

## Comparing Arthroscopic and Open Fixation for Posterior Cruciate Ligament Avulsion Injury: A Prospective Study

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Received: 10-12-2022/ Revised: 05-01-2023 / Accepted: 08-02-2023

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Conflict of interest: Nil

### Abstract

**Background:** One of the most important parts that keeps the knee stable during flexion and rotation is the posterior cruciate ligament (PCL). Avulsion fractures at the PCL's attachment site are frequent because of the PCL's extreme durability. It is commonly accepted that anatomically reducing and fixing PCL avulsion fractures is necessary for full restoration of PCL function. The main causes of unsatisfactory outcomes from conservative therapy include fracture non-union and functional impairment. Many surgeons believe that the PCL's misplaced or unstable tibial avulsion fracture should be minimized and physically corrected utilizing a variety of methods. Avulsion fractures of the posterior cruciate ligament (PCL) are not particularly common, but they are the most prevalent type of avulsion fracture around the knee, with anterior cruciate ligament avulsions coming in second. PCL injuries frequently manifest as avulsion fractures from the tibial connection. In the event that a PCL avulsion fracture is not surgically repaired, the knee joint may experience further alterations.

**Aim:** Comparing arthroscopic and open fixation for posterior cruciate ligament avulsion injury.

**Material and Method:** The Department of Orthopedics was the site of the prospective observational study. Prior to performing any surgical operations, informed consent was sought from every subject. The surgical procedures that study participants underwent followed conventional protocols. Functional results of the patients were evaluated both before and after surgery. Patients with PCL injuries between the ages of 18 and 65 were included in this study. A total of twenty-five patients who had torn PCLs were chosen and given PCL repair advice. Prior to surgery, a clinical examination was conducted and recorded using radiographs, namely an X-ray taken from the lateral and anteroposterior views. To rule out soft tissue injuries, magnetic resonance imaging (MRI) was performed. Limited computed tomography (CT) images were used to learn more about the fracture shape.

**Results:** The comparison of the age group in that only 2 patients (08%) were in the less than 30 years age group in the open reduction group compared to serve (28%) participants in the arthroscopic group. 28% of the open procedure group were in the >45 years age group compared to 16% in the arthroscopic group. However, no significant difference was seen. Comparing gender distribution 8 people (32%) were males in the open reduction group compared to seven (28%) participants in the arthroscopic group.

**Conclusion:** After a secure fixation, surgically fixing a PCL avulsion fracture from its tibial connection with a CC screw yields excellent outcomes. Because of its straightforward, safe, easy, and sufficient exposure techniques that need little soft tissue incision, it has now become the accepted standard of care. It has a short learning curve and may be done without

a great deal of experience. This method is linked to good joint function recovery, few problems, and a suitable fixation. It has consistently resulted in positive clinical, functional, and radiological outcomes without causing any long-term impairment.

**Keywords:** Intraarticular Fractures, Arthroscopic Reconstruction and Avulsion Injury.

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## Introduction

An essential tissue, the posterior cruciate ligament (PCL) aids in preserving the stability of the knee during flexion and rotation. Instability brought on by PCL injuries may cause the tibia to shift posteriorly, making it difficult to maintain the rear of the knee joint straight and causing long-term degenerative changes in the knee. Compared to anterior cruciate ligament (ACL) injuries, they are less frequent. Because PCL is robust, avulsion fractures involving its connection are frequent. [1]

According to a recent study, intrasubstance PCL tears and PCL avulsion fractures have a similar mechanism. [2] Motor vehicle accidents, especially those involving motorbikes, are the most common cause of dashboard injuries, which occur when a posteriorly directed force is applied to the proximal tibia when the knee is flexed. As a result, PCL avulsion fractures are more frequent in China, India, and other nations where motorcycling is very common. [3] The stronger of the two cruciate ligaments in the knee, the posterior cruciate ligament (PCL), prevents the knee from posteriorly dislocating in a 90-degree flexion angle. [4] If left untreated, damage to the PCL from a bone avulsion or intrasubstance rupture can result in chronic discomfort and patellar degeneration from the tibia's posterior displacement. [5,6] Bony avulsion fractures and intrasubstance tears are not the same in terms of being easily diagnosed on routine radiographs and having a generally recognized course of treatment for fixation. [7] Treatment options for tibial bone avulsion range from

internal fixation and open reduction to arthroscopic fixation using sutures or screws. [8,9]

