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Original Article

Fixation of Posterior Cruciate Ligament Avulsion Fractures with Open Reduction and Cancellous Screw Fixation using Posteromedial Approach to Knee

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Abstract

Introduction: Avulsion fracture of the posterior cruciate ligament (PCL) is a relatively uncommon injury. Numerous techniques for treatment of PCL avulsion fractures have been described in literature from closed reduction to definitive fixation, both open and arthroscopically assisted fixation.

Purpose: This study aims to evaluate the clinical outcome of open reduction and cancellous screw fixation via posteromedial approach.

Materials and Methods: This retrospective study includes 28 patients with documented PCL avulsion fractures between 2011 and 2015. They all underwent open reduction and cancellous screw fixation using posteromedial approach by the same lead operating surgeon. The inclusion criteria were an isolated displaced PCL avulsion fracture presenting within 3 weeks of injury. All patients were assessed with a pre-operative magnetic resonance imaging to confirm the fracture.

Results: Radiographs taken postoperatively showed all avulsed fragments reduced were maintained and healing was evident in all cases by the end of 3 months. Clinically, no symptoms of instability were called for and no signs of PCL deficiency were elicited. The average lysolm knee score was 96.6 (86-100), and the average International Knee Documentation Committee score was 94.6 (91-98).

Conclusion: This study demonstrated open reduction and cancellous screw fixation as a successful surgical intervention procedure for treatment of PCL avulsion fractures.

Key words: Avulsion fracture, Internal fixation, Joint instability, Knee injury, Posterior cruciate ligament

INTRODUCTION

Avulsion fracture of the posterior cruciate ligament (PCL) is a relatively uncommon injury. For the Indian population, the most common mode of injury is due to motor vehicle accidents and contact sports.[1] The main mechanism involved in PCL injuries is the dashboard injury, from direct trauma to the tibia in the anteroposterior direction with the knee in flexion.[2] In sports mediated injuries, the main mechanism of injury is sudden excessive flexion of an extended knee or fall over a flexed knee.[3]

The PCL serves as a primary restraint to posterior translation of tibia over the femur and also as a secondary restraint to internal and external rotatory forces over the knee.[4] If left untreated, a PCL deficient knee is prone to abnormal loading and is predisposed to cartilage damage and early degenerative changes.[5]

Over the past few years, a lot has been discussed about treating PCL avulsion fractures. The incidence of this subset of injury had increased over the past few years,

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partly due to improved diagnostic techniques and increasing awareness of the necessity to treat these fractures.[6] Although conservative management is no longer advocated for PCL avulsion fractures, there is a lot a debate over the favorable choice of surgical fixation technique. While open reduction and screw fixation have been in the forefront for a lot of years, recent advances in arthroscopic techniques have encouraged more surgeons to opt for arthroscopic assisted fixations. Although both techniques have their advantages and disadvantages, it is usually at the discretion of the operating surgeon toward choosing the technique of his choice and comfort. In our study, we have discussed the technique and results of open reduction and cancellous screw fixation of PCL avulsion fractures.

MATERIALS AND METHODS

The study was conducted from June 2011 to May 2015. 28 patients with PCL avulsion fractures were included in the study. The injury was diagnosed on clinical examination and plain radiographs taken in anteroposterior and lateral views. Magnetic resonance imaging evaluation was done to confirm the diagnosis, to document the size of the avulsed fragment and also to rule out any associated lesions in the affected knee. Those patients presenting within 3 weeks of injury were included in the study. Those cases presenting beyond 3 weeks, or those with multi-ligamentous injuries or those with fractures of the femur or tibia were excluded from the study. All the patients underwent open reduction and screw fixation using 4.5 mm partially threaded cancellous screws.

