

Original Article**Treatment of Tibial Avulsion Fracture of Posterior Cruciate Ligament by Open Reduction and Internal Fixation.****Ranjib Kumar Jha* and Santosh Thapa**

Department of Orthopaedics, Nobel Medical College Teaching Hospital, Biratnagar, Nepal.

Article Received: 12th February, 2020; Accepted: 20th May, 2020; Published: 30th June, 2020**DOI: <http://dx.doi.org/10.3126/jonmc.v9i1.29419>****Abstract****Background**

An avulsion fracture of posterior cruciate ligament from tibial attachment is more common in younger age group. It should be fixed otherwise it may lead to secondary changes in knee. Various techniques and approaches are available to fix posterior cruciate ligament avulsion. Different biomechanical studies have shown that, results both open and arthroscopic methods of fixation of posterior cruciate ligament avulsion by screws are comparable. The purpose of study is to evaluate functional and clinical outcome of open reduction and fixation of posterior cruciate ligament avulsion injury through posteromedial approach.

Materials and Methods

The study enrolled 19 cases of isolated posterior cruciate ligament avulsion injury with mean age of 33.21±9.07 year. All cases were treated by open reduction and internal fixation through modified posterior approach. The patients having duration of injury more than 12 weeks were excluded. The minimum follow up duration was 12 months. Results were assessed clinically and radiologically. Final functional outcome was assessed using the Lysholm scoring for knee.


Results

The mean duration of follow up was 14±1.85 months. All patients achieved union at 3 months. At final follow up the mean range of motion was 125.42±6.37 degree (range 110 to 135 degree) without any extensor lag. The functional outcome assessed by Lysholm scoring system was excellent in 15 cases and good in 4 cases.

Conclusion

Open reduction and internal fixation with early range of motion exercises provides good clinical outcome and stable knee.

Keywords: *Fracture fixation, Knee injury, Posterior cruciate ligament*

	<p>©Authors retain copyright and grant the journal right of first publication. Licensed under Creative Commons Attribution License CC - BY 4.0 which permits others to use, distribute and reproduce in any medium, provided the original work is properly cited.</p>	<p>*Corresponding Author: Dr. Ranjib Kumar Jha Assistant Professor E-mail address: ranjib.k30@gmail.com ORCID: https://orcid.org/0000-0002-4708-3347</p>
---	---	---

Citation

Jha RK, Thapa S, Treatment of Tibial Avulsion Fracture of Posterior Cruciate Ligament by Open Reduction and Internal Fixation, JoNMC. 9:1 (2020) 17-21.



Introduction

An avulsion fracture from tibial insertion of posterior cruciate ligament (PCL) is one of the spectrum of injuries of this ligament of knee [1]. It has been reported that PCL injury is more common in younger age group and mainly results from dashboard injuries in road traffic accidents and hyperextension (sudden hyperextension in conjunction with varus and valgus force) injuries of knee in sports [2-5]. Tibial avulsion fracture of PCL is not uncommon in Asia because of popularity of motorcycle transport with an associated high incidence of motorcycle accidents [6]. The PCL is one of important structure of knee. It acts as the primary restraint against posterior tibial translation and along with the anterior cruciate ligament it also regulates external rotation of tibia during extension of knee [7]. The avulsion fractures at the tibial attachment site of PCL occur commonly because it is a strong ligament.

There is common consensus that avulsion fractures of the PCL should be reduced anatomically and fixed to restore complete function of PCL because conservative treatments lead to functional disability and fracture non union [8, 9]. Since there is no any effective method to reduce bony fragment conservatively, the displaced or unstable tibial avulsion fracture of PCL should be fixed anatomically by different surgical methods [10]. Surgical treatments of tibial avulsion fracture of PCL are arthroscopic repair and open reduction and internal fixation by posterior approach. In comparison to arthroscopic surgery, open reduction and internal fixation is technically easy, has a relatively short learning curve and it does not require special arthroscopic equipments [11]; but it is not free from potential risk of soft tissue and neurovascular damage because of close proximity of neurovascular bundle to PCL insertion site [12]. Different biomechanical studies have shown that, results of both open and arthroscopic methods of fixation of PCL avulsion by screws are comparable [13].

In addition, to avoid difficulties associated with previous posterior approaches of knee, a simplified posterior approach given Burks and Shaffer [14] has become standard approach to the PCL. The study aims to assess the short term clinical and functional outcome of open reduction and internal fixation of avulsion fracture of tibial insertion of PCL through posteromedial approach to knee. We hypothesize that open reduction and internal fixation of PCL avulsion will produce stable knees, good range of motion and functional result as assessed by Lysholm score.

