

Functional Outcome of Isolated Posterior Cruciate Ligament Avulsion Fractures Treated by Open Reduction and Internal Fixation

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ABSTRACT

BACKGROUND

Isolated Posterior cruciate ligament (PCL) avulsion fractures are uncommon, but are complicated intra-articular fractures.¹ In India due to high prevalence of motorcycle transportation, the cause of PCL avulsion fractures was predominantly motorcycle accidents, though sports accidents still remain the most common cause in world over. These injuries are quite often missed in the emergency department and are often neglected. In the long run they cause severe functional disability of the knee joint. There is no consensus concerning the optimal surgical treatment approach for these injuries. Hence, we aimed to study the functional and clinical outcome of isolated PCL avulsion fractures with open reduction and internal fixation.

METHODS

This is a prospective study of 28 cases of isolated PCL tibial avulsion fractures, in patients aged between 22-38 years during the period 2014 - 2018 in our hospital. All were treated with open reduction and internal fixation with 4 mm cannulated cancellous screw and washer. Postoperatively, patient leg was immobilized in posterior POP slab for 2 weeks, allowing toe touch weight bearing. All patients were regularly followed-up at 2, 4, 6, 8, 10, and 12 weeks. The functional outcome is assessed by Lyndholm scoring at the end of 12 weeks.

RESULTS

98% of the cases have shown excellent results with good range of movement in the knee without pain and without knee instability. The other 2% of cases had mild knee arthrofibrosis and pain.

CONCLUSIONS

PCL Avulsion fractures are rarity but yet need to be managed surgically. Open reduction and internal fixation by Burks and Schaffer approach has resulted in excellent results and good functional outcome.

KEY WORDS

Posterior Cruciate Ligament Avulsion Fracture, Open Reduction and Internal Fixation

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BACKGROUND

PCL ligament avulsion fracture injuries constitute about 3 - 20% of all the knee injuries. They are less common than its counterpart ACL ligament. It's a strong ligament than ACL and 20% thicker.¹ It has two parts a bulky anterior part, and thinner obliquely running posterior part which runs with wider insertion on to the back of the tibial plateau. A small twig of the PCL is attached to the posterior horn of the lateral meniscus. The PCL ligament gives posterior and partly rotator stability to the knee joint. It forms the axis for the knee" screw home mechanism" rotation during terminal degrees of knee extension. It is usually torn due to fall on a flexed knee, like a dashboard injury in Motor vehicle accident.² Recent study³ reported the mechanism of injury is similar to intrasubstance PCL tears and is associated with meniscus injuries in 16.8% and additional ligament injuries in 19% of patients. The ligament avulsion is most commonly occurs from the tibial side, displacing the fragment intraarticularly. A rupture or avulsion of PCL leads to posterior instability of the knee joint with Posterior drawer test and Lachman's test positive on clinical examination. They are usually diagnosed as a bony avulsion in stress knee x-rays, further confirmed with CT scan.¹ MRI scan is mandatory to know the presence of other Ligament and Meniscal Injuries. The natural history of PCL deficient knee is quite variable. 80% of the Patients have started to develop degenerated osteoarthritic changes in the knee after 4 years of delay. Some of them have developed significant pain and stiffness in the knee, while others had essentially not much functional disability. Treatment of PCL avulsion is most controversial in knee surgeries. Literature has suggested non-operative treatment for fractures displaced less than 5 mm, and posterior translation of the tibia less than 10 mm in posterior drawer test. Though reports indicate that short term functional instability is less in conservative treatment, but in long term follow up its been shown that the knee joint wears off, causing difficulty in walking, squatting and climbing. Many studies have advocated surgical management for PCL Avulsion fractures ranging from Open reduction, internal fixation to Arthroscopic repair and reconstruction. In our study we have operated 28 cases of isolated PCL Avulsion fractures with Open reduction and Internal Fixation technique.