Surgical Technique

Spinal anesthesia was administered to all the patients. The procedure was performed in prone position with exsanguination of the lower limb and under tourniquet control. An inverted L-shaped incision taken with a horizontal limb just proximal to the flexion crease of the knee and a vertical limb overlying the medial aspect of the gastrocnemius muscle. Dissection carried to deep facial layer. An interval created between medial head of gastrocnemius and semimembranosus. Posterior joint capsule is reached through this interval via blunt finger dissection. Care is taken to identify and isolate the motor branch of the tibial nerve and the middle geniculate artery. A longitudinal cut in the capsule gives good exposure of the avulsed fragment. At this stage, slight flexion of the knee by keeping a leg roll beneath the ankle helps to improve visualization. The avulsed fragment is identified. The bony bed of the fragment is debrided and freshened. Following this, the bony fragment is reduced on its bed and provisionally fixed with a 2 mm Kirschner wire (K-wire). The position of this K-wire is confirmed under fluoroscopy and if satisfactory, a 4.5 mm partially threaded cancellous screw with washer is used for definitive fixation of the avulsed fragment. Following this, the position of the screw and the reduction is confirmed with fluoroscopy. Adequate wound wash is given and the wound is then closed in layers. Figures 1-3 illustrate one case example demonstrating the pre-operative lesion, post-operative reduction and intra-operative fluoroscopic images.

Post-operative Management

Postoperatively, the knee is immobilized in a long knee brace. At the end of 2 weeks, the extension knee brace is converted to a hinged knee brace and partial weight bearing is begun. During the period of immobilization, static quadriceps, hamstring flexion exercises, and straight leg raising exercises are performed. By the end of 4 weeks, full weight bearing is begun. Open chain quadriceps exercises are not initiated until 6 weeks postoperatively. Return to the previous full activities is achieved at the end of 4 months.

RESULTS

This study included 28 patients, 25 male (90.3%) and 3 female (9.7%), with the mean age of 29.8 years. The right knee was involved in 26 patients (92.8%) whereas the left knee was involved in 2 patients (7.2%). The mechanism of injury was divided into two major categories, road traffic accidents (64.3%) and sports injury (35.7%). The mean surgery time was 53.4 min (30-90 min). The mean intraoperative blood loss was 45 ml (30-60 ml). All the patients were followed up within a mean time period of 22 months (18-34 months). The characteristics of all the patients and the results are elaborated in Table 1.

At the end of 3 months, radiographs of the knee taken showed fracture healing in all patients. There were no major complications such as infection, deep vein thrombosis, or neurovascular deficit at 18 months follow-up. Few patients had Grade-I laxity on examination, however no patient had any complains of instability. Pre-operative mean lysolm score was 28.2 (17-40) which had significantly increased postoperatively to 96.6 (86-100). International Knee Documentation Committee score had also increased from a pre-operative mean of 31.6 (25-42) to post-operative mean of 94.6 (91-98).

DISCUSSION

A displaced PCL avulsion fracture leads to instability of the knee and functional compromise.[7] Approaching such a fracture through an open technique ensures clear visualization of the fracture fragment with complete reduction and secure fixation.[8] In this surgical era, there is

Table 1: Patient characteristics

Sex/age	Side	Mechanism of injury	Duration of surgery (min)	Intraoperative bleeding (ml)	Follow-up (months)	Lysolm score		IKDC score	
						Pre	Post	Pre	Post
M/21	R	Road traffic accident	35	30	30	28	96	31	94
M/25	R	Road traffic accident	60	50	34	30	98	34	92
M/34	R	Sports injury	75	40	32	24	100	29	96
M/24	R	Road traffic accident	45	50	28	30	100	41	94
M/27	R	Road traffic accident	40	40	20	25	86	40	91
M/29	R	Road traffic accident	60	60	25	29	100	27	98
F/35	R	Sports injury	65	50	20	29	100	32	94
M/27	R	Road traffic accident	30	40	18	27	96	41	96
M/36	R	Road traffic accident	35	30	29	17	100	31	94
M/40	R	Sports injury	40	60	26	22	86	29	98
M/27	R	Sports injury	45	30	22	30	96	26	98
M/37	L	Road traffic accident	35	40	24	27	88	34	98
M/22	R	Sports injury	40	40	20	22	100	30	92
M/38	R	Road traffic accident	75	60	22	29	96	21	91
M/28	R	Sports injury	80	40	30	30	100	30	95
F/33	R	Road traffic accident	90	30	19	21	100	36	94
M/27	R	Sports injury	45	50	24	26	100	28	96
M/27	R	Road traffic accident	40	60	22	28	90	26	93
M/20	R	Road traffic accident	65	40	28	27	96	42	98
M/31	R	Road traffic accident	85	50	25	36	93	35	94
M/26	R	Road traffic accident	70	50	24	30	100	38	92
M/35	R	Sports injury	35	40	20	30	98	26	94
F/32	R	Sports injury	45	60	28	30	100	30	96
M/25	R	Road traffic accident	40	50	20	40	90	34	94
M/41	R	Sports injury	65	30	24	32	100	28	96
M/27	R	Road traffic accident	60	30	20	38	96	26	98
M/28	L	Road traffic accident	50	60	21	30	100	25	91
M/33	R	Road traffic accident	45	50	18	22	100	35	94