Materials and Methods

This is a prospective study conducted between January 2017 to December 2019. Total 19 cases with tibial avulsion fracture who presented to emergency or outpatient department of Nobel Medical College were enrolled in this study. The study was approved by ethical committee of this institute. The inclusion criterion was patients age between 18 to 60 years having PCL avulsion of more than 3mm displacement and less than 12 weeks duration. Those patients having associated other ligament injuries, other articular fracture of knee and less than 3mm displacement were excluded from our study. Diagnosis was confirmed by clinical and radiological examination. All patients were clinically assessed by posterior drawer test to confirm and grade of laxity of PCL injury after adequate analgesia. Preoperative anteroposterior and lateral radiograph and MRI were done to confirm PCL avulsion and rule out other ligaments and meniscus injuries. An informed consent was taken before enrolling in the study.

The surgery was done under spinal or general anesthesia in prone position under tourniquet control through modified posterior approach described by Burks and Schaffer [14]. An inverted L-shaped incision, starting from medial border of gastrocnemius and curving along the flexor crease of knee towards lateral side was given. After incising fascia along the line of incision, capsule of knee joint was exposed in interval between gastrocnemius and semimembranosus. Joint capsule was incised longitudinally and avulsed fragment was debrided and reduced in slight flexed position of knee. The avulsed fragment was fixed with one or two cannulated screws depending on the size of fragment (Figure 1). In case of comminution, PCL was weaved by no.4 ethibond and tied around the head of screw.



Figure 1: intraoperative photograph showing skin incision and fixation avulsed fragment by two screws.

Postoperatively, the limb was immobilized by long knee brace for 6 weeks. Isometric quadriceps strengthening and passive range of motion of knee was started from the 2nd postoperative day. The patients were mobilized using crutches. Active mobilization of knee was started after suture removal at two weeks. Partial weight bearing was allowed at 6 weeks after removal of brace and full weight bearing was started at 12 weeks. Return to heavy activities were allowed after 6 to 9 months depending on the return of strength and movement of knee. Patients were followed up weekly for 1st month, monthly for 3 months and 3 monthly for 12 months. Patients were assessed clinically and radiologically in follow up. Clinical outcomes were assessed in terms of knee stability tested by posterior drawer test and range of motion (ROM). The Lysholm knee scoring system was used to assess final functional outcome.

Results

Out of 19 patients, sixteen were male and three were female. The mean age of patient was 33.21 ± 9.07 years ranging from 20 to 51 years. The mean duration of injury was 5.58 ± 3.9 days and mean duration of follow up was 14 ± 1.85 months (table.1). The most common mode of injury was road traffic accidents (n=13), in which 10 patients had motorcycle accidents. Out of remaining 6 patients, four had injury due to fall from height and two had sports related injury (Figure 2).

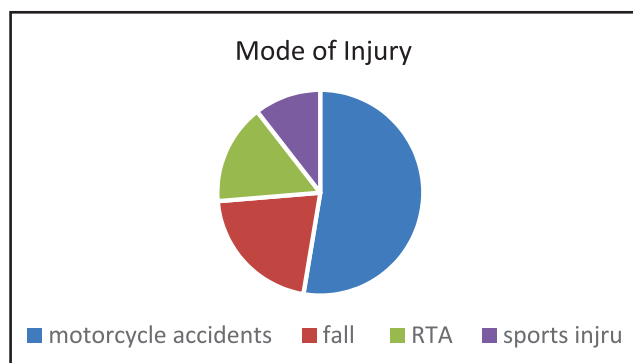


Figure 2: Pie chart showing mode of injury

Table 1: Patients characteristics

Age in years	33.21 ± 9.07
Gender(M:F)	16:3
Involved side(Rt:Lt)	10:9
Duration of injury in days	5.58 ± 3.9
Duration of follow up in months	14 ± 1.85

All patients achieved union at 3 months (Figure 3). At final follow up the mean range of motion was 125.4 ± 6.37 degree (range 110 to 135 degree)

without any extensor lag. The mean Lysholm score was 95.26 ± 5.44 . The functional outcome assessed by Lysholm scoring system was excellent in 15 cases and good in 4 cases.

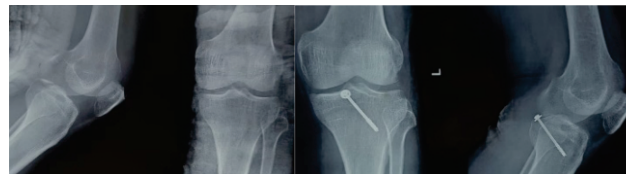


Figure 3: Preoperative and three month postoperative X-ray showing complete union of PCL avulsion.