METHODS

During the period of 2014-2018, we have selected 28 cases of isolated PCL Avulsion fractures. There were 24 cases of males and 4 cases of female patients with mean age group being 27 years and a standard deviation of 4.83. The common cause of Injury was due to Motor vehicle accident (dashboard) type of Injury. After detailed clinical and radiological examination these patients were splinted in a posterior POP slab. Further investigations like CT Scan and MRI of the knee are done to asses for size, displacement of the fracture and also to rule out for additional ligament, Meniscus injuries. We have selected only isolated PCL avulsion fractures for the study.

Most of the cases presented in a 2 weeks' time and were operated on an average delay of 3 weeks. All the patients are treated by posterior-medial approach to the knee as described by Burks and Schaffer. The patient is given spinal anesthesia and placed in prone position, with affected limb in flexion at knee joint. It's an excellent approach between the planes of gastrocnemius and soleus muscle to the posterior capsule and the PCL attachment. The fragment is visualized under C-Arm and reduced to its bed area over the posterior tibial plateau with the help of Ethibond suture at the osteo ligamentous junction. Later it is provisionally stabilized with K wire. A long thin guide wire is passed from the centre of the fragment, directing posterior to anterior through the proximal tibia under C- arm guidance with knee in flexion, ensuring it makes an angle of 45° to the posterior surface of the tibia. After safely drilling over the guide wire, and measuring the length, 4 mm cannulated cancellous screw with washer is fixed. Sometimes if the fragment is big enough, then two screws are used to fix. Postoperatively patient limb is placed in POP slab for 2 weeks. Thereafter the knee is mobilized with ROM and quadriceps strengthening exercises with the limb in a long leg knee brace. Patient is allowed to walk with partial weight from 6 weeks and total weight bearing from 12 weeks. He was advised to abstain from sporting activities for at least 6- 8 months. Patient is followed up every 2 weeks for 3 months, later every month for next 9 months. At every follow-up, patients were assessed clinically and radiographically. Outcomes were assessed in terms of stability and range of motion (ROM). Stability was assessed clinically by the drawer test and radiologically by lateral stress X-ray. Final functional outcome was assessed using the Lysholm knee scoring system. Tegner Y, Lysholm J⁴ has published in 1985, an article in clinical orthopedics and related research regarding assessment of knee function in ligament related injuries. He has mainly taken 8 categories like pain, swelling, limping, climbing, squatting, and instability to assess the function of the deranged knee.

<p>Limping (5 points) Never = 5 Mild or periodically = 3 Strong and continuous = 0</p>	<p>Pain (25 points) No pain = 25 Intermittent or mild during strong exercises=20 Marked during strong-effort exercises=15 Marked during or after walking > 2 Km= 10 Marked during or after walking < 2 Km =5 Continuous = 0</p>
<p>Support (5 points) No support= 5 Walking stick or crutches= 2 Impossible= 0</p>	<p>Swelling (10 points) No swelling = 10 Upon strong effort exercises= 6 Upon usual exercises=2 Continuous= 0</p>
<p>Restraining (15 points) No restraining or restraining feeling= 15 Has the feeling but no restraining= 10 Occasional restraining= 6 Frequent= 2 Joint restrained at examination= 0</p>	<p>Climbing stairs (10 points) No problem= 10 Slightly damaged=6 One step at a time= 2 Impossible= 0</p>
<p>Instability (25 points) Never miss a step= 25 Seldom during athletics or strong effort exercises=20 Frequently during athletics or strong effort exercises=15 Occasionally in daily activities= 5 At each step= 0</p>	<p>Squatting (5 points) No problem= 5 Slightly damaged= 4 Not exceeding 90 degrees= 2 Impossible= 0</p>
<p>Total score= Score table= Excellent= 95-100, Good= 84-94, Fair= 65-83, Poor= 64</p>	
<p>Tegner Lysholm Knee Scoring Scale</p>	

RESULTS

All the 28 cases of PCL avulsion fracture fixation are followed up for an average period of 15 months with standard deviation of 1.309. All the cases showed good fracture union in average 12 weeks of postoperative period. The average knee flexion attained in the first 6 weeks is 90 degrees and in about 12 weeks they all have achieved 125 degrees of free knee flexion. All are periodically assessed clinically and radiologically for posterior instability, except in one case rest all have negative posterior draw sign. They are assessed by Lysholm knee scoring system. 24 cases had excellent result, 3 cases were good and 1 case has fair result. There was complication of postoperative wound infection in two cases leading to debridement and dressings due to which they had dull persistent pain in the knee.

