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Posterior cruciate ligament avulsion from the Tibia: Fixation by a posterior approach

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Abstract

The authors present their experience with a posterior approach for fixation of posterior Cruciate ligament avulsion from the tibia. Avulsion usually occurs at the tibial insertion. The approach is easy, safe and demands no great technical prowess or instruments. Some minor modifications and technical tips for a safer exposure and a better fixation are highlighted. This is a reproducible method for achieving good stability in these avulsion fractures, where early intervention prevents significant late disability. A single 4-mm screw gives sufficient initial stabilization to allow supervised mobilization. A high index of suspicion should be maintained in all dashboard injuries presenting with femoral shaft fractures, especially when the patella is also fractured. The patients were objectively (posterior drawer test) and subjectively (Lysholm scale) reevaluated after a minimum follow up period of 12 post operative months.

Keywords: Lysholm scale, posterior drawer test, surgical fixation

1. Introduction

Injuries of the posterior cruciate ligament (PCL) are now gaining recognition as disabling problems that are often overlooked^[1, 2], and many times the treatment is deferred due to an apprehension that the approach to the posterior aspect of the knee is difficult^[3, 4, 5]. In spite of their common association with ipsilateral injuries, intra-substance tears are usually not primarily diagnosed nor treated at initial presentation. Avulsion injuries from the tibial attachment constitute a small subgroup that differs from other PCL injuries in two ways. Firstly an early diagnosis is usually possible on standard radiographs where a bony fragment may be visible, and secondly the treatment protocol is fairly standardised. From an anatomical point of view, knee's posterior cruciate ligament (PCL) is fixed on the anterior half of the axial surface of femoral internal condyle, protruding at caudal and medial directions, by the intercondylar incisure towards its tibial insertion located posterior, inferior and juxta-lateral to the mid line of the tibial plateau. It is a strongest of the two ligaments and acts as a major posterior knee stabilizer, limiting posterior tibial translation in relation to the femur^[24, 25, 26]. PCL injuries are estimated to account for 20% of knee ligament injuries. That incidence is higher especially in cases resulting from high-energy trauma, such in motorcycle and car accidents, while, in an athletic population, this injury is more closely associated to contact sports^[22, 23].

Surgical fixation of the bony avulsion by a CC screw is advocated and it has given almost uniformly excellent results^[2], whereas non-surgical treatment has a significant incidence of morbidity in form of residual instability and early degenerative arthritis^[1]. Some orthopaedic surgeons are apprehensive about treating tibial avulsions of the PCL because of their unfamiliarity with the standard posterior approach to the knee^[3, 6, 7] and the potential for damage to the important neurovascular structures. Many series dealing with PCL injuries have followed the standard posterior approach through the popliteal fossa as described by Abbott^[3], which is a complex approach requiring a meticulous and time consuming dissection of the neurovascular bundle in the popliteal fossa. Trickey^[7] described a modification of the above mentioned approach with the aim of decreasing the surgical dissection and time.

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However the medial head of gastrocnemius needed to be divided and the neurovascular bundle was still at risk due to its proximity. Ogata [8] and McCormick [9] described a posterolateral approach of the knee for the treatment of PCL injuries. It required osteotomy of the fibular neck which endangered the nerve and required extensive mobilisation of the tendon of the popliteus. These factors increased the complexity of the approach besides affecting the postoperative rehabilitation. Keeping this in mind, Burk and Schaffer [10] in 1988 described a simplified approach to the PCL which avoided the problems associated with the standard posterior approach. This has become the standard approach for approaching the PCL, either for fixing avulsions or for onlay reconstructive grafting. We have used this approach for the fixation of tibial avulsions of PCL and present our experience with this technically safe and easy exposure.

This article aims to assess 11 cases of PCL avulsion fractures surgically treated and to compare achieved clinical outcomes to objective and subjective evaluations.

