

Original Research Article

Arthroscopic reattachment of tibial avulsion fractures of the posterior cruciate ligament using ABS button and tightrope (Mohandas Jagsun technique)

Jagadeesh P. C., Sampath Kumar Vallabhaneni*, Prathish Rao Vennamaneni, Musthafa Bhatia

Department of Orthopaedics, Fortis Hospital, Bengaluru, Karnataka, India

Received: 14 October 2018

Revised: 20 November 2018

Accepted: 23 November 2018

*Correspondence:

Dr. Sampath Kumar Vallabhaneni,
E-mail: sampathv83@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This 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: Avulsion fractures of tibial insertion of the posterior cruciate ligament are rare among the knee injuries. Purpose of this study is to determine the functional outcome of arthroscopic reattachment of tibial avulsion of the Posterior cruciate ligament by ABS button (Arthrex) and tight rope.

Methods: 15 Patients with PCL avulsion fracture were included. The Inclusion criteria were: 1) Displaced avulsion fractures (type-2 and type-3). They were followed at regular intervals using IKDC score, Lysholm score and subjective questionnaire.

Results: All cases showed complete osseous union during follow up. All knees are stable on examination by posterior sag sign and posterior drawer test. Two patients had loss of about 10° flexion. According to the IKDC form assessment 13 patients classified as normal and 2 were classified as near normal.

Conclusions: Arthroscopic reattachment of tibial avulsion fractures of the posterior cruciate ligament using ABS button and tightrope gives fairly good clinical outcomes.

Keywords: Posterior cruciate ligament avulsion, Knee arthroscopy, Fixation, ABS button (Arthrex), Tightrope

INTRODUCTION

Posterior cruciate ligament is the strongest ligament of the knee joint. It acts as a primary restraint against posterior displacement of tibia on the femur and together with anterior cruciate ligament it regulates the screw home mechanism of the knee.¹

The incidence of PCL injuries varies from 10% to 20% among all the knee injuries. Avulsion fracture of PCL usually occurs following high energy trauma, motor accidents, and occasionally in sport related injuries in young individuals.² Most common mechanism of injury is

posteriorly directed blow to the anterior aspect of proximal tibia with knee is in 90° of flexion.

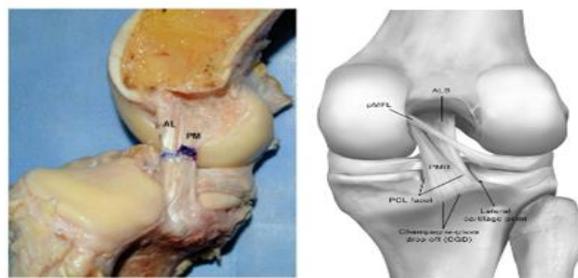


Figure 1: Anatomy of posterior cruciate ligament.⁴

The PCL lies within the joint capsule of the knee, but it is considered an extra-articular ligament because it is enclosed with its own synovial sheath. It is divided into large anterolateral bundle and small posteromedial bundle. It originates from the lateral aspect of medial femoral condyle and inserts approximately 1 cm below the joint line in a depression between the posterior aspects of medial and lateral tibial plateaus.³

Avulsion fractures of the PCL are classified into three types. Type 1 fractures are undisplaced. Type 2 fractures are hinged with superior displacement of only the posterior aspect of avulsed fragment. Type 3 fractures are completely displaced.⁵

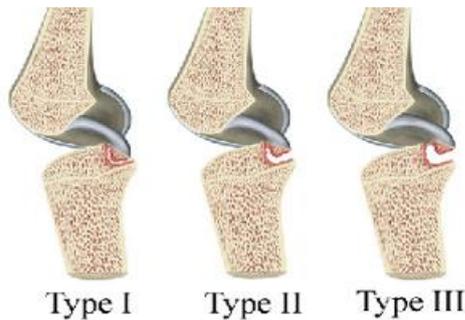


Figure 2: Classification of avulsion fractures of PCL.⁵

Patient usually presents with pain and tenderness over posterior aspect of knee, on examination posterior sag sign and posterior drawer test is positive. Nonsurgical treatment of displaced avulsion fractures leads to malunion or non-union, which can cause knee instability and patello femoral arthritis and medial compartment osteoarthritis.⁶

Surgical treatment includes open reduction and internal fixation or arthroscopic assisted fixation. Open technique is associated with high risk of neurovascular injury.⁷ Arthroscopic technique is minimally invasive and associated intra articular lesions can be identified and treated simultaneously.

