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Case Series

Evaluation of arthroscopic pull-through fixation in posterior cruciate ligament avulsion fractures: clinical and radiological results from a case series

Ritwika Nandi, Pinaki Das*, Pravash Ranjan Parida, Durga Kanta Sahoo, Deepak Kumar Nayak

Department of Orthopedics, Institute of Medical Sciences and SUM Hospital-2, Bhubaneswar, Odisha, India

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***Correspondence:**
Dr. Pinaki Das,
E-mail: docpinakidas@outlook.com

ABSTRACT

Posterior cruciate ligament (PCI) avulsion fracture is a rare type of ligamento osseous injury which is usually caused by high velocity injuries. The objective of this case series is to evaluate the improvement of knee function over time by measuring Lysholm knee score of patients treated by arthroscopic pull through fixation technique. This is a case series study of patients with PCI avulsion fractures from January 2024 to December 2025. All the patients were subjected to a single tibial tunnel pull through fiber tape fixation of the PCL over the anterior aspect of tibia. The results were analyzed by measuring knee ROM and Lysholm score over time and clinico-radiological confirmation of bony union. The patients which were included in the study consisted of 9 males and 1 female. Mean age of all the patients came around 37.6. The average knee flexion of all the patients at 6 weeks was 82 degrees, at 12 weeks was 124 degrees, at 6 months-128 degrees and at the end of 12 months was almost 130 degrees. None of the patients had any sort of extension lag. Radiological union was determined over serial X-rays and none of the study participants had non union. The mean Lysholm knee score at 6 weeks was 72.6, at 12 weeks was 80, at 6 months-88.2 and at end of 12 months it came around 95. Arthroscopic pull through fixation of PCI Avulsion fractures yielded good results with satisfactory knee function over time and faster rehabilitation.

Keywords: Posterior cruciate ligament, Arthroscopic pull through fixation, Lysholm score, Avulsion fractures

INTRODUCTION

Posterior cruciate ligament (PCL) tibial avulsion fractures are relatively uncommon ligamentous-osseous injuries encountered in orthopedic practice. If left untreated, displaced PCL avulsion fractures may result in persistent posterior instability, pain, reduced range of motion, and early degenerative changes of the knee.

Patients typically present with knee pain, swelling, difficulty in weight bearing, and a sensation of instability. Clinical examinations often reveal a positive posterior sag sign and posterior drawer test. Radiological evaluation includes plain radiographs, computed tomography (CT), and magnetic resonance imaging (MRI), which help determine fracture morphology, displacement, and associated soft tissue injuries.

Meyers and McKeever classified avulsion fractures into types I, II, and III, while Zaricznyj later added type IV fractures characterized by comminution of the avulsed fragment.[1,2] Treatment depends on the degree of displacement and associated injuries. Minimally displaced fractures may be treated conservatively, whereas displaced fractures generally benefit from surgical fixation.

Arthroscopic fixation has gained popularity because it allows direct visualization of the fracture site, management of associated intra-articular injuries, reduced soft tissue trauma, and minimal hardware. The present study evaluates the clinical and functional outcomes of arthroscopic pull-through fixation of PCL tibial avulsion fractures.

CASE SERIES

This case series included patients with PCL tibial avulsion fractures treated between January 2024 and December 2025 at our institution. Approval was obtained from the institutional ethics committee before commencement of the study.

Patients presenting with isolated PCL tibial avulsion fractures who underwent arthroscopic pull-through fixation were included. Patients with multi-ligamentous knee injuries, associated fractures of the distal femur or proximal tibia, and those requiring additional ligament reconstruction were excluded.

All patients underwent detailed clinical examination, including assessment of posterior sag sign and posterior drawer test. Fractures were classified according to the Meyers-McKeever classification system.

Preoperative evaluation included standard anteroposterior and lateral radiographs, MRI, 3D CT along with routine blood investigations.

Surgical technique

All surgeries were performed by the same surgical team under regional anesthesia. Patients were positioned supine with the knee flexed to 90 degrees.

Diagnostic arthroscopy was initially performed through standard anterolateral and anteromedial portals. The avulsed PCL fragment and associated intra-articular injuries were identified. Meniscal injuries, when present, were repaired before addressing the PCL avulsion.

A posteromedial portal was established under direct arthroscopic visualization, followed by creation of a posterolateral portal using a trans-septal approach. The posterior septum was cleared to improve visualization of the fracture site. The avulsed fragment and fracture bed were identified, and the fracture bed was prepared by debridement of fibrous tissue.

A PCL tibial guide was introduced through the interval between the anterior cruciate ligament and PCL. After fluoroscopic confirmation, a 4-mm tibial tunnel was drilled from the anteromedial aspect of the proximal tibia to the fracture bed. Fiber tape was passed around the PCL substance using a suture-passing device. The sutures were then retrieved through the tibial tunnel and secured over an Endobutton, suture disc, or suture post according to surgeon preference and bone quality. Reduction and stability of fixation were confirmed arthroscopically and fluoroscopically.

Post operative protocol

All patients followed a standardized rehabilitation protocol. The knee was immobilized in a long knee brace for three weeks. Passive range-of-motion exercises were initiated after three weeks and gradually increased to 90 degrees of flexion. Active range-of-motion exercises were commenced at six weeks.

Protected partial weight bearing with walker support was maintained for six weeks, followed by gradual progression to full weight bearing by eight weeks.