2. Materials and Methods

The study was conducted with the approval of ethics committee of the institution. Over a period of two years, 11 cases with radiographically demonstrated avulsion of the PCL were fixed using this approach. A standard pre-operative assessment of each case comprised of clinical examination to define the instability and other associated problems. Standard AP, lateral and tunnel views were taken in all 11 cases, and CT scan was done in all and MRI in all 2 cases to better define associated injuries at the knee. Associated tibia and femur shaft fractures were treated by interlocking nailing at the first stage; Lateral Condyle tibia fracture treated with CC-Screw and acetabulum roof fracture treated with Recon plating.

2.1 Operative Technique

Preoperative antibiotic (1.5 gm cefuroxime, intravenous) was administered in all the cases after sensitivity testing, one hour prior to skin incision, as a single dose. The operative procedures were performed under general or Spinal anaesthesia with tourniquet control. The patients were positioned in prone position. Skin incision was made over the posterior aspect of knee with the horizontal limb over the popliteal crease and vertical limb on the medial aspect of gastrocnemius. The deep fascia over the gastrocnemius was incised and interval between medial gastrocnemius and Lateral gastrocnemius was identified. The dissection was carried bluntly with finger until the posterior capsule of knee joint was reached. The middle geniculate artery was ligated wherever necessary. The motor branch of the tibial nerve to medial head of gastrocnemius was preserved and neurovascular bundle retracted laterally thus protecting it. The posterior aspect of femoral condyles and proximal tibia could be palpated at this stage. Slight knee flexion was done in almost all the cases for better visualisation. Recession of tendinous origin of medial gastrocnemius was carried out wherever necessary for

enhancing exposure. The posterior knee joint capsule was incised vertically to access the contents of posterior intercondylar notch and tibial attachment of posterior cruciate ligament. The bony base of avulsion was debrided wherever necessary. The bony fragment was pushed down and secured with a guide wire and positioning verified under fluoroscope. The bony fragment was then fixed with 4 mm partially threaded Cortico Cancellous screws with Washer (one or two, AO, Synthes) depending upon the fragment size. The position of bony fragment was again assessed under fluoroscope and if found adequate the wound was washed and closed with drain. Postoperatively, the patients were advised to wear hinged knee brace and ranges of motion exercises of the operated knee were started at 0 to 30 degrees from day three with the help of continuous passive motion machine. The range of motion of the operated knee was advanced as per pain tolerability and considering other associated injuries. The patients were allowed to bear weight as tolerated with knee brace locked in extension depending upon the concomitant injuries and advised to remove the brace for range of motion exercises. They were instructed to undergo rehabilitation under the guidance of a physical therapist and therapy was carried out twice a week at the institution for range of motion exercises, mobility and quadriceps strengthening. The active hamstring exercises were not allowed for eight weeks.

2.2 Observations

From January 2014 to January 2016, 11 cases with avulsion of PCL with a bony fragment from its tibial insertion were operatively fixed by senior author (table 2). All the cases in the study were male and ages ranged from 17 – 50 years. As per data, associated injuries included tibiae fracture (2 cases) and femur shaft fracture (1 case) which were treated with intramedullary locking nail and Lateral condyle tibia Fracture (1 case) treated with cc screw and Acetabulum roof fracture (1 case) treated with recon plating. The duration between surgery and time of injury ranged from 2 weeks to 3 months. Routine lateral x-rays could identify avulsed fragment in all cases. Ct scan was done as an adjunct to x-rays in all 11 cases while MRI was done in 2 cases. Out of 11 cases, 6 were affected in left knee and 5 in right knee. All cases were result of road traffic accident. Fixation by 2 screws was done in one case while one screw considered sufficient for stability in other case.

All patients regained 90° of knee motion within 6 weeks of surgery. Full flexion to 130° or higher was achieved at end of three months. No residual instability was noted in any case and at follow up of 6 months. There was no pain or feeling of instability while negotiating stress. The mean Lysholm scorer was 90.88 \pm 5.58 in 9 patients.

Bony union was achieved in all patients at time of last follow up.

No patient had to undergo implant removal; for hardware related problems.

Table 1

LYSHOLM KNEE SCORING SCALE

This questionnaire is designed to give your Physical Therapist information as to how your knee problems have affected your ability to manage in everyday life. Please answer every section and mark only the ONE box which best applies to you at this moment.