Between 3% and 38% of acute knee injuries are found to result in general PCL damage. [10,11] Despite the low frequency of PCL injuries, patients—who are primarily young men—may experience great distress from consequences in untreated patients, including as instability and early degenerative changes. [12] Uncommon injuries, isolated PCL avulsion fractures are frequently overlooked. [13] When the knee is flexed to a 90° angle, a blow to the anterior side of the proximal tibia directed posteriorly is the most frequently documented mechanism of single PCL damage. [14] Another mechanism is abrupt hyperextension linked to knee hyperflexion or varus or valgus force. [15] A PCL disruption can manifest as a mid-substance tear or as an avulsion at the tibial insertion or femoral origin. [16,17] A plaster cast can be used as a conservative treatment for a nondisplaced bone avulsion, with the knee flexed and the tibia pushed forward to lessen strain on the PCL. Avulsion injuries can be repaired either openly or by use of an arthroscopic procedure. Comparable outcomes of open or arthroscopic screw fixation have also been shown in biomechanical investigations. [18] On the other hand, arthroscopic repair is more costly, technically demanding, necessitates specialist equipment, has a high learning curve, and may result in unstable fracture fixation. [19,20] A good technique to treat PCL avulsion injuries that yields

acceptable outcomes is open reduction and internal fixation with screws. Currently, a large range of materials are available for internal fixation, such as spring plates, absorbable screws, steel wires, lag screws, suture anchors, and straddle nails. [21,22] Screw fixation has shown good outcomes. However, with PCL avulsion fractures, no single method has been proven to be the most effective.

Ligaments are stronger than the growing physis, hence osteochondral avulsions are more common in skeletally immature patients than intrasubstance PCL tears. [23] This study's goal was to present our experience treating PCL avulsion fractures from the tibial site of attachment through open reduction and internal fixation with a CC screw.

We wanted to know if this readily available implant could produce stable knees, good range of motion, and an acceptable radiological union along with improved clinical and functional outcomes through a straightforward and safe surgical procedure.

### **Material and Methods**

The Department of Orthopedics was the site of the prospective observational study. Prior to performing any surgical operations, informed consent was sought from every subject. The surgical procedures that study participants underwent followed conventional protocols. Functional results of the patients were evaluated both before and after surgery.

Patients with PCL injuries between the ages of 18 and 65 were included in this study. A total of twenty-five patients who had torn PCLs were chosen and given PCL repair advice. Prior to surgery, a clinical examination was conducted and recorded using radiographs, namely an X-ray taken from the lateral and anteroposterior views.

To rule out soft tissue injuries, magnetic resonance imaging (MRI) was performed.

Limited computed tomography (CT) images were used to learn more about the fracture shape. The mechanism of injury, demographic information, injury severity score, surgical delay, administered treatment, complications from the fracture or therapy, and, if necessary, revision surgery were all determined by reviewing the hospital records.

Additionally, information was gathered about concomitant disorders, related limb injuries, and the side of the injury.

### **Inclusion criteria**

Skeletally mature patients above 18 years of age, patients with an isolated tibial avulsion fracture of PCL, fracture displacement >3 mm, avulsed fracture fragment size >20 mm, and fresh injury

### **Inclusion criteria**

Skeletally mature patients above 18 years of age, patients with an isolated tibial avulsion fracture of PCL, fracture displacement >3 mm, avulsed fracture fragment size >20mm, and fresh injury (<3 weeks old) were included in the study.