Follow up

Patients were followed at 6 weeks, 12 weeks, 6 months, and 12 months postoperatively. Functional outcome was assessed using the Lysholm knee score. Range of motion, posterior drawer test, posterior sag sign, and complications were documented at each follow-up visit.

Radiological union was assessed using serial anteroposterior and lateral radiographs (Figure 1 and 2).

Figure 1: Radiograph-pre-operative-demonstrating a PCL avulsion fracture.

Figure 2: Radiograph-six months post-operative.

Ten patients were included in the study, comprising nine males and one female. The mean age of the study population was 37.6 years. Six patients had right-sided involvement, while four had injuries involving left knee.

Three patients had associated meniscal injuries. Three meniscal injuries were identified and repaired arthroscopically during the same procedure. No patient required additional ACL reconstruction.

The mean interval between injury and surgery was 13 days.

Range of motion improved progressively during follow-up. The mean knee flexion was 82 degrees at 6 weeks, 124 degrees at 12 weeks, 128 degrees at 6 months, and 130 degrees at final follow-up. None of the patients demonstrated extension lag at any stage of follow-up (Table 1).

Table 1: Range of motion and Lysholm knee score at follow-up intervals (Mean±SD).

Parameters	6 weeks	12 weeks	6 months	12 months
ROM (Mean±SD)	82.0°±7.9°	124.0°±7.0°	128.0°±4.2°	130.0°±0.0°
Lysholm score (Mean±SD)	72.6±2.3	80.0±3.1	88.2±3.0	95.0±2.2

Table 2: Categorical distribution of ROM and Lysholm knee score grades at follow-up intervals.

Parameters	Grade	6 weeks, n (%)	12 weeks, n (%)	6 months, n (%)	12 months, n (%)
ROM	Excellent (≥120°)	0 (0%)	9 (90%)	10 (100%)	10 (100%)
	Good (90°-119°)	4 (40%)	1 (10%)	0 (0%)	0 (0%)
	Fair (60°-89°)	6 (60%)	0 (0%)	0 (0%)	0 (0%)
	Poor (<60°)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lysholm score	Excellent (95-100)	0 (0%)	0 (0%)	0 (0%)	6 (60%)
	Good (84-94)	0 (0%)	1 (10%)	10 (100%)	4 (40%)
	Fair (65-83)	10 (100%)	9 (90%)	0 (0%)	0 (0%)
	Poor (<65)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

*N=10 at each follow-up interval. ROM grading: Excellent ≥120°, Good 90°-119°, Fair 60°-89°, Poor<60°. Lysholm knee score grading: Excellent 95-100, good 84-94, fair 65-83, poor <65.

Radiological union was achieved in all patients. No cases of delayed union or non-union were observed.

Functional outcomes showed steady improvement throughout study period. The mean Lysholm knee score improved from 72.6 at 6 weeks to 80 at 12 weeks, 88.2 at 6 months, and 95 at 12 months. Most patients achieved excellent functional outcomes at final follow-up (Table 2).

No major complications were encountered. One patient developed a superficial surgical site infection that resolved completely with local wound care and oral antibiotics. There were no cases of fixation failure, deep infection, neurovascular injury, postoperative arthrofibrosis, or reoperation.

DISCUSSION

The PCI is a primary stabilizer of the knee and plays a critical role in preventing posterior tibial translation.[3] Although PCL injuries account for a relatively small proportion of acute knee injuries, displaced tibial avulsion fractures require prompt treatment to prevent long-term instability and functional impairment.[4]

Surgical fixation is generally recommended for displaced PCL avulsion fractures because restoration of the native anatomy and ligament tension is essential for optimal knee biomechanics. Arthroscopic techniques have become increasingly popular because they provide excellent visualization of the fracture site, facilitate treatment of associated intra-articular injuries, and minimize soft tissue dissection.[5]

Several studies have demonstrated favorable outcomes following arthroscopic fixation of PCL avulsion fractures.[6,7] Sabat et al reported superior functional outcomes following arthroscopic fixation compared with open screw fixation.[8] In contrast, Pardiwala et al found no significant difference between open and arthroscopic techniques, suggesting that satisfactory outcomes can be achieved with either approach when anatomical reduction is obtained.[9]

In the present study, all patients achieved radiological union and excellent functional outcomes. The mean Lysholm knee score of 95 at final follow-up compares favorably with previously reported results in the literature. Similarly, restoration of near-normal knee motion in all patients indicates that stable fixation combined with a structured rehabilitation program can produce excellent clinical outcomes.

An important aspect of our technique was the routine use of the posterolateral portal, which provided improved visualization of the posterior compartment and facilitated accurate reduction of the avulsed fragment. The use of a

single tibial tunnel pull-through construct provided stable fixation while avoiding the need for bulky implants. Arthroscopic fixation minimizes soft tissue trauma, allows simultaneous management of associated pathology, and reduces implant-related complications. Larger prospective comparative studies with longer follow-up are necessary to further validate these findings.

CONCLUSION

Arthroscopic pull-through fixation of PCL tibial avulsion fractures is a safe and effective treatment modality that provides reliable fracture union, restoration of knee range of motion, and excellent functional outcomes. The technique allows anatomical reduction, and stable fixation with minimal surgical morbidity. Based on the findings of this case series, arthroscopic pull-through fixation represents an effective option for the management of displaced PCL avulsion fractures.

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