Name: _____ Date: _____

SECTION 1 - LIMP

☐ I have no limp when I walk. (5)

☐ I have a slight or periodical limp when I walk. (3)

☐ I have a severe and constant limp when I walk. (0)

SECTION 2 - Using cane or crutches

☐ I do not use a cane or crutches. (5)

☐ I use a cane or crutches with some weight-bearing. (2)

☐ Putting weight on my hurt leg is impossible. (0)

SECTION 3 - Locking sensation in the knee

☐ I have no locking and no catching sensation in my knee. (15)

☐ I have catching sensation but no locking sensation in my knee. (10)

☐ My knee locks occasionally. (6)

☐ My knee locks frequently. (2)

☐ My knee feels locked at this moment. (0)

SECTION 4 - Giving way sensation from the knee

☐ My knee gives way. (25)

☐ My knee rarely gives way, only during athletics or vigorous activity. (20)

☐ My knee frequently gives way during athletics or other vigorous activities. In turn I am unable to participate in these activities. (15)

☐ My knee frequently gives way during daily activities. (10)

☐ My knee often gives way during daily activities. (5)

☐ My knee gives way every step I take. (0)

SECTION 5 - PAIN

☐ I have no pain in my knee. (25)

☐ I have intermittent or slight pain in my knee during vigorous activities. (20)

☐ I have marked pain in my knee during vigorous activities. (15)

☐ I have marked pain in my knee during or after walking more than 1 mile. (10)

☐ I have marked pain in my knee during or after walking less than 1 mile. (5)

☐ I have constant pain in my knee. (0)

SECTION 6 - SWELLING

☐ I have swelling in my knee. (10)

☐ I have swelling in my knee only after vigorous activities. (6)

☐ I have swelling in my knee after ordinary activities. (2)

☐ I have swelling constantly in my knee. (0)

SECTION 7 - CLIMBING STAIRS

☐ I have no problems climbing stairs. (10)

☐ I have slight problems climbing stairs. (6)

☐ I can climb stairs only one at a time. (2)

☐ Climbing stairs is impossible for me. (0)

SECTION 8 - SQUATTING

☐ I have no problems squatting. (5)

☐ I have slight problems squatting. (4)

☐ I cannot squat beyond a 90deg. Bend in my knee. (1)

☐ Squatting is impossible because of my knee. (0)

Total: _____/100

Instructions: Please place a mark on the line to indicate the amount of pain you have had in your knee(s) in the past 24 hours.

RIGHT KNEE
No pain at all _____ Worst pain possible

LEFT KNEE
No pain at all _____ Worst pain possible

Table 2

Sr no.	Age/sex	Side	Asso. Injury	Time b/w injury & surg.	f/up	Range of motion	instability
1	33/M	L		2 weeks	2 years	0-140	nil
2	22/M	L		3 months	2 years	0-120	nil
3	18/M	R		1 month	2 years	0-120	nil
4	44/M	R	Tibia shaft fracture	2 weeks	2 years	0-140	nil
5	28/M	R		9 weeks	2 years	0-120	nil
6	17/M	L		5 weeks	2 years	0-130	nil
7	23/M	L		7 weeks	2 years	0-120	nil
8	21/M	L		3 weeks	2 years	0-110	nil
9	50/M	R	Acetabulum roof fracture	1 week	2 years	0-120	nil
10	40/M	L	Femur shaft Fracture	2 weeks	2 years	0-120	nil
11	45/M	R	Tibia shaft Fracture	2 weeks	2 years	0-120	nil