Various open or arthroscopic techniques have been described in the literature regarding fixation of PCL avulsion injuries by using lag screws, steel wires, absorbable screws, suture bridge, suture anchors and tightrope, but no one technique has been considered a gold standard.^{8,9} In this study we are present our experience with fixation using ABS button (Arthrex) and tightrope. It has a wide surface area to achieve compression at fracture site.

METHODS

Patients

15 patients were enrolled for this prospective study. The study was carried out from January 2016 to August 2018

in Fortis Hospital, Bengaluru. All patients were operated upon by the same surgeon and had the same rehabilitation protocol. The main inclusion criteria were: 1) isolated tibial avulsion fractures of PCL; agreement to participate in the study and signed informed consent prior to inclusion. Exclusion criteria were: 1) multiligament knee injury patients.

The diagnosis in all cases was based on history, clinical examination and imaging studies. Pre-operative assessment is done by posterior sag sign and posterior drawer test. Plain radiography of the knee showed avulsion fracture. MRI is done all cases to rule out other injuries.

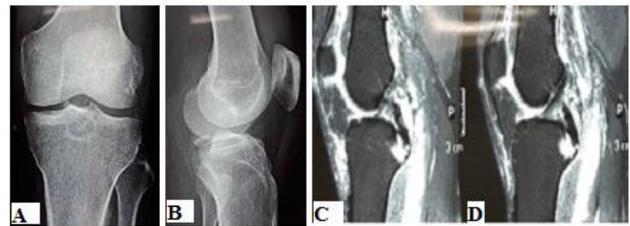


Figure 3: A, B, C, D, X-rays and MRI shows tibial avulsion fracture of the PCL.

Surgical technique

The patient receives intravenous antibiotics pre-operatively. After induction of anaesthesia, patient is positioned supine and tourniquet applied. Knee is examined under anaesthesia.

The leg is prepared and draped in a sterile fashion and the knee is held in 90° of flexion. The portals used are: anterolateral portal, anteromedial portal and two posteromedial portals. Diagnostic arthroscopy is performed to rule out other intra articular lesions. In diagnostic arthroscopy ACL sagging is seen which confirms the PCL injury. The arthroscope is advanced posteriorly between ACL and PCL by removing fat pad. Under arthroscopic guidance low posteromedial portal and high posteromedial portals established.



Figure 4: Shows PCL drill guide in anteromedial portal, 8.5 mm cannula in low posteromedial portal, arthroscope in high posteromedial portal.

High posteromedial portal is used for visualization and low posteromedial portal and anteromedial portal are used as working portals. 8.5 mm cannula is used in low posteromedial portal. PCL avulsion from its tibial attachment is noted and will be displaced superiorly and medially. Fracture base is debrided with shaver and fracture reduction is checked with probe.

