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Original Article

Fixation of tibial avulsion fractures of the posterior cruciate ligament using pull through suture and malleolar screw

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Abstract

BACKGROUND: Tibial avulsion fractures of the posterior cruciate ligament are not infrequent. However, controversies exist between the fixation of the fragments and their reconstruction in the cases with small bony fragments. This prospective study was undertaken to study the results after fixation of the fragments by the malleolar screw and the pull through suture techniques.

METHODS: From June 2003 to March 2005, 26 patients with acute isolated posterior cruciate ligament avulsion fracture of the tibial attachment were treated surgically at Qhaem and Emam Reza hospitals at Mashhad University of Medical Sciences. The screw fixation was used in 18 cases with large bony fragments and the suturing method for other cases who had small or comminuted fragments. The patients were followed for an average of 14 months; and according to The International Knee Documentation Committee the results were evaluated.

RESULTS: All our patients were men and all the avulsion fractures achieved union at an average of 4.8 months (range, 3-8 months). All the patients had sever posterior instability (>10 mm) pre-operatively. However, when the union of the fracture was achieved, no one suffered severe instability.

CONCLUSIONS: Both of these two techniques (especially screw fixation) had satisfactory results. Although the number of our cases was not high enough, it can be claimed that when the bony fragment is small and the screw fixation increases the risk of fragment breakage, the double bundles pull-through suture technique is an effective alternative choice.

KEY WORDS: Posterior cruciate ligament, fracture, knee.

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Tibial avulsion fractures of posterior cruciate ligament (PCL) have long been regarded as rare injuries. However, in the countries like Taiwan where motorcycles are numerous and motorcycle related injuries are frequent, PCL injuries (either ligamentous tears or avulsion fractures) are seen frequently [1].

The PCL plays a major role in knee stabilization and it is the primary restraint to posterior tibial translation. The PCL resists 85% to 100% of a posteriorly directed knee force at both 30 and 90 degrees of the knee flexion. The PCL is also a secondary restraint to the external tibial rotation, and it is important when dealing with combined PCL-posterolateral corner injuries [2,3].

Many studies have demonstrated that the chronic PCL insufficiencies may result in medial and patellofemoral compartments, degenerative arthritis and increased risk of meniscal tear [4-6]. The management of an isolated PCL intrasubstance tear is still controversial. However, in cases with the bony avulsion of PCL of the tibia, surgical treatment is strongly

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indicated to avoid the morbidities associated with the nonunion of this fracture [7].

In cases of tibial avulsions in which the bony fragment is too small (less than 3 times the size of the screw) to allow the screw purchase, controversies exist between PCL reconstruction and the fixation of the fracture with suturing [8]. The aim of this paper was to study the results of the fixation of tibial avulsion fracture of the PCL, using the pull-through suture and the AO malleolar screw.

Methods

From June 2003 to March 2005, 34 patients with PCL avulsion fracture of the tibial attachment were treated surgically at Qhaem and Emam Reza hospitals at Mashhad University of Medical Sciences. 8 patients were missed during the follow ups. From the 26 cases, 18 patients were treated with the screw fixation and the suturing method was used for the other patients. All the patients had fresh injuries and underwent surgery within 2 weeks after sustaining trauma. The causes of the injuries are shown in table 1.

Table 1. Causes of PCL avulsion fractures.

Cause of injury	Number of patients
Motorcycle crash	18
Car crash	4
Pedestrian-car collisions	3
Bicycle fall	1

All the cases were diagnosed based on the radiographic findings of a bony fragment at the posterior intercondylar space. Surgical indications for the suturing technique were the comminution or the diameter less than 5 mm of the PCL bony fragment.

Surgical Technique

The patient was placed in the prone position and a tourniquet was applied to the thigh. A gently curved incision was made in the popliteal fossa with a horizontal limb near the flexion crease of the knee and a vertical limb overlying the medial aspect of the gastrocnemius muscle. By protecting the medial sural cutaneous nerve, the interval between the medial gastrocnemius and the semimembranosus tendon was developed and the posterior joint capsule was exposed. As the capsule was exposed, the medial head of the gastrocnemius protected the neurovascular structures [9].

