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## To assess functional outcome of posterior cruciate ligament tibial avulsion fracture treated with open reduction internal fixation by cancellous screws with washer through Burk's and Schaffer's posteromedial approach

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### Abstract

Posterior Cruciate Ligament (PCL) tibial avulsion fracture is relatively rare injury. PCL is main posterior stabilizer of the knee. There is controversies in literature about surgical indication for PCL Injuries treatment. But if PCL tibial avulsion fracture left untreated it may leads to chronic instability and early degenerative changes. Numerous technique for treatment of PCL tibial avulsion Fracture have been Described in literature from closed reduction to definite fixation, both open and arthroscopically assisted fixation. Objective of study, to access functional Outcome of Posterior cruciate ligament tibial avulsion fracture treated with open reduction internal fixation by cancellous screws with washer through Burk's and Schaffer's Posteromedial approach. Functional outcome measure with Lysholm score. Total thirty patient cases of PCL tibial avulsion fracture were included for study from January 2015 to November 2018, which were operated in our Institute Smt. Kashibai navale medical college and General hospital, Narhe, Pune. Assessment with help of clinically, Radiologically and functional outcome by Lysholm score. We got result like, age of the patients was between 20-50years (Avg. 35.6years). Total follow up months between 6-12 months (Avg. 8.3 Months). Preoperative Lysholm score between 25-35 (Avg. 29.8). Postoperative Lysholm score between 84-100 (Avg. 96 which is excellent). Male to Female incidence ratio was 2.7:1. There were 3 patients with Postoperative Laxity with Mild grade (< 5 mm). There three patients with Residual pain after last follow up but on radiographic study found union. There Four patients with Superficial infection which were treated with oral antibiotics and cure that only no need operative procedure for same. We concluded as, PCL tibial avulsion treated with open reduction and internal fixation by one cancellous screws with washer through Burk's and Schaffer's posteromedial approach leads to excellent clinical results, radiological findings and functional outcome.

**Keywords:** PCL avulsion fracture, Burk' and Schaffer's approach

### 1. Introduction

Posterior cruciate ligament tibial avulsion fracture relatively uncommon injury. 20% incidence rate of PCL tibial avulsion fracture of total ligament injury in knee joint. PCL is stronger among two cruciate ligaments. Anatomically PCL acts as a posterior knee stabilizer and limits the posterior tibial translation [10, 20, 22, 30]. Most common mode of injury is due to road traffic accidents, sport activity and domestic fall accident [2]. Main mechanism of injury involved in PCL Injuries is the dashboard injury, from direct trauma to the tibia at anterior portion with the knee in flexion [13]. In sport activities the main mechanism of injury is sudden excessive flexion of an extended knee or fall over a flexed knee [12].

PCL serve as primary restraint to posterior translation of tibia over the femur and also as a secondary restraint to internal and external rotatory force over the knee [27]. If left untreated, PCL deficient knee is leads to abnormal loading and is predisposed to cartilage damage and early degeneration with chronic instability [3].

Toritsu *et al* have quoted that PCL tibial avulsion fracture neglected beyond 11 weeks, have poor results [26].

Griffith *et al* strongly advocated fixation of displaced PCL tibial avulsion fracture to avoid the morbidities associated with PCL avulsion fracture non-union<sup>[9]</sup>.

PCL tibial avulsion injury differ from other PCL injuries in that they are easily diagnosed on Standard radiographs where bony fragments may be visible.

Over the past few years, a lot has been discussed about treating PCL tibial avulsion fracture. The incidence of this subset of injury had increased over the past few years, due to advance diagnostic techniques like standard plain radiograph antero-posterior view and lateral view, CT scan and MRI scan and increased awareness of the necessity to treat these fractures. Although conservative management is no longer advocated for PCL tibial avulsion fracture, there is various debate on favourable choice of surgical fixation techniques likes open or arthroscopically with cancellous screws, Stain steel wires, absorbable screws, suture anchor, straddle nail, sutures. While open reduction internal fixation have been in the forefront for lots of years, recent advances in arthroscopic techniques have encouraged more surgeon to option for arthroscopic assisted fixation. Arthroscopic repair is technically more challenging, require specialized equipment and has a long learning curve<sup>[8]</sup>. Although both techniques have their advantage and disadvantage, it is usually at the discretion of the operating surgeon toward choosing the technique of his choice and comfort.