At final follow up posterior drawer test showed grade +1 instability in three patients and remaining 16 patients did not have any instability. Two patients had residual intermittent pain on prolonged walking and three had superficial infection which healed after dressing and antibiotics. No any other complications were seen at final follow up (Table 2).

Table 2: Outcome and complications

Post-op ROM (degree)	125.4 ± 6.37
Post-op instability tested by posterior drawer test	
Stable	16
unstable	
Grade 1	3
Post-op Lysholm score	95.26 ± 5.44
Residual pain	2
Superficial infection	3

Discussion

PCL injury is common which accounts approximately 20% of total ligament injuries of the knee [15]. Although early diagnosis of PCL tears is difficult and the treatment is controversial, diagnosis and treatment protocol of bony PCL avulsion injuries are easy and universally standard [16, 17]. However apprehension of treating PCL avulsion injuries among surgeons is due to lack of familiarity of posterior approach. Open fixation of PCL avulsion injury through posteromedial approach of Burk and Schaffer is simple and can be done at any orthopedic center. On the other hand arthroscopic fixation which is becoming popular now days is challenging and technically demanding which is not possible in all orthopedic centres [15, 20]. In our series the most common cause of PCL avulsion injury was motor cycle accident because it is commonest vehicle used for travel in our part of world. All patients had excellent to good functional outcome and results were good in terms of ROM and stability of knee at final follow up. In our series of total 19 cases, the average time to union was 3 months. The results were excellent in 79% and good in 21% with an average Lysholm score of 95.26. All patients

attained fair to good ROM with average of 124 ± 5.6 degree and full extension. Only three cases had grade 1 posterior instability on posterior Drawer test. The results of our study were comparable to other studies published by different author. In a study by Joshi et. al. [18] in 14 cases treated by open reduction and fixation with cannulated screws by posteromedial approach, 78.6% had excellent, 14.3% had well and 7.1% had fair result with average postoperative Lysholm score 97 ± 7.6 . In their study all patient attained good ROM with an average flexion of 121.7 ± 9.2 degree and full extension and four patients had mild (1+) residual instability. In another similar study done by Zhang et. al. [19] who used posteromedial approach and suture anchors to fix PCL avulsion in 16 cases, average time to union was 4 months, average Lysholm score was 94 (79-100) and ROM at final follow up was 120 degree.

In a study of 21 cases by Piedade S R and Mischan MM [21], they found excellent in 57% and good in 43% in a subjective evaluation done by Lysholm score and grade 1 instability in 57% and grade 2 instability in 38% of the cases in posterior drawer test. Despite objective laxity, all patients had satisfactory subjective outcome. But in our study, only three patients had grade one instability in which two had excellent and one had good outcome. The results of our study is nearly as good as a study done by Gui et al. [22] who treated 28 cases with PCL avulsion arthroscopically showed that the knee ROM was $135.3 \pm 6.3^\circ$ (range 125-150°). The Lysholm score was 95.2 ± 2.3 (range 92-100) and average time to union was 2.8 months. They also found that only one patient had grade 1 posterior instability.

Conclusion

Open reduction and internal fixation of PCL avulsion injuries provided good clinical outcome, radiological healing and stable knee. The posteromedial approach to knee is safe without any danger to neurovascular bundle. We recommend open reduction and internal fixation of PCL avulsion injuries through posteromedial approach where arthroscopic surgical facilities are not available.

Conflicts of interests: None

References

- [1] Clendenin MB, DeLee JC, Heckman JD, Interstitial tears of the posterior cruciate ligament of the knee, *Orthopedics*. 3 (1980) 764-772. DOI: 10.3928/0147-7447-19800801-07.
- [2] Fanelli GC, Posterior cruciate ligament injuries in trauma patients, *Arthroscopy*. 9 (1993) 291-294. DOI:

