

## Outcome of Isolated PCL Avulsion Fractures Treated with Cancellous Screw Fixation.

Nilesh Vishwakarma<sup>1</sup>, Sarabjeet Kohli<sup>2</sup>, Shaival Chauhan<sup>3</sup>, Kuldip Salgotra<sup>4</sup>, Anant Joshi<sup>5</sup>

<sup>1</sup>Consultant Sports Medicine, MGM hospital / Assistant Professor, Department of orthopaedics, MGM university of health sciences, Navi mumbai.

<sup>2</sup>Associate Professor, Department of orthopaedics, MGM university of health sciences, Navi mumbai.

<sup>3</sup>Assistant Professor, Department of orthopaedics, MGM university of health sciences, Navi mumbai.

<sup>4</sup>Professor and Chief of surgical sciences, Department of orthopaedics, MGM university of health sciences, Navi mumbai.

<sup>5</sup>Sports Medicine Consultant, Sportsmed Mumbai, Parel, Mumbai.

Received: November 2016

Accepted: December 2016

**Copyright:** © the author(s), publisher. Annals of International medical and Dental Research (AIMDR) is an Official Publication of "Society for Health Care & Research Development". It is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Isolated PCL avulsion fractures are uncommon. The road traffic accidents (RTA), sports injuries are common causes along with domestic trauma. **Methods:** We conducted a prospective study with sample size of 34 patients to evaluate the outcome of isolated PCL avulsion fractures treated with cancellous cannulated screws over washers. **Results:** Our study included 47.06% RTA, 26.47% sports trauma and 26.47% domestic injuries. Standard Burks schaffers approach was used in all 34 cases. Delayed union was found in 5.88 % beyond 16 weeks although none needed revision or reconstruction. The delayed union was obvious in patients with comminuted fractures, which were fixed with washers on screws along with pull through sutures. All the cases were evaluated using Lysholm, IKDC and objective PDT manual examination. **Conclusion:** 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:** Isolated PCL avulsion fractures.

### INTRODUCTION

Isolated PCL avulsion fractures are uncommon. The road traffic accidents (RTA), sports injuries are common causes along with domestic trauma. The mode of trauma is specific in PCL injuries and include dashboard, hyperextension and hyperflexion injuries.<sup>[1]</sup> The aim of treating PCL avulsion fractures is to prevent the disability and long-term development of medial compartment and patellofemoral arthritis. Many studies<sup>[2,3]</sup> have demonstrated that the chronic PCL insufficiencies may result in medial and patellofemoral compartments, degenerative arthritis and increased risk of meniscal tears.

#### Name & Address of Corresponding Author

Dr. Nilesh Vishwakarma,  
DND, D'Orth, Fellowship in Sports Medicine (Brasil)  
203, Sai Vishwakarma Darshan,  
Shahaji Raje Marg, Vile Parle East, Mumbai-57

Various studies are present indicating the actual percentages of PCL injuries with respect to mode of injury. Anatomically PCL acts as a posterior knee stabilizer and limits the posterior tibial translation.<sup>[1,4,5]</sup> PCL injuries are estimated to account for 20% of knee ligament injuries. Higher incidence is seen in cases resulting from high-energy trauma, such as road traffic accidents, and in an athletic population, this injury is more closely associated to contact sports.<sup>[6,7]</sup> Domestic trivial injuries forms a less sizable group Torisu et al<sup>[8]</sup> have mentioned that the neglected and delayed beyond 11 weeks, the PCL avulsion fractures have poor results. Griffith et al<sup>[9]</sup> in Arthroscopy 2004, strongly advocated fixation of displaced PCL avulsion fractures to avoid the morbidities associated PCL avulsion fracture nonunion. Literature suggests controversial treatment protocols in PCL tibial avulsion fractures but generally surgical reinsertion of the avulsed fragment is a recommended procedure.<sup>[7-9]</sup>

We focused our study specifically on isolated PCL avulsion fractures so that we can obviate the

compounding factors, which can influence the result

**Aim:**

- 1) To study the outcome of Isolated PCL avulsion fractures treated with cancellous screw fixation.
- 2) Complications related to surgically treated isolated PCL avulsion fractures.