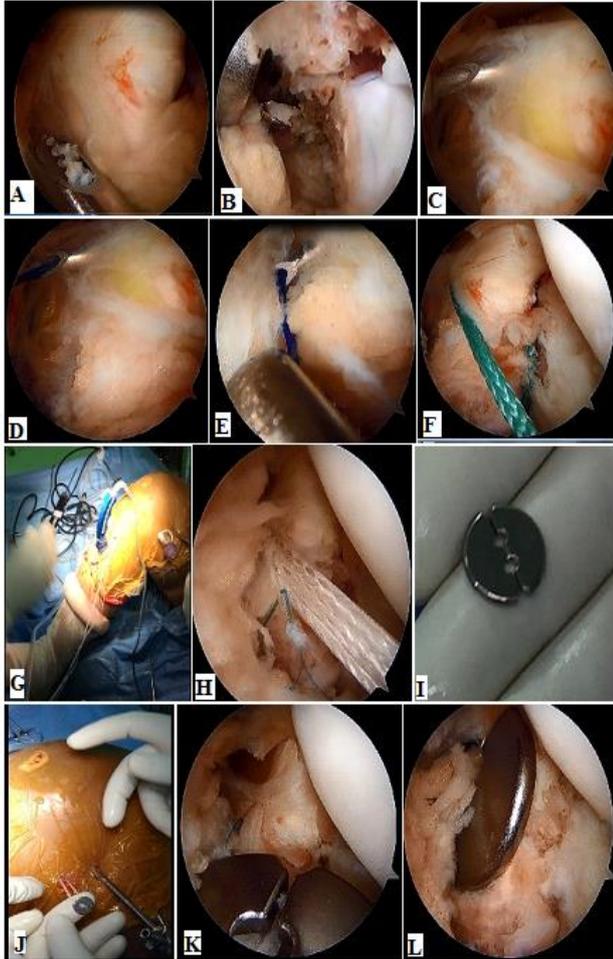


Figure 5: Intraoperative views.

A) Fracture base is debrided with shaver. B) The guide wire is drilled from anteromedial tibial cortex to the fracture base by using PCL drill guide. C) Spinal needle pierced through base of the PCL where it attached to the avulsed fragment. D) Prolene suture is passed through the needle. E) one end of prolene suture is taken out through the low posteromedial portal. F) Prolene is replaced by Ethibond no 2. G, H) Free end of tightrope is pulled through the tibial tunnel from anterior aspect and through the base of the PCL and then taken out from the low posteromedial portal. J) ABS button. J) ABS button is fixed to the free end of tightrope. K), Tightrope is cinched from anteriorly to till the ABS button sits over the avulsed PCL fragment. L) Final picture showing reduction of Avulsed PCL fragment.

The guide wire is drilled from anteromedial tibial cortex to the fracture base by using PCL drill guide. It is over drilled with 4.5 mm cannulated drill bit. Spinal needle passed into the joint through the anteromedial portal and pierced at the junction of the PCL ligament and avulsed

bone fragment. Prolene suture is passed through the needle and one end of suture is taken out through the low posteromedial portal and other end of the suture is passed through the pre drilled tibial tunnel. Prolene is replaced by Ethibond no. 2.

With the help of Ethibond no. 2, free end of tightrope is pulled through the tibial tunnel from anterior aspect and through the base of the PCL and then taken out from the low posteromedial portal. At this stage the cannula is removed and ABS button (Arthrex) is fixed to the free end of tightrope.

ABS button is guided through the low PM portal. The Tightrope is cinched from anteriorly to till the ABS button sits over the avulsed PCL fragment. Anterior drawer is applied while cinching.



Figure 6: Post-operative X-rays shows anatomical reduction of the avulsion fracture.

Postoperative rehabilitation

Post operatively, patient is placed in a posterior tibial support splint to avoid posterior tibial translation. Isometric quadriceps exercises and ankle exercises started from first postoperative day. During the first 3 weeks, passive knee bending up to 60° is allowed. The passive flexion is then increased, gradually reaching full flexion within 12 weeks. Weight bearing is not allowed for 6 weeks. Patients were assessed clinically and radiographically at 6 weeks, 3 months, 6 months, 1 year and 2 years later.

The SPSS 17.0 software package (SPSS, Inc., Chicago, Illinois) was used for the Statistical analysis. Microsoft Word and Excel were used to generate Tables.

RESULTS

The mean age in our study was 28 years. The youngest patient was 21 years and the oldest patient was 46 years old. The maximum number of patients were in the age group of 26-30 years (46.66%) followed by the age group 20-25 years (26.66%) (Table 1).

Table 1: Age distribution.

Age (in years)	Number	Percentage (%)
20-25	4	26.66
26-30	7	46.66
31-35	2	13.33
36-40	1	6.66
41-45	1	6.66

In our series of 15 patients, 11 patients were males and 4 patients female, (male predominance). It may be because of the involvement of males in outdoor activities like sports, farming and road traffic accidents (Table 2).

Table 2: Sex distribution.