IKDC: International Knee Documentation Committee

very little place for conservative management. Conservative management can lead to early degenerative changes, meniscus tears, and chondral damage.[9] In 1975, Meyer had reported poor functional outcomes following conservative management of PCL avulsion fractures. An appropriately done PCL repair/fixation can prevent these complications.[10]

Furthermore, in the recent years, there is more inclination toward arthroscopic techniques for fixation of such avulsed fractures. Although arthroscopy is considered the minimally invasive surgical approach, the surgical technique needs advanced instrumentation, longer duration of surgery, complicated surgical technique, and a long learning curve.[11]

With regard to the open surgical approach, many different fixation methods have been described in literature. In 1997, Seitz *et al*. described fixation with K-wires and with cannulated screws, achieving comparable results.[12] Dhillon *et al*. in 2003 also reported good functional results using cannulated screws in all of their 9 cases with complete fracture healing and no pain at 6 months follow-up.[13] Similarly, Veselko *et al*. in 2003 reported good to excellent functional results using a cannulated screw with washer.[14] In 2011, Fu *et al*. described a surgical technique using anchors along with cannulated screws.[15] Chen *et al*. in 2016 described a technique using toothed plate and hollow lag screw. They achieved good functional results with average intraoperative blood loss of 54.3 ml, average surgery time of 65.5 min and average post-operative lysolm score of 93.6.[16]

With the posteromedial open approach, we achieved satisfactory reduction with a mean surgical time of 53.4 min and mean intraoperative blood loss of 45 ml, results being comparable to the arthroscopic technique. Moreover, all patients included in our study were able to resume the previous athletic and strenuous activities at the end of 9 months. There are very few reported cases of complications associated with this technique. In 2016, Li *et al*. reported a case of a broken screw post fixation of the PCL avulsion fracture, which leads to the further meniscus and chondral damage.[17] Khatri *et al*. in 2015 reported two of their 27 patients developed arthrofibrosis post fixation.[18] In this study, none of the patients included had any post-operative complications.

CONCLUSION

This study demonstrates that PCL avulsion fractures can be effectively treated using the posteromedial open surgical approach and cancellous screw fixation.

Figure 1: Pre-operative X-ray of a patient included in the study showing the avulsed posterior cruciate ligament fragment

Figure 2: Post-operative X-ray of the patient demonstrating cancellous screw fixation with washer of the displaced avulsed fragment

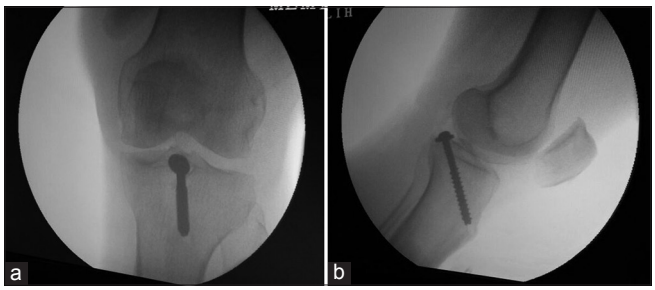

Figure 3: (a and b) Intraoperative fluoroscopic images showing the reduction and fixation of the fragment

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