**MATERIALS AND METHODS**

**Type of study:** Prospective. The enrolment was done with prior intimation of the patient and their relatives. Ethical committee approval was taken prior to the study protocol application.

**Sample size:** 34 patients.

**Inclusion criteria:**

- 1) Isolated PCL avulsion fractures as confirmed with CT and MRI.
- 2) Skeletally mature knees.

**Exclusion criteria:**

- 1) Multi ligamentous knee injuries.
- 2) Fracture dislocations of knee.
- 3) Arthritic knees with PCL avulsion fractures
- 4) Patients with compound fractures needing external fixation and reconstructive procedures including flaps or skin grafting.
- 5) Old chronic untreated fractures over 3 months.
- 6) Associated any long bone fractures.
- 7) Poly-traumatised patients
- 8) Patients with open physis.
- 9) Patient lost to follow up.
- 10) Prior knee surgery.

We did CT and MRI scan of one and each case included in the study so as to exclude any other major ligamentous knee injuries.

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.

In our study, there were total 34 patients with age ranging from 28 years to 50 years. All patients could be categorised as having acute up to 3 weeks and subacute from 3 weeks to 6 weeks. Chronic fractures beyond 6 weeks were included up to 12 weeks only i.e upto three months. Avulsion fractures beyond three months were excluded as the bony union would not be possible due to non-union and PCL reconstruction was advised as per Griffith et al<sup>[9]</sup>. Dhillon et al<sup>[11]</sup> had advised against avulsion fracture fixation beyond 3 months as well.

At the time of presentation in casualty /OPD all patients were examined thoroughly for vital signs,

head injury, thoraco-abdominal injury and other associated injuries. The distal circulation was checked and the limb was examined for any neurological deficit. The compartment syndrome signs were monitored stringently.

Standard antero-posterior and lateral views of affected knees were obtained to figure out the major fractures associated. Stress posterior drawers were not carried out in view of pain in acute phase. Subsequently all patients underwent CT and MRI scans. CT and MRI was done to rule out any concomitant injuries in the knee joint thereby excluding any case with additional complete tear of extra-articular ligaments.

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. Attempt was made to keep incision minimum at the knee posterior crease. We utilized a standard Burks and Schaffers<sup>[12]</sup> approach. This approach has been proven safe and less time consuming and provides direct PCL tibial access. By protecting the medial sural cutaneous nerve, the interval between the medial gastrocnemius and the semimembranosus tendon was developed and the posterior joint capsule was exposed. As the capsule was exposed, the medial head of the gastrocnemius protected the neurovascular structures.

Length of the incision varied from 5 to 7 cm The incision was L shaped long enough to negotiate the cancellous cannulated screws with washers. The majority of cases needed two screws but one screw was also adequate in some of the fixations. Chronic cases needed multiple punctures in PCL substance to reduce the shortening due to possible fibrosis as described by Dhillon et al<sup>[9]</sup>. The avulsed PCL facet bed was debrided of soft tissue before fixation. The posterior capsule was incised longitudinally in line with PCL.

Screws position was confirmed under image intensifier in each case.

Patients with extreme PCL comminution were first whip stitched and pulled through separate tunnels anteriorly followed by single screw washer fixation if or additional stability.

Post-operatively the patients were given compressive crepe bandage dressing with knee immobiliser. The injectable antibiotics were continued for 72 hours according to wound condition and other systemic disease like diabetes.

Static and dynamic quadriceps exercises and ankle mobilization was started as soon as patient's recovery and pain permitted, usually from second postoperative day. Non weight bearing walking was permitted. Suture removal was done on postoperative day 14.

1<sup>st</sup> Follow up was on 14<sup>th</sup> post operative day after the patient was discharged for suture removal. Subsequent follow up was follow up was

conducted regularly 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. 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. Range of motion exercise was started after two weeks, passive first, active assisted later after four weeks. Active knee bending was allowed thereafter.

At follow up, the standard X-rays were done and the Lysholm and IKDC score was evaluated upto 8 months, 12 months and 24 months post surgery.

**Clinical**

-As per Lysholm and IKDC score.