Statistical Analysis

Based on the eight parameters in the Lysholm scoring index, all the 28 patients are assessed and given points both preoperatively and postoperatively. Later, the Chi square test (X_2) is done to calculate from the observed values to that of deviation. From the value X_2 so obtained is then converted to probability value (p), by using X_2 table.

Scoring Index	Pre-Opt Value	Post - Opt Value	p-Value	Remarks
Lysholm Score	5±4.71	93.4±5.5	<0.001	Significant

Table 1. Statistical Analysis

DISCUSSION

isolated PCL avulsion fractures are rare injuries. The management of the PCL avulsion fracture is complicated and controversial. There is a vast literature, but with no consensus for any particular method of treatment. The modalities vary from conservative, open technique and arthroscopic method.

Zhao et al. suggested conservative treatment for avulsion fractures displaced less than 5 mm, and should be less than 10 mm of posterior translation of the tibia in 90° of knee flexion. Pierce et al.⁵ suggested a three-phase protocol for recovery, which lasts 12 weeks to return to pre-injury activities. With conservative treatment though the results were good in the short term, but eventually lead to functional disability of the knee due to increased articular cartilage degeneration, meniscus tears and quadriceps atrophy. Hence, in our present study we tried to restore the kinematics of the knee by fixing the PCL avulsion fracture anatomically with open reduction.

There are various surgical approaches described for the fixation of PCL avulsion fractures. The classical posterior approach described by Abbott⁶ was risky to the posterior neurovascular structures and delays recovery. Later, Burks and Schaffer⁷ simplified the procedure by approaching the fracture postero-medially. There was no necessity of splitting the Gastrocnemius muscle, neither exposing the popliteal neurovascular structures. 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 injury.

Seitz et al,⁸ had reported excellent results in their series of 26 patients treated for PCL bony avulsion with open reduction and internal fixation. Huang et al,⁹ used cannulated screws combined with sutures, while Fu et al, used the anchor system in combination with hollow lag screws. In 2003, Veselko et al,¹⁰ reported a simpler method to stably fix fracture fragments using a hollow lag screw combined with a gasket.

There are many studies in the literature, comparing the open approach and arthroscopic approach for displaced PCL tibial avulsion fractures. All of them have showed satisfactory outcomes, despite significant heterogeneity. Regarding knee outcomes, the postoperative scores at final follow-up were analyzed. The range of Lysholm score at final follow up was to 85–100 for the open approach and 80–100 for the arthroscopic approach.¹¹ There was no noticeable difference between the 2 groups in regard to postoperative Lysholm scores. The rates of normal and nearly-normal knees at final follow-up were 92%–100% in patients with the open approach and 90%–100% in patients with the arthroscopic approach in the IKDC subjective knee assessment at final follow-up. All studies on the open approach and arthroscopic approach for displaced PCL tibial avulsion fractures showed satisfactory outcomes. Advantages of the arthroscopic technique include diagnosis and treatment of associated ligament injury, meniscus, and cartilage injuries.

Ling et al. reported on a randomized study with a small sample size that evaluated open screw fixation with or without arthroscopy. At a mean follow-up of 46 months, there is no significant difference in postoperative range of motion, and Lysholm score. Sabat et al.¹² provided a retrospective review of patients with PCL avulsion fractures treated with arthroscopic suture fixation versus open screw fixation. At 1 year follow-up Lysholm, Tegner activity, IKDC scores and one-leg hop test were similar between the two groups. The most common complication reported in both open and arthroscopic techniques is arthrofibrosis, which is more frequently reported with the arthroscopic approach (0–36%) vs open approach (0–25%).

CONCLUSIONS

PCL Avulsion fractures are rarity but yet need to be managed surgically. Open reduction and internal fixation by Burks and Schaffer approach has resulted in excellent results and good functional outcome.

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