The fracture site was identified through the acute rupture hole or by making a longitudinal arthrotomy incision in the posterior capsule of the knee. After cleaning the fracture site, if the bony fragment was large enough for the screw fixation, the screw fixation method would be performed. In cases that using this method was not possible, the anterolateral portion of the PCL was identified and the bone fragment and the distal portion of the PCL were sutured with number 5 Ethibond. Then, the baseball whip-stitch method was used. The posteromedial portion was sutured in the same manner. During the surgery, it is not difficult to trace the anterolateral and posteromedial bundles proximally and it is also easy to suture at the tendon-bone junction. Two separate holes were then drilled anteriorly and inferiorly from the tibial fracture defect to the anterior tibial cortex with a 2 mm Kirschner`s wire. The exit point of the wire was directed anteriorly to avoid the anterolateral musculature and the peroneal nerve. A 2-cm incision was then made at the opening of the drill holes at the anterior tibial cortex. Using a suture passer, the sutures were pulled through the holes to the anterior tibial cortex sequentially. The posteromedial portion was tightened at the full extension of the knee. The anterolateral portion was tightened at 70 degrees of flexion [10,11] and the posterior capsule was then repaired. The incision wounds in the popliteal fossa and the anterior tibia were closed layer by layer. A sterile dressing was applied and the knee was placed in a long leg splint in full extension. After 2 weeks, the skin sutures were removed and the splint was changed to long leg cast and the cast was used for 4 more weeks postoperatively and the full weight bearing was allowed as tolerated with the cast. Straight leg raising and quadriceps isometric exercises may be initiated early in the postoperative period. At 6 weeks, the cast was removed and closed-chain kinetic exercise was

started. At 8 weeks, the range of motion was increased to 90 degrees.

Follow-Up Assessments

We placed our patients in two groups. Patients with large bony fragments, who were treated with the screw fixation, were placed in the first group; and the patients who were treated with the double bundles pull-through suture method, were placed in the second group. All the patients were followed up using the clinical and radiographic evaluations including activity levels, subjective measurements, symptoms, range of motion, laxity, crepitus, radiographic findings and functional strength. The clinical results were evaluated using the guidelines of the International Knee Documentation Committee (IKDC) rating system [12]. The posterior instability was measured preoperatively and postoperatively using the manual examinations, including the posterior drawer test, the posterior sag test and the quadriceps active displacement test [13]. Then, the overall final rating of the two groups was assessed statistically.

Results

We observed all the 26 patients regularly for an average of 14 months (range, 10-24 months). All our patients were men and all the avulsion fractures, achieved union at an average of 4.8 months (range, 3-8 months). All the patients were assessed regularly according to the guidelines of the IKDC rating system (table 2). The posterior instability was evaluated using the manual examinations on the basis of side-to-side difference (table 3).

Table 2. Knee scores for the 26 patients in IKDC system.

Rating	Normal		Nearly normal		Abnormal		Severely abnormal	
	Group 1	Group2	Group1	Group2	Group1	Group2	Group1	Group2
Subjective	15	6	2	1	1	1	0	0
Symptoms	16	7	2	1	0	0	0	0
Range of motion	15	7	3	1	0	0	0	0
Laxity	15	5	2	1	1	2	0	0
Crepitus	16	7	2	1	0	0	0	0
Radiography	17	8	1	0	0	0	0	0
Functional test	15	6	2	1	1	1	0	0
Final rating	14	5	3	1	1	2	0	0

Table 3. Preoperative and postoperative posterior instability of the knee in 26 patients.

Posterior instability	Preoperative		Postoperative	
	Group1	Group2	Group1	Group2
0-5 mm	0	0	17	6
6-10 mm	0	0	1	2
>10 mm	18	8	0	0

Discussion

Avulsion fractures of the PCL tibial insertion usually constitute only a small subgroup of PCL injuries. Although several fixation techniques have been reported in the literature, surgical fixation is usually recommended. Abbott et al used the screw fixation technique [8] and Torisu used the staples for fixation [14]. Lee advocated suturing the PCL to the capsular tissue after pulling down the bone fragment to as near to its original insertion site as possible [8]. All these studies have reported satisfactory results. Seitz et al compared the results after the Kirschner`s wire or the screw fixation and he found that all the patients had excellent functional results with either fixation techniques [15]. In all the above-mentioned articles, the authors did not specify the sizes of the bony fragments and they seemed to treat relatively large fragments. Chen et al used double bundles pull-through suture method (the method we used in our study for the fixation of small tibial avulsion fracture of PCL) and he cited excellent results [8].

In our study, the results in the first group (screw fixation technique) and in the second

group (double bundles pull-through suture method) indicated that although the results of the screw fixation technique seemed to be higher, both methods had satisfactory results. Although the number of our cases was not high enough, it can be claimed that when the bony fragment is small and the screw fixation increases the risk of fragment breakage, the double bundles pull-through suture technique is an effective alternative choice.

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