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**Milind V Ingle**  
MS (Orthopaedics), Assistant  
Professor, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

**Abhishek P Bhalotia**  
MS (Orthopaedics), Senior  
Resident, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

**Vijasing Chande**  
Junior Resident, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

**Shrikant Gade**  
Junior Resident, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

**Maroti R Koichade**  
MS (Orthopaedics), Professor  
and Head, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

**Correspondence**  
**Abhishek P Bhalotia**  
MS (Orthopaedics), Senior  
Resident, Department of  
Orthopaedics, Indira Gandhi  
Government Medical College,  
Nagpur, India

## Functional outcome of bony PCL avulsions fixed with Mini open technique

**Milind V Ingle, Abhishek P Bhalotia, Vijasing Chande, Shrikant Gade,  
Maroti R Koichade**

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### Abstract

**Introduction:** To evaluate the functional outcome in bony Posterior Cruciate Ligament (PCL) avulsion fractures treated with open reduction and internal fixation through Mini open technique. The approach is safe, and simple with a slight modification and technical tips.

**Material and Methods:** Twenty four patients (19 males and 5 females) were included in the study. Fixation was done through a modified mini open technique using 4 mm cannulated cancellous screws. The minimum follow up considered in study was one year. Functional outcome was assessed using clinical examination, Tegner Lysholm knee score and stress radiography.

**Results:** The mean Tegner Lysholm scores at the time of 1 year follow up was 91.66. The PCL laxity assessed clinically by posterior drawer test on stress radiography was grade I in 3 cases and nil in rest of 21 at 8 weeks follow-up. All the patients had achieved bony union of tibial avulsion fractures at the time of last follow up.

**Conclusion:** Bony PCL avulsion fractures treated by Mini open technique with open reduction and internal fixation achieved good to excellent results and can prevent significant late onset disability.

**Keywords:** Mini open, Tegner Lysholm, PCL

### 1. Introduction

Bony avulsions of the posterior cruciate ligament (PCL) are often overlooked and not treated adequately because of apprehension regarding approach to expose the surgical field. <sup>[1]</sup> Injury to PCL can be either due to bony avulsion or intra substance rupture. There are a great number of long term disabilities in these patients if not treated timely and adequately like patellar degeneration and chronic pain due to instability <sup>[2]</sup>. The difference between bony avulsion fractures and intra substance tear is of ease of diagnosis and treatment protocol for the former <sup>[3]</sup>.

The treatment of bony PCL avulsions may vary from open reduction and internal fixation to arthroscopic fixation with screws or sutures <sup>[4-6]</sup>. Surgical fixation of the bony avulsion by either a screw or K-wire is routinely done nowadays with excellent results <sup>[7]</sup>.

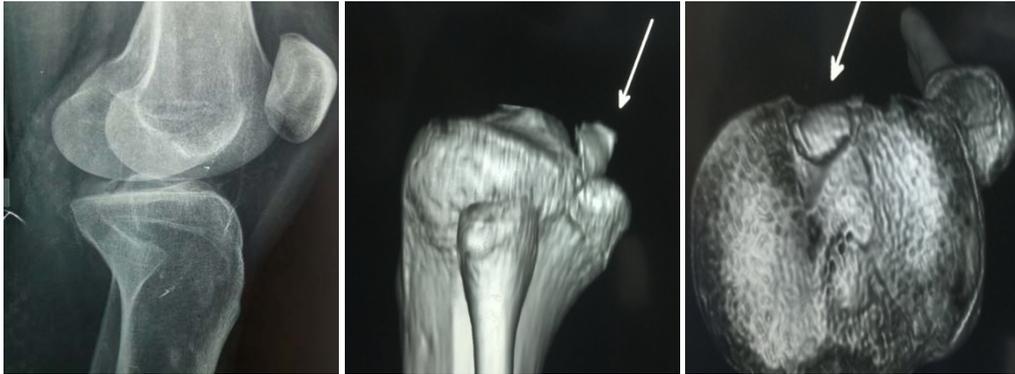
The apprehension of treating bony avulsions of PCL due to difficult standard posterior approach and risk of damage to neurovascular structures in the past have been tried to be solved with many modifications of standard approach and several newer approaches. Trickey *et al*, modified the standard posterior approach to decrease the amount of surgical dissection and time, but still was not accepted widely because medial head of gastrocnemius was divided and neurovascular structures were still at risk of injury <sup>[8]</sup>. Posterolateral approach described by Ogata *et al* and McCormick *et al* required osteotomy of the fibular neck and extensive dissection of popliteus tendon which endangers common peroneal nerve and was too complex <sup>[9, 10]</sup>.