**Radiological Status:**

-Union status

-Position of screw

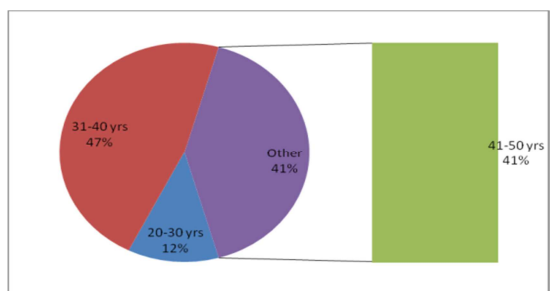
**Assessment Criteria**

All patients were reviewed in a dedicated clinic and radiographs were obtained immediately post operatively and then at 6 weeks, three months, 12 months and further if they still had symptoms. From 3 months onwards symptoms and functions were assessed using the scoring system of Lysholm and IKDC score.

The data was analyzed using frequency, percentage, mean and graphs, charts were derived and evaluated.

**RESULTS**

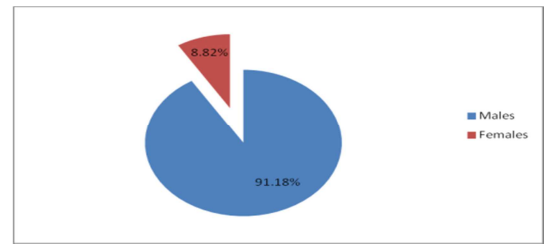
1) Age wise distribution



**Figure 1: Age Distribution.**

- In this study, patients were of age group between 28-50 years.
- Average age was 36.26 years.
- There was increased incidence of fracture in the age group of 31-40 years (34%) noted in this study.

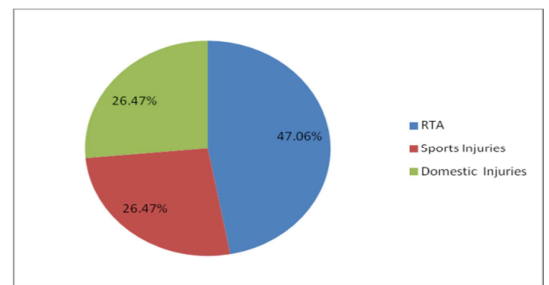
2) Sex distribution



**Figure 2: Sex Distribution.**

- The males were 91% as compared to the females who amounted to 9% in this study.
- There was definite male preponderance.
- The reason behind male dominance is obvious due to the road traffic accidents and involvement in sports. The domestic falls were females.

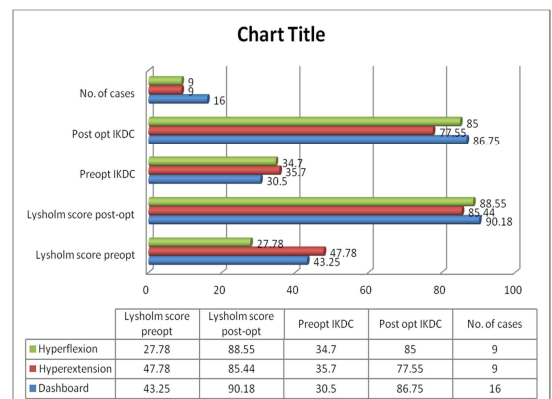
3) Mode Of Injury



**Figure 3: Mode of injury.**

- Vehicular accident dashboard type was the main cause to produce upper pre tibial contusion and PCL avulsion fractures in our study.
- Other cause is fall from hyperextension or hyperflexion involving either of trauma due to vehicular accident, sports or domestic injury.
- 47.05% had dashboard injuries and 26.47% had each hyperflexion and hyperextension injury.

4) Comparison of IKDC, Lysholm scores preoperatively and post operatively.



**Figure 4: Preoperative and post-operative comparison of IKDC, Lysholm scores.**

- The above graph shows the preoperatively and postoperative comparison of IKDC and Lysholm scores.
- Hyperflexion group and hyperextension group shows less better IKDC scores as compared to dashboard type.
- Although the postoperative IKDC scores are lower in hyperflexion and hyperextension group but the significant subjective complaints affecting ADL have not been present the those group of patients with lower scores. Although lower scores does precluded some patients to avoid high impact sporting activities.