Sex	Number	Percentage (%)
Male	11	73.33
Female	4	26.66

15 patients included in this study. The injury was caused by motor vehicle accidents in 10 patients and sports activities in 5 patients. All patients underwent surgery in the second week after trauma (7-15 days). The average surgery time was 60 minutes. There were no complications such as neurovascular injuries and infections.

All patients were followed up on average for 24 months. During follow up, all knees were stable on the posterior sag sign and posterior drawer test. In all cases, plain radiography showed complete osseous union at an average of three months after the surgery. Posterior stress X-rays in the follow-up period objectively described the stability. Only two patients had loss of flexion of about 10°. Remaining patients showed a full range of knee motion. At end of 6 month, the patients are subjected to IKDC, Lysholm scoring and the subjective questionnaire.

Table 3: IKDC scoring.

IKDC scoring	Frequency	Percentage (%)
Normal	13	86.66
Near normal	2	13.33
Abnormal	0	0

86.66% of the patients graded their post-operative recovery as normal and 13.33% as near normal according to IKDC score (Table 3).

86.66% of the patients reported outcome as excellent and 6.66% as good and 6.66% as fair according to LGS scale (Table 4).

At the regular follow up and at the end of 6 months, 86.66% patients graded their recovery as very satisfied and the remaining 13.33% were satisfied with the outcome (Table 5).

Table 4: Lysholm scoring.

Lysholm scoring	Frequency	Percentage (%)
Excellent	13	86.66
Good	1	6.66
Fair	0	6.66
Poor	0	0

Table 5: Subjective questionnaire.

Subjective questionnaire	Frequency	Percentage (%)
Very satisfied	13	86.66
Satisfied	2	13.33
Not satisfied	0	0

DISCUSSION

Posterior cruciate ligament is one of the most important structures for knee joint stability. Tibial avulsion fractures of the posterior cruciate ligament have always been regarded as rare injuries.¹⁰ It is reported to be more commonly found in the younger age group. A biomechanical experiment showed that the in vitro tensile strength of the posterior cruciate ligament is twice that of the anterior cruciate ligament.¹¹

In the context of a dashboard accident with a posteriorly directed blow to a flexed knee, the injury is often overlooked because it frequently presents in association with a posterior dislocation of the femoral head. Isolated injury will cause the patient to experience a swelling at the posterior aspect of the knee, the inability to fully bear weight, and bruising at the anterior aspect of the knee related to the direct impact. Further clinical examination confirms posterior sag and a positive posterior drawer test.¹²

Most of the authors agree that surgical fixation is the treatment of choice even for minimal displacement of the fragments. Nonsurgical treatment for displaced avulsion fractures results in malunion or non-union.¹³ According to the existing literature, two approaches are mainly used: open and arthroscopic. Both have advantages and disadvantages. Open reduction can be performed by the traditional posterior approach or the posterolateral or posteromedial approach. Disadvantages of open approach are the need for a big incision with possible scarring and stiffness especially in flexion. Also with open fixation with anterograde screw can't be used for comminuted fragments or when the fragment size is small as well as the need for hardware removal latter on.

Trickey recommend division of the medial head of gastrocnemius across its muscle fibers in 1968, which enhances exposure of the PCL avulsion, but inevitably leads to postoperative weakness of the muscle.^{14,15} In Burks and Schaffer's approach uses the interval between medial head of gastrocnemius muscle and semi-membranosus. In this approach there is difficulty in

exposing the posterior capsule and the avulsed bony fragment.¹⁵

Martinez-Moreno et al first described an experimental percutaneous fixation technique with the use of arthroscopic visualization to fix PCL avulsion fractures in 8 cadaveric knees.¹⁶ Kim et al. demonstrated arthroscopic technique for fixation of PCL avulsion fractures. They used a variety of methods for fixation including wires, loop sutures and screws. The choice of fixation method was based on the size of the avulsed fragment. Small bone fragments (<10 mm) with comminution were fixed with the use of multiple sutures. Medium-sized fragments (10–20 mm) were fixed with Kirschner wires. Large single fragments of bone (>20 mm) that involved the condyles were fixed with one or two cannulated screws.¹⁷

Advantages of our arthroscopic surgery are: 1) minimally invasive, less hospital stay, early recovery 2) associated intra-articular lesions can be diagnosed and treated simultaneously 3) comminuted avulsion fractures can be fixed. 4) no need of large skin incision. The limitations of this study include the limited number of patients and the lack of a control group.