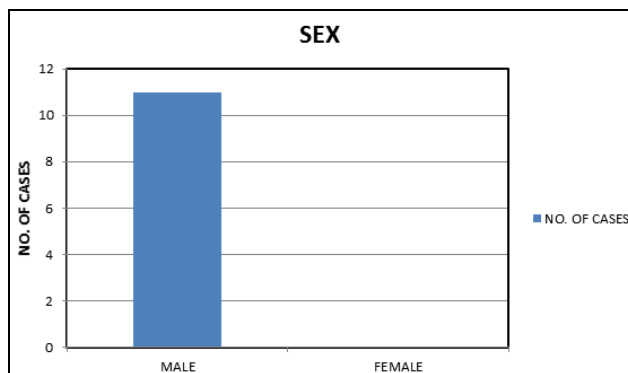


Fig 1

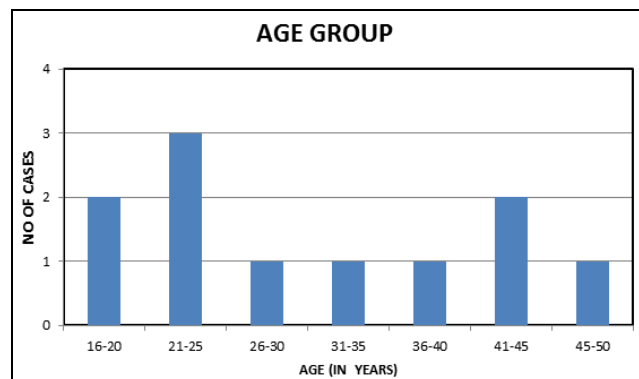


Fig 2

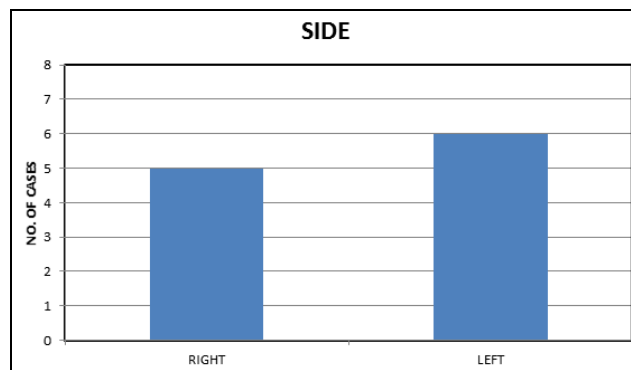