Aim of the Study is to assess functional outcome of Posterior Cruciate ligament tibial bony avulsion fracture with open reduction internal fixation by one cancellous screws with washer through Burk's and Schaffer's Posteromedial approach.

## 2. Material and Methods

From January 2015 to November 2018, Thirty patients with PCL tibial avulsion fracture injury presented at Smt. Kashibai Navale medical college and general hospital, Narhe, Pune were included in study.

The Mode of injuries may be Road traffic accidents, sports activities or domestic fall accidents in which mechanism of injuries may be dashboard injury, hyper-flexion injuries.

The Injury was diagnosed by clinical examination were patients subjected with Lachman test, anterior drawer test, posterior drawer test for integrity of cruciate ligaments. The collateral ligaments assessed with varus and valgus stress test in extension and in 30 degree flexion. The dial test and external rotation recurvatum test were performed to assess the associated posterolateral ligament complex insufficiency.

Patients also subjected to radiological investigations to confirm diagnosis like Standard plain radiograph Anteroposterior view and Lateral view, CT scan and MRI scan. CT scan for document size of the fragment and MRI to rule out other ligaments injuries.

All the patients were examined again under anaesthesia in the operative room prior to surgical intervention.

### 2.1 Surgical Technique

Preoperative antibiotics (1.5 gm cefuroxime, intravenous) was administered in all the cases after sensitivity testing, 30 mins prior to skin incision. The operative procedure were performed under spinal anaesthesia with tourniquet control.

The patients were positioned in prone position. Skin incision was made over posterior aspect of knee through Burk's and Schaffer's approach with horizontal limb over popliteal crease and vertical limb on medial aspect of medial head of gastrocnemius. The deep fascia over the Medial head of

gastrocnemius was incised as skin incision and interval between medial head of gastrocnemius and semimembranosus tendon was identified. The Dissection was carried bluntly with finger until the posterior capsule of knee joint was reached. Care is taken to identify and isolate the motor branch of tibial nerve and the middle geniculate artery. Whenever necessary middle geniculate artery was ligated. The Medial head gastrocnemius was retracted laterally, thus protecting the neuro-vascular bundle of popliteal fossa. The posterior aspect of femoral condyle and proximal tibia could be palpated at this stage. Slight knee flexion was done in almost all the cases for better visualization. Recession of tendinous origin of medial head gastrocnemius was carried out whenever necessary for enhancing exposure. The posterior joint capsule was incised vertically to access the content of posterior intercondylar notch and tibial attachment of posterior cruciate ligament. The PCL tibial bony avulsion fracture fragment was reduced anatomical and secured with Kirschner's wire (K wire) and positioning verified under fluoroscope. The PCL tibial bony avulsion fracture fragment was then fixed with one Cancellous partially threaded screw with washer. Position of fragment again assessed under fluoroscope and if found adequate the wound was washed and closed over drain. Patients were discharge on postoperative day 12 with suture removal.

### 2.2 Post-Operative protocol

The limb was kept Immobilized using a long knee brace for 6 weeks. Postoperative two doses of antibiotics was given (1.5 gm cefuroxime, intravenous). Quadriceps strengthening was started from the 2<sup>nd</sup> postoperative day. Passive knee bending was started after suture removal on 12<sup>th</sup> Post-operative day. Active Knee range of motion was started 3 weeks after surgery. Partial weight bearing was allowed after 6 weeks and full weight bearing was allowed depend on Radiographic finding of fracture fragment union near about 12 weeks when the brace was also discarded. Return to heavy activities, such as running and sport, were allowed only after 6-9 months.

Patient were regularly followed up every 14 days in first month then every month for next 6-9 months. At every follow up, patients were assessed clinically and radiologically. Laxity assessed with Drawer test and radiological stress view. Final functional outcome measure with Lysholm scoring system.

## 3. Results

Of total Thirty Patients of PCL tibial avulsion fracture in this study male were 73% as compared to the female who counted to 27%. 24(80%) patients had Road traffic accidents while 4(13%) patients with Sports activities accident and remaining 2(6%) patients with domestic fall accidents. Patients Falling age group Between 20year to 50years of age (average 35.6years). Out of thirty patients 17(56%) patients were affected on right side remaining 13(43%) patients with left side affected. Duration between trauma and fixation is Average 8.9 days (7-12 days). Patients were followed up till 8.3 months (6-12 months).

