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**Dr. Sarabjeet Kohli**  
Associate Professor, Department  
of Orthopaedics, MGM  
University of Health Sciences,  
Navi Mumbai, India

**Dr. Nilesh Vishwakarma**  
Consultant Sports Medicine,  
MGM Hospital. Assistant  
Professor, Department of  
Orthopaedics, MGM University  
of Health Sciences, Navi  
Mumbai, India

**Dr. Shaival Chauhan**  
Assistant Professor, Department  
of Orthopaedics, MGM  
University of Health Sciences,  
Navi Mumbai, India

**Dr. Kuldip Salgotra**  
Professor and Chief of Surgical  
Sciences, Department of  
Orthopaedics, MGM University of  
Health Sciences, Navi Mumbai,  
India

## Correspondence

**Dr. Nilesh Vishwakarma**  
Consultant Sports Medicine,  
MGM Hospital. Assistant  
Professor, Department of  
Orthopaedics, MGM University  
of Health Sciences, Navi  
Mumbai, India

## Functional evaluation of fixation for PCL bony avulsion fractures using Burk and Schaffer's approach

**Dr. Sarabjeet Kohli, Dr. Nilesh Vishwakarma, Dr. Shaival Chauhan and  
Dr. Kuldip Salgotra**

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### Abstract

**Background:** Posterior cruciate ligament (PCL) is the chief posterior stabilizer of the knee. In literature, surgical indications for PCL injuries treatment remains debatable, but in PCL bony avulsion, surgical reinsertion of the avulsed fragment is a recommended procedure.

**Objective:** This study was aimed to evaluate efficacy of Burk Schaffer's approach for fixation of tibial avulsion of PCL and to abstract the outcome of bony PCL avulsion fractures treated with cancellous screw fixation and their complications if any.

**Study Design:** This was a prospective study conducted in 34 patients of isolated PCL avulsion fracture.

**Material and Methods:** This study had 34 patients with age ranging from 28 to 50 yrs. It included 47.06% RTA, 26.47% sports trauma and 26.47% domestic injuries. All patients were evaluated by X-rays, MRI and CT preoperatively. Standard Burks Schaffer's approach was used in all cases. All patients were assessed radiologically for union, Tegner Lysholm Knee Scoring Scale and IKDC score and objective PDT manual examination for a period of 2 years after surgery were done. 67.65% achieved union in 12 weeks and 26.47% achieved union by 16 weeks, Delayed union was found in 5.88% beyond 16 weeks although none needed revision or reconstruction. Average pre-operative Lysholm score of 40 improved to 88 postoperatively. Average IKDC score preoperative was 33 which meliorated to 83 after treatment.

**Conclusion:** Improvised approach by Burk and Schaffer is safer and easier than the classical one. Open reduction and fixation with cannulated screw is one of the excellent techniques for tibial avulsion of posterior cruciate ligament (PCL). The isolated PCL avulsion fractures treated with fixation have good Lysholm and IKDC scores, although objective laxity is present in significant number of cases without subjective disability. The isolated PCL injuries have good results if managed surgically.

**Keywords:** PCL avulsion fractures, Burks Schaffer's approach

### 1. Introduction

Isolated bony PCL avulsion fractures are infrequent, estimated to account for 20% of knee ligament injuries. Anatomically PCL acts as a posterior knee stabilizer and limits the posterior tibial translation [1, 4, 5, 6]. The road traffic accidents (RTA), and sports injuries are common causes. The mode of trauma in PCL injuries is peculiar and comprises dashboard, hyperextension and hyper flexion injuries [1]. Many studies [2, 3] have established that the chronic PCL insufficiencies lead to medial femoral and patellofemoral compartments, degenerative arthritis and increased risk of meniscal tears. Torisu *et al* [8] have quoted that PCL bony avulsion neglected beyond 11 weeks, have poor results. Griffith *et al* [9] strongly advocated fixation of displaced PCL avulsion fractures to avoid the morbidities associated with PCL avulsion fracture nonunion. Research advocate controversial treatment protocols in PCL tibial avulsion fractures but universally surgical reinsertion of the avulsed fragment is an endorsed procedure [7, 8, 9, 10].

We centered our study explicitly on isolated bony PCL avulsion fractures so that we can preclude the compounding factors which can influence the results.

### 2. Materials and methods

This study included total of 34 skeletally mature consented patients. Ethical committee approval was taken prior to the study protocol application.