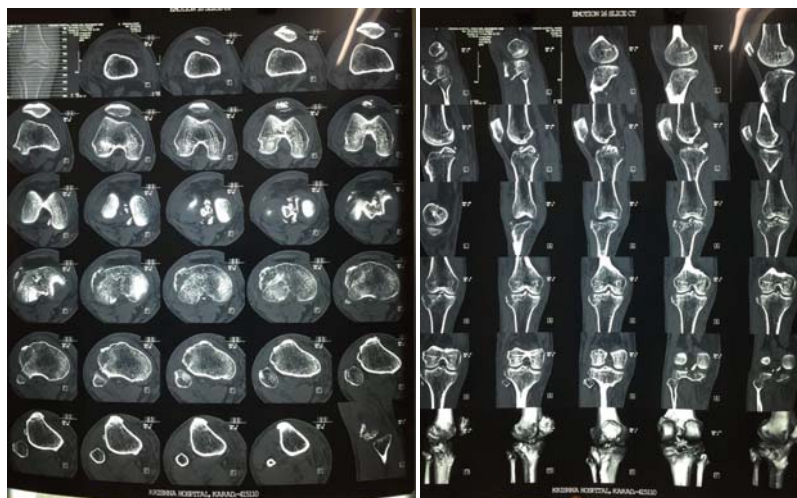
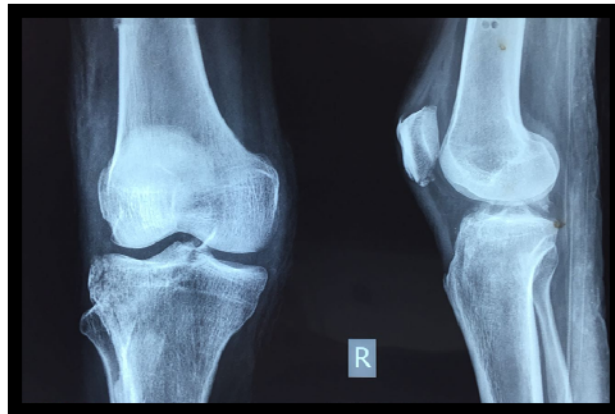
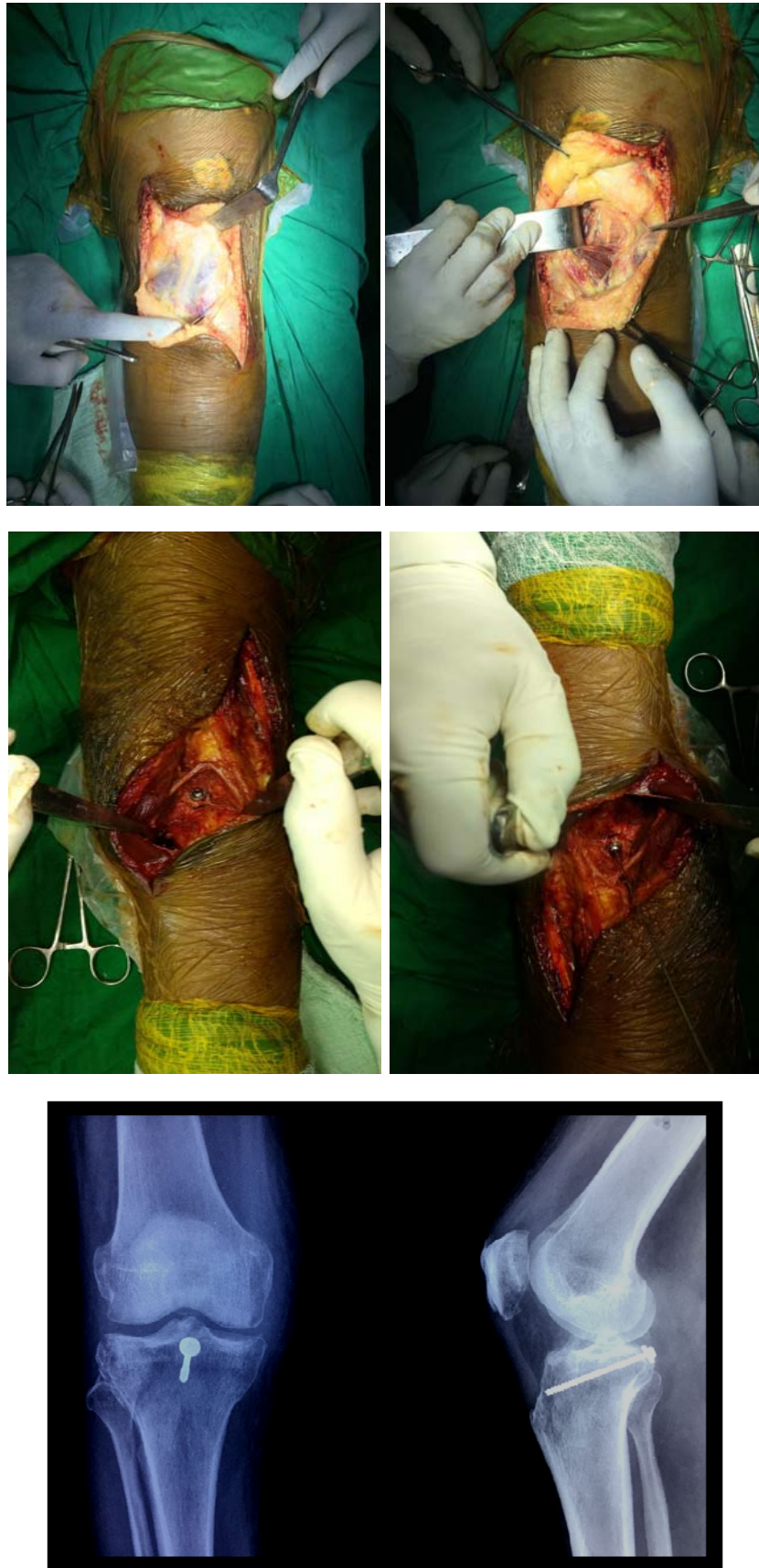
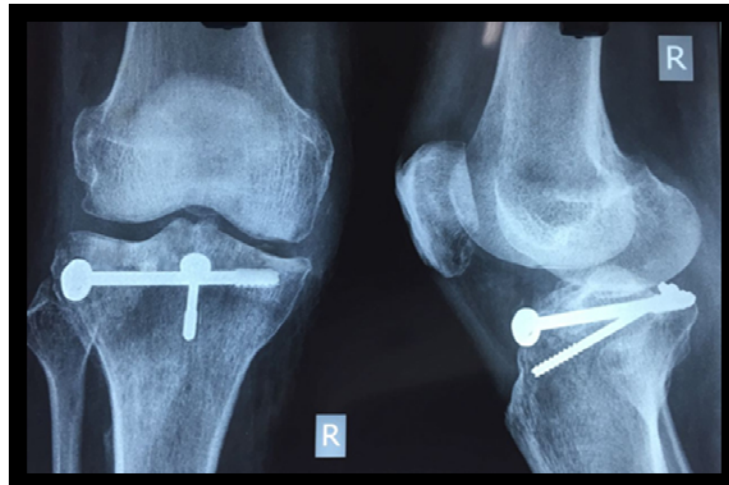