The Lysholm score ameliorated from an Average 29.8 pre-operative to 96 postoperative, p value <0.001 with Paired t test. Pre-operative posterior drawer testing showed that all had sag and the drawer test was positive either in grade 1(<5mm), grade 2(6-9mm) or grade 3(>10mm). Post-operative 3 cases had Mild grade 1 laxity.

In this study 28 patients united radiologically within 12 weeks. Average time of union was 10 weeks. Two case

developed delayed union (more than 16 weeks). There were 4 Patients with superficial infection which healed with oral

antibiotics. And 3 patients with residual mild pain on last visit.



**Fig 1:** Anteroposterior and Lateral Plain radiograph showing PCL tibial avulsion fracture



**Fig 2:** Anteroposterior and Lateral Plain radiograph showing PCL tibial avulsion fracture treated with Open reduction internal fixation  
Single cannulated screw with washer POD 2<sup>nd</sup>.



**Fig 3:** Anteroposterior and Lateral Plain radiograph showing PCL Tibial avulsion fracture united at 10 weeks after surgery

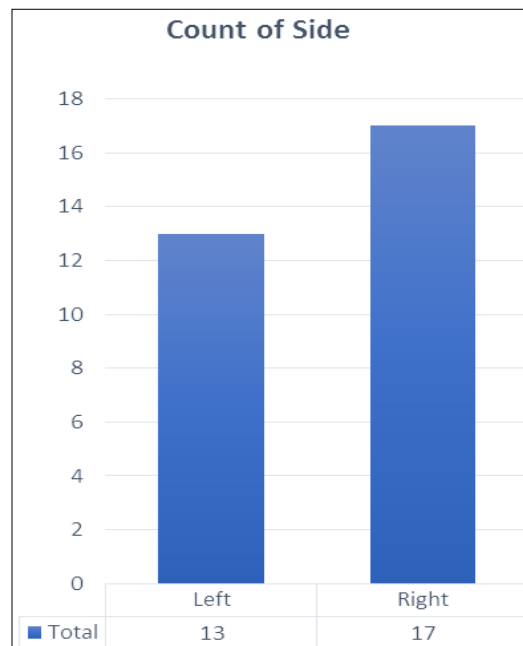


**Fig 4:** Showing Clinical picture of one of the operated patient from study, with excellent functional outcome

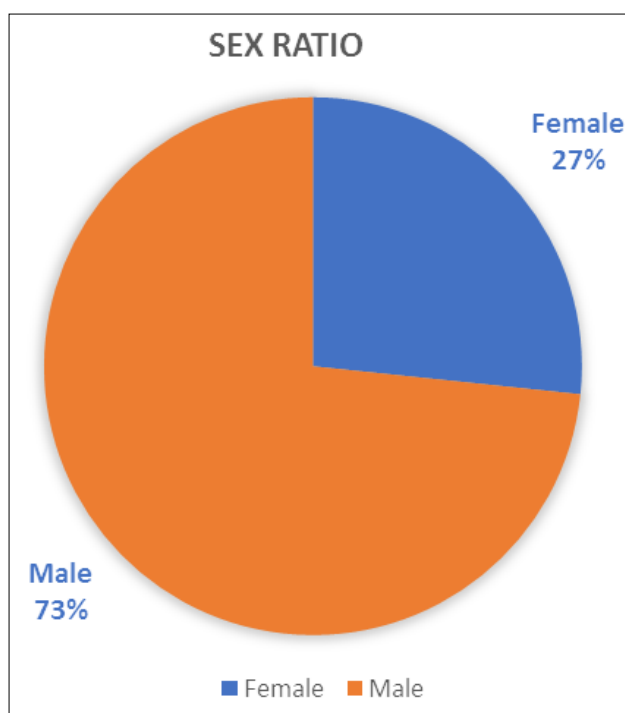
**Table 1:** Details of the 30 patients. Pre op- Preoperative, Post op- Postoperative