Burks and Schaffer in 1988 described a simplified approach to the PCL which was widely accepted because it avoided the risks associated with all the previous approaches <sup>[11]</sup>. Now it has been the standard approach for fixation of bony PCL avulsions and reconstruction. We have used the modification of this approach in the form of Mini open technique for the fixation of bony PCL avulsions with the aim of early rehabilitation and minimal invasive surgery without any added risk.

**2. Materials and Methods**

After taking approval from the institutional ethics committee, 24 patients went for surgical fixation of PCL avulsion injuries using a Mini open technique. The approach is a modification of classically described approach of Burks and Schaffer. All patients were assessed preoperatively with clinical

examination, radiographs (AP & Lateral view), 3D CT (Fragment size) and MRI (Figure 1). All patients were operated in the time frame of 3 days to 2 weeks. Antibiotic prophylaxis consisted of preoperative dose which was then continued for 24 hours.



**Fig 1:** Preoperative X-ray and CT showing bony PCL avulsion

The modification in technique is that of longitudinal skin incision around 4 cm in length which was made along the medial aspect of the gastrocnemius muscle and extended proximally up to the flexion crease, the horizontal part of it is not taken as classically described by Bucks and Schaffer (Figure 2) [11]. Both the superficial and deep fasciae were cut in the line of incision, and blunt dissection, developing a plane between the medial border of medial gastrocnemius and semimembranosus muscle, until the capsule was exposed. The middle medial geniculate artery, which lies over the mid

capsule is protected as much as possible or might require ligation in some cases. The level of the joint was identified by gently performing flexion-extension movements, and a longitudinal cut in the capsule was given to expose the fracture site. The avulsed bony attachment of the PCL, with gentle flexion of the knee, was provisionally fixed with K-wires. Final fixation was done using one or two 4 mm partially threaded cancellous screws after confirming trajectory of guide wire under image intensifier (Figure 3).



**Fig 2:** Intraoperative image showing incision location and size



**Fig 3:** IITV image showing Reduction and Fixation with 4 mm CC screw

After taking wound lavage, the capsule is sutured followed by fasciae and subcutaneous layer, lastly skin. All patients were given knee brace and mobilized from the first postoperative day with passive ROM exercises, static quadriceps strengthening exercises and allowed to weight bear as tolerated with knee brace in situ. Gradually ROM was increased according to patient tolerability and full ROM was achieved in most of the cases by the end of 4<sup>th</sup> week. From 4<sup>th</sup> week onwards knee brace was discontinued with active ROM and muscle strengthening exercises. Patients were followed up on 2<sup>nd</sup> week for suture removal, 4<sup>th</sup> week to discontinue knee brace and start active ROM exercises and every monthly for minimum 1 year. On every visit from 4<sup>th</sup> week onwards patients were assessed clinically with posterior drawer test and stress radiographs as suggested by Jung *et al* [12]. Tegner Lysholm score was measured from 8 week onwards till one year with every visit and progress in functional outcome assessed with its improvement [13, 14].

### 3. Results

The study included 24 patients during the period of January 2015 to December 2016 for fixation of bony PCL avulsion through Mini open technique including 21 males and 3 females. The patients were followed up every 4 weeks and were assessed clinically with posterior drawer test, stress radiographs with active hamstring contraction and Tegner Lysholm scoring [12-14]. The PCL laxity was graded as grade I (<5mm), grade II (6 to 10 mm) and grade III (>10 mm). Out of 24 patients operated with this technique 21 cases did not have any laxity at 8 weeks, three cases with grade II laxity and none with grade III laxity (Table 1). Both Bone leg fractures was the most common associated injury seen in 4 cases and all of them were operated with nailing in the same sitting.

The Tegner Lysholm score was graded as excellent, good, fair and poor depending upon the final score out of 100. The mean Tegner Lysholm score was 91.66 in 24 patients with range from 88 to 96 (Table 2). The mean period of follow up in our study was 16 months with range from 13 to 21 months. Full range of motion (140° degrees or more) was achieved in 16 cases and the rest of 8 patients also have ROM between 120° to 130° degrees which was clinically acceptable to them (Table 3). The reduced ROM in remaining 8 cases could be due to non-compliance and apprehension for physiotherapy in post-operative period. The full ROM achieved early in most of the cases was because of less painful scar at flexor crease due to modification in technique. The bony union was achieved in all the patients at the time of last follow up. Complications like superficial infection in two cases were managed with dressings and oral antibiotics. We did not have any other complications like nonunion, instability and arthrofibrosis.