Fig 3







Another patient with associated Lateral Tibial Condyle Fracture



Another patient with associated Acetabulum fracture treated with plating

3. Discussion

The posterior cruciate ligament (PCL) is the stronger of the two cruciate ligaments and is the primary restraint for posterior tibial translation during knee flexion [1]. When it is Avulsed, this results in posterior subluxation of the tibia, wherein an abnormal pressure on the patellofemoral joint is created, leading to chronic pain and early cartilage degeneration [7, 11, 12]. There is no consensus about the primary repair of PCL injuries [21], although late reconstruction in experienced hands is regaining popularity. One fact is however clear; tibial avulsion gives the best results after stable fixation [13, 14, 15], and if this injury is isolated, it can be treated at any center with a little experience and some understanding of the pertinent anatomy.

Numerous series have consistently demonstrated excellent results with fixation and uniformly poor results with non-surgical methods [2, 4, 7]. This article aims to assess Eleven cases of PCL avulsion fractures surgically treated, and to compare achieved clinical outcomes to objective (posterior drawer test) and subjective (Lysholm scale) evaluations.

The fixation of the avulsed tibial attachment of the PCL can be done either by open exposure or by arthroscopically assisted means [15, 16, 17, 18, 19]. The latter is an ideal method provided the necessary expertise and equipment is available. Despite adequate experience, Kim *et al.* [20] believed that the technique of arthroscopy-assisted reduction and fixation was difficult and had a steep learning curve. In our experience a similar fixation

can also be achieved by open exposure through the posterior approach where original PCL substance is Preserved, which can be done at any center.

The classical posterior approach to the knee as described by Abott and Carpenter [3] requires dissection of the neurovascular bundle and is time consuming. Various others approaches described by Trickey [7], McCormick *et al.* [9] and Ogata [8] have failed to significantly simplify the exposure; Burks and Schaffer [10] described a simplified posterior approach to the knee which did not require the neurovascular dissection besides giving good exposure of the PCL and posterior horns of both menisci. We followed a similar approach for fixation of the tibial avulsion of the PCL attachment and found it to be technically easy, time saving and safe.

Another factor that plays a role in postoperative rehabilitation is the role of associated injuries; Femur and Tibia shaft fractures can be well managed by interlocking nailing while Lateral Condyle tibia fracture treated with CC screw and Acetabulum roof fracture treated with Recon Plating and rehabilitation after this is fairly uncomplicated. In our case series, all cases have been rated as good and excellent in a subjective evaluation (Lysholm).

4. Conclusion

In conclusion, surgical treatment of PCL avulsion from its tibial attachment gives good results after stable fixation. The

posterior approach is a good option, and minimal dissection gives a safe and adequate exposure for screw fixation. A high index of suspicion should be maintained in all dashboard injuries presenting with femoral shaft fractures, especially when the patella is also fractured. The diagnosis may be missed in the acute setting if the bony avulsion is not adequately appreciated; routine MRI in this situation is a good option.

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