. It results from tear of both root attachments from tibial surface with tear in coronary ligaments of meniscus resulting in meniscal complete displacement. Paridiwala reported 7 cases of such floating meniscus where 5 were operated on emergency basis and two on elective basis [12]. They reported all their injuries in medial meniscus. On the contrary in our patient it was LM floating meniscus with disruption of both anterior and posterior roots with bony avulsions with tear in posterior horn menisco-capsular junction of LM causing floating meniscus.

Management of avulsion injuries of cruciates or menisci are generally operative which yields excellent outcomes. ACL avulsion fractures showed favourable outcome in terms improving Lachmans test and patient related outcomes following surgical [13]. PCL avulsion fractures too, though rare greater fracture union rates and improved side to side posterior

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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