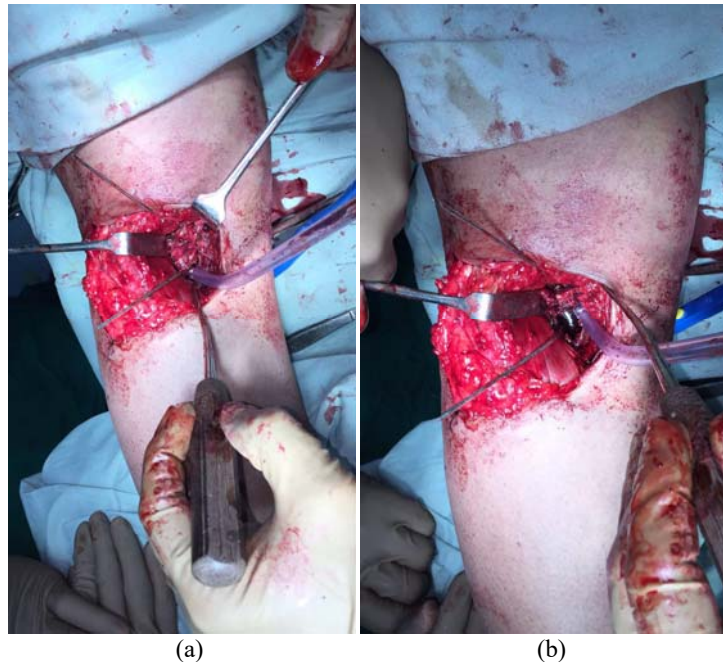
At the time of presentation patients were evaluated thoroughly for vital signs and other associated injuries. The limb was checked for the intact neurovascular status. Males were 91% as compared to the females in this study group. Vehicular accident dashboard type was the commonest (47.05%) mechanism of injury for PCL avulsion fractures in this study. Other mechanism being hyperextension (26.47%) or hyperflexion (26.47%) involving either of trauma due to vehicular accident, sports or domestic injury.

Standard antero-posterior and lateral views of affected knees were obtained to rule out associated major fractures. Stress posterior drawers radiography was not carried out due to pain in acute phase. Subsequently all patients underwent CT and MRI scans to rule out any concomitant injuries in the knee joint thereby excluding any case with additional complete tear of extra-articular ligaments. Multi-ligamentous injuries, fracture dislocations of knee, arthritic knees with PCL avulsion fractures, associated any long bone fractures and prior knee surgery were excluded. The concomitant meniscus tears were included in the study as the focus was not on early arthritis due to post-menisectomies, although that might have had influenced subjective Lysholm scores and IKDC scores. Avulsion fractures beyond three months were excluded in view of nonunion and PCL reconstruction was advised as per Griffith *et al* [9] and Dhillon *et al* [11].

All surgeries were performed under regional anesthesia except in cases with head injury in which general anesthesia was given. All surgeries were performed under tourniquet in prone position, and the lower extremity was held in 30 degree flexion

with help of bolster.

Modified Burks and Schaffer's [12] approach was utilized along the posteromedial corner of the knee joint. L shaped incision with intention to keep incision minimum at the knee posterior crease and a vertical limb overlying the medial aspect of the gastrocnemius muscle was taken. Dissection was carried to the deep fascial layer, which was incised vertically over the medial head of the gastrocnemius. The medial border of the medial gastrocnemius was identified, and the interval was developed between it and the semimembranosus tendon protecting the medial sural cutaneous nerve. This plane was developed by blunt dissection until the posterior joint capsule was reached. Medial head of gastrocnemius is retracted laterally so neurovascular structures are away from surgical field. A vertical incision was made in the capsule. The contents of the posterior intercondylar notch and the tibial attachment of the PCL were exposed. Chronic cases needed multiple punctures in PCL substance to reduce the shortening due to possible fibrosis as described by Dhillon *et al* [9], avulsed fragment was isolated; the crater was cleaned, reduced the fragment to the site and fixed with 4 mm cannulated screws with washer. Patients with extreme PCL comminution were first whip stitched and pulled through separate tunnels anteriorly followed by single screw washer fixation. Screws position was confirmed under image intensifier. Stability was checked with range of motion of the knee joint. Posterior capsule was closed, and the wound was closed with suction drain.



**Fig 1:** Intraoperative picture of left knee retracted gastrocnemius thereby protecting the neurovascular bundle and preliminary fixation of fragment with k-wire (a), and final screw fixation (b).

Post operatively the patients were given compressive crepe bandage dressing with knee immobilizer. The injectable antibiotics were continued for 72 hours.