- 5.88% of cases developed delayed union although when followed upto 20 weeks showed radiological union without any further intervention. The delayed union was obvious in patients with comminuted fractures, which were fixed with washers on screws along with pull through sutures.

4) **Preoperative and Postoperative posterior drawers tests.** in the 34 cases

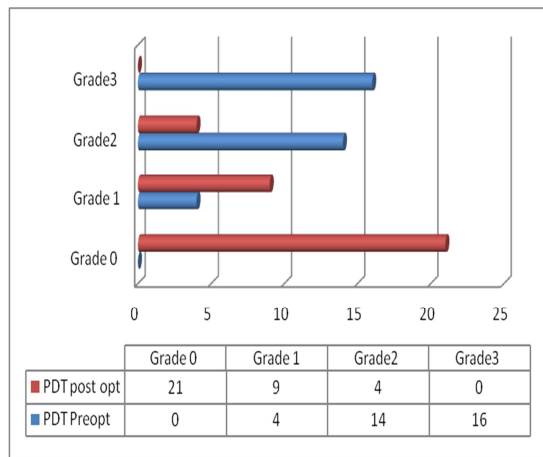


Figure 5: Pre-operative and postoperative posterior drawers comparison.

- 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.

5) Radiological fracture union

Table 1: Time for fracture union.

Time	No. Of Patients	Percentage (%)
0 – 12 weeks	23	67.65 %
12 – 16 weeks	9	26.47 %
More than 16 weeks	2	5.88 %
TOTAL	34	100

- Majority of the fracture united radiologically within 12 weeks.
- Average time of union was 10 weeks.

14) Complications

Table 2: Complications found in the present study.

Complications		No. of Patients
Difficulty in squatting		04
FFD upto 5 degrees		3
Delayed union		02
Delayed wound healing		2
Infection	Superficial Stitch abscess	02
	Deep	0
Total		13

- 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.

DISCUSSION

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. Seitz et al<sup>[13]</sup> in his retrospective study of 26 patients reported mean age of 23 years and 73% males.

Torisu et al<sup>[6]</sup> had 76% males in his study of 21 patients with PCL tibial avulsion fractures.

R Piedade et al<sup>[14]</sup> in 2007 reported ages from 15 to 53 years with a mean of 29 years also having predominantly males (76%). The males were 91% as compared to the females who amounted to 9% in this study.

There was definite male preponderance. The reason behind male dominance is obvious due to the road traffic accidents and involvement in sports. Due to usual society practice, certain tasks, which involve high risk, are done by males e.g. working at height, driving, labour and travelling.

The domestic falls were females.

Vehicular accident dashboard type (47.06%) was the main cause to produce upper pre tibial contusion and PCL avulsion fractures in our study.



47.05% had dashboard injuries and 26.47% had each sports and domestic injuries. As compared to our study, Torisu et al<sup>[8]</sup> in his study of 36 patients found 47 % anterior tibial injury suggesting of dashboard type whereas in the retrospective study by Seitz et al<sup>[13]</sup> found 87% to be dashboard type with all these patients having pretibial ecchymosis. In R Piedade et al<sup>[14]</sup> 2007 case series, 57% of the injuries were resultant 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.

Hyperflexion group and hyperextension group shows less better IKDC scores as compared to dashboard type. Although the postoperative IKDC scores are lower in hyperflexion and hyperextension group but the significant subjective complaints affecting ADL have not been present, those group of patients with lower scores. Although lower scores does precluded some patients to avoid high impact sporting activities. R Piedade et al<sup>[14]</sup> in 2007 case series reported that his all cases have been rated as good and excellent in a subjective evaluation (Lysholm) in 43% and 57% of cases, respectively.

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 but this fact needs studies with controlled simulations in experimental lab to endorse such conclusion authoritatively.

Inoue et al<sup>[15]</sup> 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.

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. In R Piedade et al<sup>[14]</sup> in his case series the posterior draw test in neutral rotation showed a residual posteriorization of + (0.5 cm) and ++ (1 cm) in 57% and 38% of the cases, respectively.