### **Exclusion criteria**

Excluded from the study were patients with prior ipsilateral knee surgery, polytrauma or head injuries that would undoubtedly affect rehabilitation, occult mid-substance injury of the avulsed PCL, or any other bone fracture of the ipsilateral lower limb.

### **Statistical Analysis**

The data was collected in Microsoft Excel and statistical software SPSS version 20 was used for analysis. The procedure of the data analysis was a transcription, preliminary data inspection, content analysis, and interpretation. The categorical variables like age, sex, side, and mode of injury were expressed as the number of patients and to differentiate using the mean scores a non-parametric Wilcoxon matched paired test was used at 0.05 level of significance.

## Result

In this study, a total of 25 patients participated. Of the 25 patients, 10 (40%) were in the open reduction group and another 15(60%) were included in the arthroscopic group. The mean age and

standard deviation in the open reduction group were 40.3 and 10.3 years respectively.

Similarly, the mean age and standard deviation in the arthroscopic group were 30.3 and 12.1 years respectively.

**Table 1: Comparison of age groups**

Age groups	Open Reduction		Arthroscopic	
	n	%	n	%
≤30	2	08	7	28
31-45	3	12	4	16
>45	5	20	4	16
Total	10	40	15	60

The comparison of the age group in that only 2 patients (08%) were in the less than 30 years age group in the open reduction group compared to seven (28%) participants in the arthroscopic group. 28% of the open procedure group were in the >45 years age group compared to 16% in

the arthroscopic group. However, no significant difference was seen.

Comparing gender distribution 8 people (32%) were males in the open reduction group compared to seven (28%) participants in the arthroscopic group.

**Table 2: Posterior drawer test distribution**

Laxity (in mm)	Pre-operative Number of patients (%)	Post-operative Number of patients (%)
Grade 0 (nil)	0	7 (87.5)
Grade I (0-5) (mild)	0	1 (12.5)
Grade II (6-10) (moderate)	1 (12.5)	0
Grade III (>10) (severe)	7 (87.5)	0
Total	8 (100)	8 (100)

Among 8 patients, the majority (87.5%) of patients had severe instability at the time of presentation and none of them had nil instability pre-operatively. Post-operatively, 87.5% of the patients did not have any instability. There was only 1 case of mild laxity on clinical examination but subjectively, the patients were not aware of the instability.

**Table 3: Post-operative final range of motion distribution**

Final ROM (in degrees)	Number of Patients	Percentage (%)
0-120	0	0
0-130	1	12.5
0-140	7	87.5
Total	8	100.0

Out of 8 patients, 1 patient had 0-130° ROM, and 7 (80%) patients had 0-140° ROM post-operatively by the end of 9 months.

## Discussion

PCL's primary purpose is to limit the posterior tibial translation. Tibial subluxation results from ligament damage

because to instability. The accepted procedure for treating acute avulsion fractures is to fix the bone PCL avulsion, as multiple studies have demonstrated. There are two methods for doing open reduction internal fixation: posterior and posteromedial. An additional arthroscopic method was also employed, although it is complicated and has a steep learning curve.

Nicandri et al 2008 [24] reported arthrofibrosis in only one of the ten cases when aggressive physiotherapy protocol was initiated instead of cast immobilization. To get good functional results, they suggested early range-of-motion exercises and the use of a functional brace. Stable fixation is necessary for the same, though. Seitz et al 1975 [25] reported excellent results in their series of 26 patients treated for PCL bony avulsion with open reduction and internal fixation. Meyer 1975 [5] reported poor functional outcomes in patients of bony PCL avulsion treated non-operatively. Prior research has evaluated functional outcomes in PCL bone avulsion injuries using functional assessment instruments such as Gillquist and Lysholm scores, as well as the musculoskeletal functional assessment (MFA).