Static and dynamic quadriceps exercises and ankle mobilization were started usually from second postoperative day. Mobilization non weight bearing on operated limb was done. Suture removal was done on post-operative day 14.

1<sup>st</sup> Follow up was on 14<sup>th</sup> post-operative day for suture removal. Subsequent follow up were at an interval of 4-6

weeks in the outdoor department and with Physiotherapy unit. At the time of follow up, a thorough clinical evaluation was done for progress of union and for joint range of motion. Range of motion exercise of knee joint started after two weeks, passive first, active assisted after four weeks. Active knee bending was allowed thereafter. Partial weight bearing walking was allowed after 4 weeks followed by full weight bearing walking at the end of 6 weeks unless the X-rays showed delayed Union wherein the weight bearing was further

delayed by additional 2 weeks. At follow up, the standard X-rays were done at 6 weeks, three months, 12 months and further if they still had symptoms, and evaluated for signs of

healing From 3 months onwards symptoms and functions were assessed using the scoring system of Lysholm score and IKDC score.

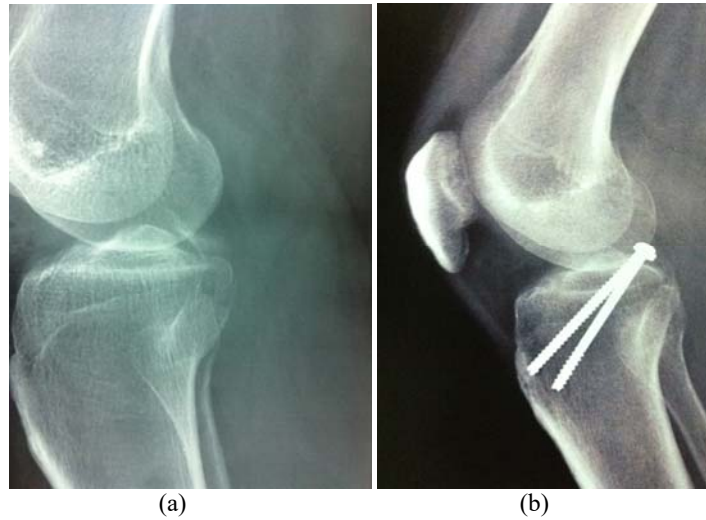


Fig 2: Preoperative (a) and postoperative (b) Xrays.

**3. Results of the present study**

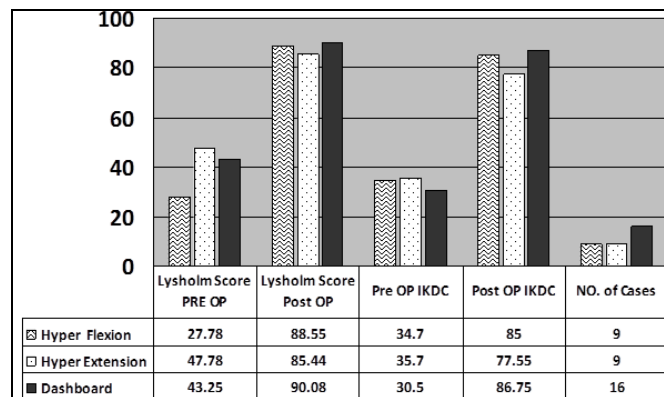
We had in total 34 patients in this study Males were 91% as compared to the females who amounted to 9% in this study .16 (47.06%) patients had dashboard injury while there were 9 (26.47%) patients each with hyperextension and hyperflexion type of injury. Maximum patients were falling in the age group between 28-50 years with mean age being 36.26 years. There was increased incidence of fracture in the age group of 31-40 years (34%) noted in this study

The Lysholm score ameliorated from an average of 37.9 preoperative to 88 postoperative. Preoperative posterior drawers testing showed that all three groups had sag and the drawers test was positive either in grade 1, 2 or 3. Postoperative 9 cases had grade I laxity and 4 cases had grade II laxity. The IKDC score excelled from an average of 33.63

preoperative to 83 postoperatively. The dashboard type had better postoperative IKDC scores as compared to hyperflexion and hyperextension type. Although the postoperative IKDC scores are lower in hyperflexion and hyperextension group but the significant subjective complaints affecting ADL were not present in those group of patients with lower scores. Although lower scores restrained some patients to avoid high impact sporting activities.

In this study 23 cases united radiologically within 12 weeks. Average time of union was 10 weeks. Two cases developed delayed union (more than 16 weeks). In this study, there were four cases of restricted full flexion with difficulty in deep squatting movement. There were 2 cases with superficial skin stitch abscess infection both of which healed uneventfully after minor debridement.