**Table 1:** Outcome according to PCL laxity on stress radiographs

Grade	Amount of Laxity	Number of Patients
I	< 5 mm	3
II	6 – 10 mm	0
III	> 10 mm	0

**Table 2:** Outcome according to Tegner Lysholm Knee score and Grading

Grade	Tegner Lysholm Score	Number of Patients
Excellent	>90	19
Good	84 – 90	5
Fair	65 – 83	0
Poor	< 65	0

**Table 3:** Outcome according to Range of Motion achieved at the end of 12 weeks

Range of Motion (degrees)	Number of patients
> 140°	16
130° – 140°	6
120° - 130°	2

### 4. Discussion

The function of posterior cruciate ligament (PCL) is of primary restraint for posterior tibial translation during knee flexion [2]. Injury to it results in posterior subluxation of the tibia due to instability with increased stress over patellofemoral joint leading to long term disability in the form of chronic pain and cartilage degeneration [8, 15]. Fixation of bony PCL avulsion is now the standard of care with excellent results as quoted by many authors. There are many ways to do it like open reduction through standard posterior or posteromedial approach and arthroscopic fixation. Kim *et al* believed that the technique of arthroscopy-assisted reduction and fixation was difficult and had a steep learning curve [16]. In our experience a similar fixation can also be achieved by open exposure through the posteromedial approach, which can be used at any center.

The standard classical approach described by Abbott *et al* was extensive, time consuming and associated with the risk of damage to neurovascular structures. [1] Many modifications of this approach has been described by different authors like Trickey *et al*, Ogata *et al*, McCormick *et al* and Burks and Schaffer [8-11]. The modification of Trickey *et al*, was not accepted widely because medial head of gastrocnemius was divided and neurovascular structures were still at risk of injury [8]. Posterolateral approach described by Ogata *et al* and McCormick *et al* required osteotomy of the fibular neck and extensive dissection of popliteus tendon which endangers common peroneal nerve and was complex [9-10].

Burks and Schaffer simplified the procedure and did not require either division of medial head of gastrocnemius or fibular osteotomy [11]. Short learning curve, minimal dissection and no risk of damage to neurovascular structures made this approach the best option for fixation of bony PCL avulsions. The post-operative rehabilitation was accelerated and excellent functional results were gained without any need of technical expertise and tools. We have used this approach in the management of all the cases of bony PCL avulsions. Conservative treatment in the form of cast immobilization was recommended by many authors but was associated with poor functional outcome and went into disregard [7, 8, 17]. Meyer *et al* too had reported poor functional outcome in patients of bony PCL avulsion treated conservatively [18]. Excellent results were quoted by Seitz *et al* in their series of 26 patients treated for PCL bony avulsion with open reduction and internal fixation using screws and K-wires [7].

In our study, the stress testing with kneeling was conducted for PCL laxity as described by Jung *et al* [12]. The Tegner Lysholm knee scoring was used to assess the functional outcome of bony PCL avulsion fixation by many studies as in our study [13, 14]. The full ROM was achieved early in most of the cases which may be due to modification in technique by avoiding the scar over flexor crease. Compliance of the patient and postoperative rehabilitation also plays a major role in achieving early ROM. The mean duration of follow up was 16 months with range from 13 months to 21 months. Functional outcomes rarely change after one year as suggested by various studies, so it had been selected as the minimum follow-up criteria [19]. The major limitation of study was smaller number

of patients and limited follow-up.

### 5. Conclusion

Open reduction and internal fixation for bony PCL avulsion is now becoming standard of care due to simple, safe and easy exposure techniques without any expertise and short learning curve. Time and again it has produced good clinical results without any long term disability. Arthroscopic repair has steep learning curve. The Mini open modification of posteromedial approach allows good exposure for screw fixation with minimal dissection and less painful scar at flexor crease achieving full ROM as early as 12 weeks. A high index of suspicion in screening of all knee injuries can prevent long term disability using this technique.

### 6. Consent

Written informed consent was obtained from each patient included in the study.

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