Singla et al 2014 [26] also propagated - the use of IKDC over the Lysholm score for the assessment of functional results in PCL injuries. One explanation for this might be that, in contrast to Lysholm scoring, IKDC permits a more thorough evaluation of signs and symptoms. In comparison to other questionnaire questions on the scale, pain and instability receive higher marks under the Lysholm scoring system. On the other hand, every parameter in the documentation form receives the same weight in the IKDC grading system. Furthermore, compared to the Lysholm score, the IKDC exhibits higher criteria-related validity for patients with knee injuries.

For the fixation of single PCL tibial bone avulsions, the arthroscopic and conventional open posterior approaches produced comparable surgical results and outcomes. The clinical grading of PCL arthrometer testing, laxity, stress radiography, and two distinct knee ligament rating scale scores (International Knee Documentation Committee and Hospital for Special Surgery) at a minimum 2-year follow-up showed no significant differences between the two groups, supporting this. Nevertheless, three of the six patients in the open method group required additional surgery due to concurrent symptomatic meniscal and chondral lesions, and three others experienced implant-related issues. A preoperative MRI was performed, and in 28% of patients with isolated displaced PCL tibial bone avulsions, the scan indicated coexisting meniscal/chondral damage or intraarticular-free osteochondral fragments. [20]

Piedade et al 2007 [27] evaluated 21 patients with an average age of 30 years, who underwent operative management for the PCL fracture avulsion. The surgical procedure involved a posterior approach to the knee, in which the bone fragment was fixed in 18 cases using a screw and washer, and in 3 cases, where the fragment was very small; trans-bone ties were used. After a minimum of 12 months of postoperative follow-up, they evaluated the patients both objectively (using the posterior drawer test) and subjectively.

They discovered that 53% of the patients had outstanding results, and 47% had good results. Attia et al 2014 [28] designed a prospective study to evaluate the efficacy of the treatment of PCL avulsion fractures by fixation using the posteromedial approach.

Avulsed bone fragments were fixed with a surgical procedure using a rotary screwdriver in eight patients with washers and four without. In an average of 10 to 14 weeks, all of the avulsion fractures fused.

None of the fractures experienced extreme instability when they united. The average duration of patient follow-up was 7.58 months. Based on the Lysholm knee score, 4 (33.3%) of the 12 patients who were part of this study had excellent outcomes, 7 (58.3%) had good results, and 1 (8.3%) had a fair result.

Eladawy et al 2018 [29] did a prospective study on 11 patients with PCL avulsion fracture of the tibial attachment who were treated surgically through a posterior approach. The patients' average age was 24.72 years. In nine cases, a single screw and washer were used for fixation, while in two situations, multiple screws were employed. An average of twenty-two months was spent monitoring each patient. Every radiograph taken a year after surgery showed union at the fracture site. The average Lysholm score at the conclusion of the follow-up period was 89.7 points. While five patients had fair to good results and one patient had a fair outcome, six patients had good to excellent results. Every patient was happy with the outcome.

Depending on the size and degree of comminution of the avulsed fragment as well as the treating surgeon's experience, a variety of methods and implants have been employed for reduction and fixation. Currently, however, screw fixation is the most often utilized technique and has demonstrated positive outcomes. Single institution bias, a small patient sample, a brief follow-up time, and the absence of a control group were among the study's limitations. Future prospective and biomechanical investigations must to be carried out to validate these results. To validate the advantages of this therapy approach, a multicentre trial including a larger patient population is necessary.

### Conclusion

Both of the PCL avulsion fracture repair techniques have demonstrated encouraging outcomes and are better at enhancing

patients' everyday activities and reducing discomfort. Furthermore, the open reduction procedure with cc screw fixation has proven to be a straightforward method that does not require complex tools like the arthroscopic technique. Based on the aforementioned findings, it is clear that the open treatment for PCL avulsion fractures is superior to the complex arthroscopic method and offers numerous benefits over arthroscopic fixation. As seen in the discussion above, the open reduction method ensures improved wound management, good postoperative compliance, and a decent range of motion for the extension and flexion of the knee. Compared to an arthroscopic treatment, the open reduction technique results in less knee instability.

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