Sr. No.	Age in years	Sex	Side	Mechanism	Days before Fixation	Follow up months	Lysholm Score		Postop Laxity	Complications
							Pre Op	Post Op		
Case 1	35	Male	Right	RTA	7	6	30	100	Nil	Nil
Case 2	40	Male	Right	RTA	8	7	30	96	Nil	Nil
Case 3	38	Male	Left	RTA	8	8	29	99	Nil	Nil
Case 4	42	Male	Left	RTA	9	6	35	95	Nil	Superficial Infection
Case 5	49	Male	Right	RTA	10	8	31	100	Nil	Nil
Case 6	45	Male	Right	RTA	11	9	30	95	Nil	Nil
Case 7	42	Female	Right	RTA	9	10	29	96	Nil	Nil
Case 8	25	Male	Left	Sport	7	9	30	100	Nil	Nil
Case 9	29	Male	Left	RTA	8	10	29	95	Nil	Nil
Case 10	30	Female	Left	RTA	10	9	31	96	Nil	Nil
Case 11	25	Female	Right	RTA	12	8	30	88	Mild Grade 1	Residual Pain
Case 12	24	Male	Left	Sport	7	7	29	99	Nil	Nil
Case 13	29	Male	Left	RTA	8	6	28	100	Nil	Nil
Case 14	30	Female	Right	RTA	9	10	29	99	Nil	Nil
Case 15	37	Male	Right	RTA	7	12	28	96	Nil	Nil

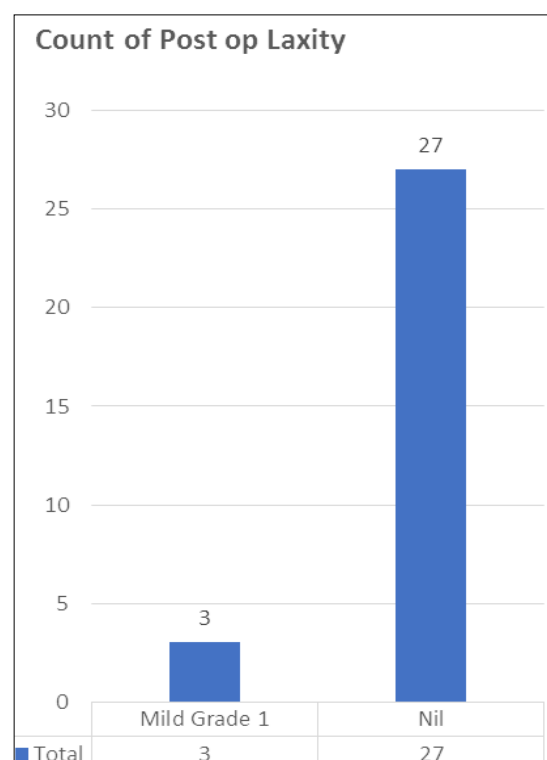
Case 16	39	Male	Right	RTA	9	9	35	97	Nil	Superficial Infection
Case 17	42	Female	Right	Domestic	10	10	28	98	Nil	Nil
Case 18	45	Male	Right	RTA	11	9	29	100	Nil	Nil
Case 19	47	Male	Left	RTA	9	8	30	99	Nil	Nil
Case 20	38	Male	Left	RTA	8	7	31	85	Nil	Nil
Case 21	30	Female	Left	RTA	7	6	32	98	Nil	Nil
Case 22	32	Male	Right	RTA	10	10	30	97	Nil	Nil
Case 23	45	Male	Left	RTA	12	8	28	96	Nil	Nil
Case 24	50	Female	Right	Domestic	9	9	29	95	Nil	Superficial Infection
Case 25	20	Male	Right	Sport	7	8	25	85	Mild Grade 1	Residual Pain
Case 26	22	Male	Left	Sport	8	7	28	98	Nil	Nil
Case 27	29	Male	Right	RTA	9	9	27	97	Nil	Nil
Case 28	35	Female	Right	RTA	10	8	29	100	Nil	Nil
Case 29	36	Male	Left	RTA	11	9	35	99	Nil	Superficial Infection
Case 30	38	Male	Right	RTA	9	7	30	84	Mild Grade 1	Residual Pain