CONCLUSION

Arthroscopic reattachment of tibial avulsion fractures of the posterior cruciate ligament using ABS button (Arthrex) and tightrope gives fairly good clinical outcomes. This technique is associated with satisfactory fixation, minimal complications and good recovery of joint function. However, additional larger-scale controlled studies are needed to further evaluate the long-term efficacy of this technique for the management of PCL avulsion fractures of the tibia.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

- Huang W, Gong X, Rahul M, Priyanka S, Wang C, Liang X, Ding G, Hu NN. Anterior arthroscopic assisted fixation of posterior cruciate ligament avulsion fractures. 2015;20:88.
- Taghi Nourbakhsh ST, Bahramian F, Zafarani Z, Alidousti A, Aslani H, et al. Arthroscopic Bridge Technique for PCL Avulsion: Surgical Technique and Key Points. Archives Bone Joint Surg. 2016;4
- Sedeek SM, Choudry Q, Karunatilake NAA, Arshad MS. Posterior cruciate ligament injury: Diagnosis and management. Hard Tissue. 2014;3(2):11.
- Gali JC, de Sousa Oliveira HC, Lisboa BCB, Dias BD, de Godoy Casimiro F, Caetano EB. Tibial Insertions of the Posterior Cruciate Ligament: Topographic Anatomy and Morphometric Study. Rev Bras Ortop. 2013;48(3):263-7.
- White EA, Patel DB, Matcuk GR, Forrester DM, Lundqis RB, George FR. Cruciate ligament avulsion fractures: Anatomy, biomechanics, injury patterns, and approach to management. Emergency Radiol. 2013;20(5):429–40.
- 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. 2007;23(11):1226–30.
- Lee KW, Yang DS, Lee GS, Choy WS. Suture Bridge Fixation Technique for Posterior Cruciate Ligament Avulsion Fracture. Clinics in Orthopedic Surg. 2015;7:505-8.
- 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. 2017;29(3):210-6.
- Gwinner C, Kopf S, Hoburg A, Haas NP, Jung TM. Arthroscopic Treatment of Acute Tibial Avulsion Fracture of the Posterior Cruciate Ligament Using the TightRope Fixation Device. Arthroscopy Techniques. 2014;3(3):377-82.
- Rosenthal MD, Rainey CE, Tognoni A, Worms R. Evaluation and management of posterior cruciate ligament injuries. Phys Ther Sport. 2012;13:196-208.
- Yang CK, Wu CD, Chih CJ, Wei KY, Su CC, Tsuang YH. Surgical treatment of avulsion fractures of the posterior cruciate ligament and postoperative management. J Trauma. 2003;54(3):516–9.
- Trickey EL. Injuries to the posterior cruciate ligament- Diagnosis and treatment of early injuries and reconstructions of late instability. Clin Ortho. 1980;147:76-81.
- 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.
- Trickey EL. Rupture of the posterior cruciate ligament of the knee. J Bone Joint Surg. 1968;50(2):334–41.
- Jazayeri SM, Esmaili Jah AA, Karami M. A safe posteromedial approach to the posterior cruciate ligament avulsion fracture. Knee Surg Sports Traumatol Arthrosc. 2009;17(3):244–7.
- Martinez-Moreno JL, Blanco-Blanco E. Avulsion fractures of the posterior cruciate ligament of the knee-An experimental percutaneous rigid fixation technique under arthroscopic control. Clin Orthop Relat Res. 1988;237:204–8.
- Kim SJ, Shin SJ, Choi NH, Cho SK. Arthroscopically assisted treatment of avulsion fractures of the posterior cruciate ligament from the tibia. J Bone Joint Surg Am. 2001;83(5):698–708.9.

Cite this article as: Jagadeesh PC, Vallabhaneni SK, Vennamaneni PR, Bhatia M. Arthroscopic reattachment of tibial avulsion fractures of the posterior cruciate ligament using ABS button and tightrope (Mohandas Jagsun technique). Int J Res Orthop 2019;5:167-71.