With respect to complications 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.

We summarised the following complications in the cohort of 34 patients enrolled in our study.

- 1) Delayed union: The delayed union was obvious in patients with comminuted fractures which were fixed with washers on screws along with pull through sutures

- 2) Temporary stiffness.
- 3) Grade 1-2 sag on posterior drawers testing.
- 4) Minor swelling persisting for 2 weeks post surgery.
- 5) Extension lag: Temporary due to likely quadriceps wasting in chronic cases which was treated and resolved with aggressive physiotherapy.
- 6) Fixed subtle flexion deformity 3-5 degree especially in chronic cases as the PCL needed to be pie crusted.
- 7) No cases of FFD persisted after 24 months

## CONCLUSION

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 Avulsion fractures PCL from tibia gives excellent results and is now considered the standard modality of treatment.

**Conflict of interest:** Nil

## REFERENCES

1. Veltri DM, Deng XH, Torzilli PA, Warren RF, Maynard MJ. The role of the cruciate and posterolateral ligaments in stability of the knee. A biomechanical study. *Am J Sports Med.* 1995;23:436-43.
2. Boynton MD, Tietjens BR. Long-term follow up of the untreated isolated posterior cruciate ligament. *de cient knee.* *Am J Sports Med.* 1996; 24: 306-310 .
3. Dandy DJ, Pusey RJ. The long-term results of unrepaired tears of the posterior cruciate ligament. *J Bone Joint Surg Br.* 1982; 64:92-4.
4. O'Donoghue DH. Surgical treatment of fresh injuries to the major ligaments of the knee. *J Bone Joint Surg Am.* 1950;32: 721-38.
5. Hughston JC. The posterior cruciate ligament in knee joint stability. *J Bone Joint Surg Am.* 1954; 54:1045-6.
6. Miyasaka KC, Daniel DM, Stone ML. The incidence of knee ligament injuries in the general population. *Am J Knee Surg.* 1991; 4:3-8.
7. Torisu T. Isolated avulsion fracture of the tibial attachment of the posterior cruciate ligament. *J Bone Joint Surg Am.* 1977;59:68-72.
8. Torisu T. Avulsion fractures to the tibial attachment of the posterior cruciate ligament: indications and results of delayed repair. *Clin Orthop Relat Res.* 1979; (143):107-14.
9. Griffith JF, Antonio GE, Tong CWC, Ming CK. Cruciate ligament avulsion fractures. *Arthroscopy.* 2004;20(8):803-12.
10. Meyers MH. Isolated avulsion of the tibial attachment of the posterior cruciate ligament of the knee. *J Bone Joint Surg Am.* 1975; 57:669-72.
11. Dhillon et al. Posterior cruciate ligament avulsion from the tibia: Fixation by posteromedial approach. *Acta Orthopædica Belgica.* 2003; 69:2.
12. Burks RT, Schaffer JT. A simplified approach to the tibial attachment of the posterior cruciate ligament. *Clin Orthop.* 1990; 254: 216-219

13. Seitz H, Schlenz I, Pajenda G, Vecsei V. Tibial avulsion fracture of the posterior cruciate ligament: K-wire or screw fixation? A retrospective study of 26 patients. Arch Orthop Trauma Surg. 1997; 116:275-8.
14. R Piedade , M M Mischan. Surgical treatment of avulsion of the knee PCL tibial insertion: experience with 21 cases: Acta Orthop Bras. 2007; 15(5): 272- 275.
15. Inoue M, Yasuda K, Kondo E, Saito K, Ishibe M. Primary repair of posterior cruciate ligament avulsion fracture. The effect of occult injury in the mid substance on postoperative instability. Am J Sports Med. 2004; 32:1230-7.

**How to cite this article:** Vishwakarma N, Kohli S, Chauhan S, Salgotra K, Joshi A. Outcome of Isolated PCL Avulsion Fractures Treated with Cancellous Screw Fixation. Ann. Int. Med. Den. Res. 2017; 3(1):OR20-OR25.

**Source of Support:** Nil, **Conflict of Interest:** None declared