**Fig 5:** Comparison side affected in patients with PCL tibial bony avulsion fracture

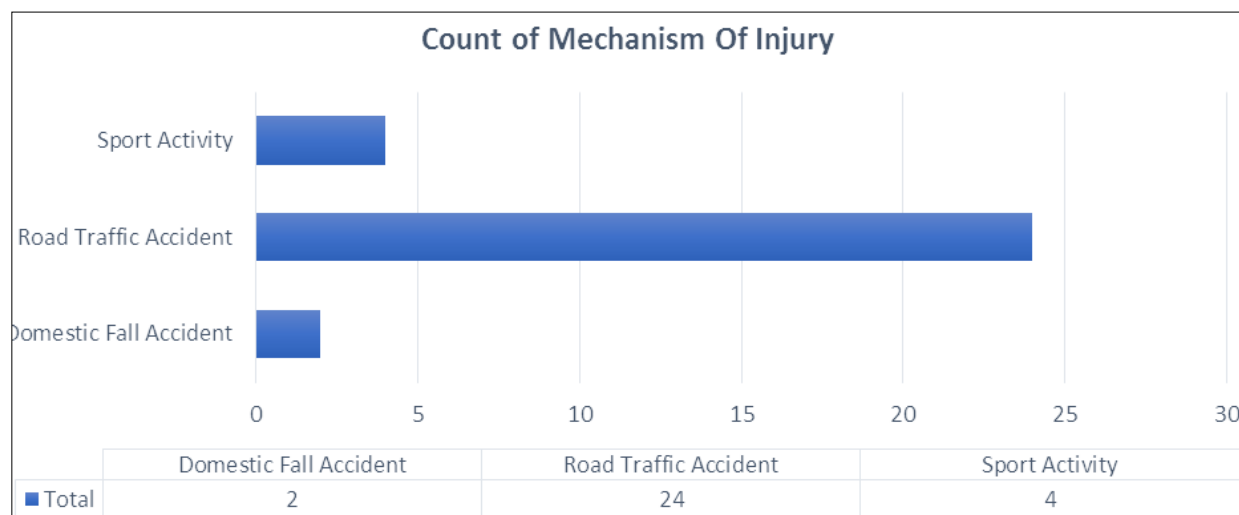


**Fig 6:** Pie chart: Comparison between Male and Female in patients with PCL tibial bony avulsion fracture

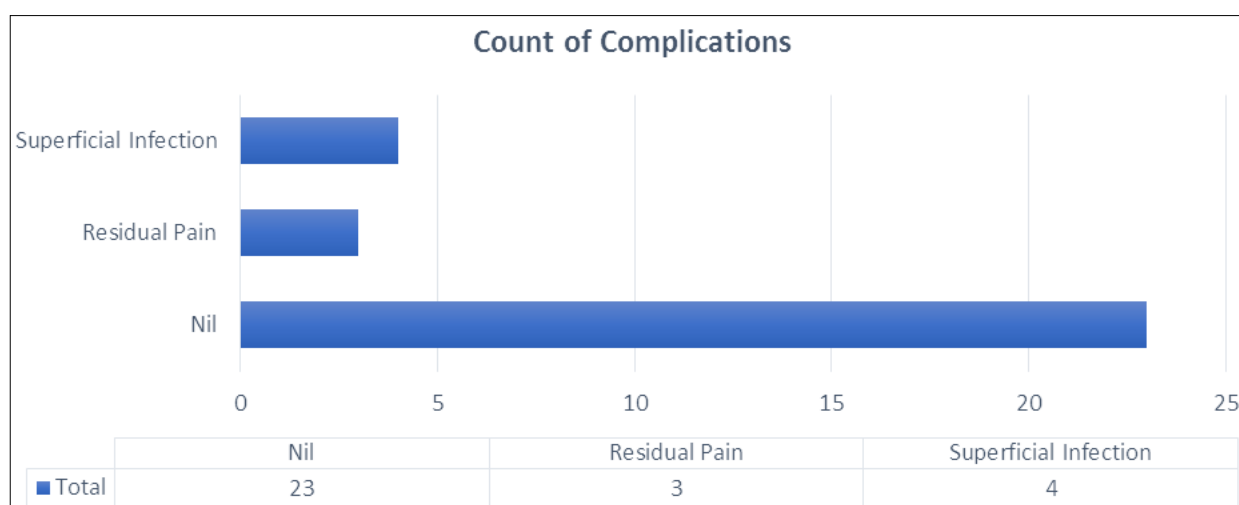


**Fig 7:** Comparison between postoperative finding of posterior laxity in patients with PCL tibial bony avulsion fracture