Table 1: Comparison of IKDC, Lysholm scores preoperatively and post operatively.



**4. Discussion**

Bony avulsion fracture of the posterior cruciate ligament constitutes 3–40% of all acute knee joint injuries of which 35% are displaced Nonsurgical treatment of displaced PCL avulsion fractures have a high incidence rate of nonunion or malunion and can cause loss of ligament function, leading to further knee instability and traumatic arthritis. Nicandri *et al* [15]. Believe that, regardless of the size of the displacement, an operation is necessary for the treatment of bony avulsion

fractures of the posterior cruciate ligament. Surgical methods include arthroscopic surgery or open reduction and internal fixation. Arthroscopic surgery is less invasive; however, because the end point of the posterior cruciate ligament is located deep on the posterior part of the tibial plateau, an arthroscopic operation would be relatively difficult and may result in avulsion of the posterior cruciate ligament, loose fracture suturing and problems in postoperative rehabilitation, which causes some patients to exhibit limited knee range of

motion after the surgery [4, 17, 18, 19]. As open reduction and internal fixation have a clear surgical field exposure, the fractures can be reduced accurately under direct vision, with reliable fixation and early rehabilitation can be performed [5].

Direct posterior approach (Abbott and Carpenter) for the avulsion of PCL was the commonly used approach in many series. This approach through the popliteal fossa to the tibial attachment of the posterior cruciate ligament (PCL) can be time-consuming and is regarded as hazardous. Burk and Schaffer approach is safe and easy, this simplified approach does not transect or expose neurovascular structures as in other procedures. This approach has been proven safe and less time consuming and provides direct PCL tibial access [2]. In this study it was found in cohesive to the above statement. There were no difficulties during the procedure through Burk and Schaffer approach and there were no postoperative complications related to the approach.

Vehicular accident dashboard type was the main cause to produce all PCL avulsion fractures 47.06% (n=16) in this study. Sports and domestic injuries each accounted for .26.47% (n=9) of the study group. Torisu *et al* [8] in his study of 36 patients found 47% anterior tibial injury suggesting of dashboard type whereas in the retrospective study by Seitz *et al* [13] found 87% to be dashboard type with all these patients having pretibial ecchymosis. In R Piedade *et al* [14] 2007 case series, 57% of the injuries were resulting from motorcycle accidents, and 17% have been caused by car accidents, while the presence of injury on the anterior leg surface was found in 62% of the cases.

Two cases which had delayed union (more than 16 weeks) when followed upto 20 weeks showed radiological union without any further intervention. The delayed union developed in patients with comminuted fractures which were fixed with screws along with pull through sutures. R Piedade *et al* [14] in 2007 case series reported that all his cases have been rated as good and excellent in a subjective evaluation (Lysholm) in 43% and 57% of cases, respectively.

Preoperative posterior drawers testing showed that all three groups had sag and the drawers test was positive either in grade 1, 2 or 3. None of PCL avulsion fractures had normal anterior tibial offset. The hyperextension group had more residual grade 1-2 laxity in posterior drawers testing. This finding needs mechanistic studies to reinforce the conclusion. Plastic deformation along with avulsion could be present in certain forms of trauma especially hyperextension [16] but this fact needs to be studied in controlled simulations in a experimental lab to endorse such conclusion authoritatively. The posterior draw test in neutral rotation in R Piedade *et al* [14] case series showed a residual posteriorization of + (0.5 cm) and ++ (1 cm) in 57% and 38% of the cases, respectively.

Inoue *et al* [15] in his prospective study evaluated clinical prognosis of open reduction and PCL avulsion fracture fixation. It suggested that 60% patients showed a certain degree of posterior instability on operated knees when compared to intact knees, even after anatomical reduction and stiff fixation of the bone fragment [18, 19, 20, 21].

With respect to complications in this study, there were four cases of restricted full flexion with difficulty in deep squatting movement. No cases of FFD persisted after 24 months.

## 5. Conclusion

Improvised approach by Burk and Schaffer is safer and easier than the classical one. Open reduction and fixation with cannulated screw is one of the excellent techniques for tibial avulsion of posterior cruciate ligament (PCL). The isolated

PCL avulsion fractures treated with primary fixation tends to have good Lysholm and IKDC scores, although objective laxity is present in significant number of cases without subjective disability. Fixation of displaced avulsion fractures PCL from tibia gives excellent results and is now considered the standard modality of treatment.

## 5.1 Conflict of interest: Nil

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