- 10.1016/S0749-8063(05)80424-4.
- [3] Schulz MS, Russe K, Weiler A, Eichhorn HJ, Strobel MJ, Epidemiology of posterior cruciate ligament injuries, *Arch Orthop Trauma Surg*. 123(2003) 186-191. DOI: 10.1007/s00402-002-0471-y.
- [4] Shelbourne KD, Davis TJ, Patel DV, The natural history of acute, isolated, nonoperatively treated posterior cruciate ligament injuries: A prospective study, *Am J Sports Med*. 27 (1999) 276-283. DOI: 10.1177/03635465990270030201.
- [5] Meyers MH, Isolated avulsion of the tibial attachment of the posterior cruciate ligament of the knee, *J Bone Joint Surg [Am]*. 57-A(1975)669-672. PMID: 1150710.
- [6] L. B. Chen et al, Arthroscopic fixation of an avulsion fracture of the tibia involving the posterior cruciate ligament, *Bone Joint J*. 97-B (2015)1220-5. DOI:10.1302/0301-620X.97B9.35765.
- [7] Mariani PP, Becker R, Rihn J, Margheritini F, Surgical treatment of posterior cruciate ligament and posterolateral corner injuries: An anatomical, biomechanical and clinical review, *Knee*. 10:4 (2003) 311-24. DOI: 10.1016/s0968-0160(02)00141-2.
- [8] Sabat D, Jain A, Kumar V, Displaced posterior cruciate ligament avulsion fractures: a retrospective comparative study between open posterior approach and arthroscopic singletunnel suture fixation, *Arthroscopy*. 32 (2016) 4453. DOI: 10.1016/j.arthro.2015.06.014.
- [9] Strobel MJ, Weiler A, Schulz MS, Russe K, Eichhorn HJ, Arthroscopic evaluation of articular cartilage lesions in posterior cruciate ligament deficient knees, *Arthroscopy*. 19 (2003) 2628. DOI: 10.1053/jars.2003.50037.
- [10] Chiarapattanakom P, Pakpianpairoj C, Liupolvanish P, Malungpaishrope K, Isolated PCI avulsion from the tibial attachment: residual laxity and function of the knee after screw fixation, *J Med Assoc Thai*. 92 (2009) Suppl 6:S1818. PMID: 20120683.
- [11] Yang CK, Wu CD, Chih CJ, Wei KY, Su CC, Tsuang YH, Surgical treatment of avulsion fracture of the posterior cruciate ligament and postoperative management, *J Trauma*. 54 (2003) 5169. DOI: 10.1097/01.TA.0000047048.37775.32.
- [12] Huang W, Gong X, Rahul M, Priyanka S, Wang C, Liang X, Ding G, Hu N, Anterior arthroscopic assisted fixation of posterior cruciate ligament avulsion fractures, *Eur J Med Res*. 20 (2015) 88. DOI: 10.1186/s40001-015-0177-6.
- [13] Sasaki SU, da Mota e Albuquerque RF, Amatuzzi MM, Pereira CA, Open screw fixation versus arthroscopic suture fixation of tibial posterior cruciate ligament avulsion injuries: a mechanical comparison, *Arthroscopy*. 23:12 (2007) 2630. DOI: 10.1016/j.arthro.2007.06.012.
- [14] Burks RT, Schaffer J, A simplified approach to the tibial attachment of the posterior cruciate ligament, *Clin Orthop Relat Res*. 254 (1990) 2169. PMID: 2323134.
- [15] Deehan DJ, Pinczewski LA, Arthroscopic reattachment of an avulsion fracture of the tibial insertion of the posterior cruciate ligament, *Arthroscopy*. 17(2001)422-5. DOI: 10.1053/jars.2001.21841.
- [16] Torisu T, Avulsion fractures to the tibial attachment of the posterior cruciate ligament: indications and results of delayed repair, *Clin Orthop Relat Res*. 143(1979)107-114. PMID: 509810.
- [17] Trickey E, Injuries of the posterior cruciate ligament: diagnosis and treatment of early injuries and reconstruction of late instability, *Clin Orthop Relat Res*. 147(1980)76-81. PMID: 7371320.
- [18] Joshi S, Bhatia C, Gondane A, Rai A, Singh S, Gupta S,



- Open Reduction and Internal Fixation of Isolated Posterior Cruciate Ligament Avulsion Fractures: Clinical and Functional Outcome, *Knee Surg Relat Res.* 29:3 (2017) 210-216. DOI:10.5792/ksrr.17.022.
- [19] Zhang X, Cai G, XU J, Wang K, A minimally invasive postero-medial approach with suture anchors for isolated tibial avulsion fracture of the posterior cruciate ligament, *Knee.* 20 (2012) 96–99. PMID: 23159153.
- [20] Chen S, Cheng C, Chang S, Tsai M, Chiu C, Chen AC, Chan Y, Arthroscopic suture fixation for avulsion fractures in the tibial attachment of the posterior cruciate ligament, *Arthroscopy.* 28:10 (2012) 1454–1463. DOI: 10.1016/j.arthro.2012.04.141.
- [21] Piedade S R, Mischon MM, Surgical treatment of avulsion fractures of the knee PCL tibial insertion: experience with 21 cases, *Acta Ortop Bras [serial on the Internet].* 15:5 (2007) 272-275.
- [22] Gui J, Wang L, Jiang Y, Wang Q, Yu Z, Gu Q, Single-tunnel suture fixation of posterior cruciate ligament avulsion fracture, *Arthroscopy.* 25:1 (2009) 78–85. DOI: 10.1016/j.arthro.2008.08.011.