**Fig 8:** Comparison between mechanism of injury in patients with PCL tibial bony avulsion fracture



**Fig 9:** Comparison between postoperative complications in patients with PCL tibial bony avulsion fracture

#### 4. Discussion

PCL tibial avulsion fracture is rare injury. A displaced PCL tibial avulsion fracture leads to instability of the knee and functional compromise [25]. Approaching such a fracture through an open technique ensures clear visualization of the fracture fragment with anatomical reduction and secure fixation [29]. In this surgical era, there is very little place for conservative management. Conservative management can lead to early degenerative changes, meniscus tear, and chondral damage [17].

There are various surgical approaches have been described for the fixation of PCL avulsion fracture. The standard classical approach described by Abbott [1] was time consuming as it required handling of popliteal vessels. Later on modification were described by Trickey *et al*, Ogata and Burk's and Schaffer's to standard posterior approach.

Trickey [28] had made some headway in decreasing the operative time but still required the division of the medial head gastrocnemius which led to delayed rehabilitation. Ogata [23] had described the osteotomy of fibular neck which increased the complexity of the procedure.

Burk's and Schaffer's [4] simplified the procedure and did not require division of medial head of gastrocnemius or fibular osteotomy. The post operative rehabilitation was accelerated and good functional results were obtained. We had used this approach in the management of all the cases of PCL tibial avulsion fracture injury.

Meyer [19] had reported poor functional outcome following non-operative management of PCL tibial avulsion fracture injury.

Seitz *et al* [24] had reported excellent results in their series of 26 patients treated for PCL tibial avulsion fracture with open reduction and internal fixation.

Nicandri *et al* [21] had reported arthrofibrosis in only one patient of total ten patients study, when aggressive physiotherapy protocol was initiated instead of cast immobilisation.

Inoue *et al* [11] had reported some patients with posterior laxity after open reduction internal fixation of PCL tibial avulsion fracture.

Dhillon *et al* [7] had reported good functional results using cannulated screws in all of their 9 cases with complete fracture healing and no pain at 6 months follow up.

Veselko *et al* [31] had reported good to excellent functional results using a cannulated screw with washer.

Along with open approaches, other techniques for the treatment of PCL avulsion injuries have also been reported that use arthroscopy. The fixation of large PCL avulsion fractures has succeeded via all arthroscopic or arthroscopic assisted K wires or cannulated screw fixation methods [5, 6, 16, 18, 31] and arthroscopic approaches by mean of fiber wire or suture fixation for smaller fragments have been described [14, 15, 32]. These technique evade the requirement of direct dissection in popliteal fossa, easing the fixation of smaller

fragments in contrast to approaches performed with lag screw technique. However, arthroscopic approach are accompanied by a steep learning curve<sup>[32]</sup> and do not completely remove risk of neurovascular bundle injury; therefore may not be suitable for all patients with PCL tibial avulsion fracture. Furthermore, arthroscopy of the damaged knee may be contraindicated in a subgroup of these patients because of severe soft tissue injury. In addition visualization may be difficult, or an impending compartment syndrome may start following an arthroscopic approach.

In our study, Lysholm score ameliorated from an Average 29.8 (25-35) pre-operative to 96(84-100) postoperative (p Value <0.001). Pre-operative posterior drawer testing showed that all had sag and the drawer test was positive either in grade 1(<5mm), grade 2(6-9mm) or grade 3(>10mm). Post-operative 3 cases had Mild grade 1 laxity.

## 5. Conclusion

Avulsion fracture of PCL tibial insertion usually constitute only a small group of Knee ligament Injury. Although several fixation techniques have been reported in literature, surgical fixation with open reduction is recommended. Dissection with Burk's and Schaffer's approach (Posteromedial Approach) is very minimal and remote the risk to neurovascular structures. Despite mild laxity in some patients, excellent functional outcome after Open fixation through Burk's and Schaffer's approach of PCL tibial avulsion which were measured with Lysholm score and subjective analysis.

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