Displaced Posterior Cruciate Ligament Avulsion Fractures: A Retrospective Comparative Study Between Open Posterior Approach and Arthroscopic Single-Tunnel Suture Fixation

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Purpose: To retrospectively compare the clinical outcomes of displaced tibial-side posterior cruciate ligament (PCL) avulsion fractures treated with open reduction and screw fixation versus arthroscopic suture fixation. **Methods:** From 2005 to 2013, all displaced PCL tibial-side avulsion fractures treated surgically—initially by an open posterior approach and later by arthroscopic-assisted suture fixation—were retrospectively reviewed. The cases with radiographic evidence of greater than 3 mm of displacement and/or grade II or III laxity on the posterior drawer test were included in the study group. The associated injuries were duly treated. A conservative rehabilitation protocol was followed until radiologic fracture union occurred. The patients' clinicoradiologic assessment data at 1 year of follow-up were used for comparison between the open and arthroscopic groups. **Results:** Forty-seven patients were available with 1 year of follow-up: 27 in the open group and 20 in the arthroscopic group. More than 90% of patients in both groups rated their knee function as normal or nearly normal. At 1 year of follow-up, knee function in terms of the Lysholm score (mean of 95.3 with 95% confidence interval [CI] 92.85 to 97.75 in open group and mean of 94.8 with 95% CI 91.38 to 98.22 in arthroscopic group; $P = .812$), Tegner activity level (mean of 6.8 with 95% CI 6.16 to 7.44 in open group and mean of 7.0 with 95% CI 6.44 to 7.66 in arthroscopic group, $P = .677$), International Knee Documentation Committee evaluation, and 1-leg hop test was comparable in both groups. The postoperative arthrometric laxity measurements with a KT-2000 arthrometer (MEDmetric, San Diego, CA) were better in the arthroscopic group, with 0 to 3 mm of laxity in 85% of cases in the arthroscopic group versus 74% in the open group. Avulsed fracture fragments were usually united by 3 months after surgery. No significant complication was noted. **Conclusions:** Both arthroscopic and open methods of treatment for PCL tibial-side avulsion injuries resulted in comparably good clinical outcomes, radiologic healing, and stable knees at short-term follow-up. **Level of Evidence:** Level III, retrospective comparative study.

See commentary on page 54

Tibial-side avulsion injuries of the posterior cruciate ligament (PCL) are usually considered rare injuries.[1] However, in countries in which motorcycle injuries are frequent, PCL bony avulsion injuries are not so uncommon.[2] It is generally agreed that a displaced tibial-side bony avulsion of the PCL should be anatomically reduced and fixed.[3] Acute fixation of the displaced PCL avulsion fracture, preferably within the first 3 weeks, is usually advocated.[4] Both open[2,5-13] and arthroscopic[3,14-30] methods of fixation have been reported to produce good outcomes, although only 4 case series using arthroscopic methods have been reported to date.[14-17] One biomechanical study has also shown comparable results of screw fixation using open or suture fixation by arthroscopic means.[31] However, there is a lack of comparative clinical studies (open *v* arthroscopic) in the literature.

The purpose of this study was to retrospectively compare the clinical outcomes of displaced tibial-side PCL avulsion fractures treated with open reduction

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and screw fixation versus arthroscopic suture fixation. The hypothesis was that the clinical and radiologic outcomes and results of laxity measurement would be comparable in both groups without statistical significance at short-term follow-up.

Methods

From 2005 to 2013, all displaced PCL tibial-side avulsion fractures treated surgically at our tertiary care hospital and trauma center were retrospectively reviewed. In the initial 5 years, all the cases were operated on by an open posterior approach, and the arthroscopic method was used thereafter. The inclusion criteria for this retrospective study were as follows: PCL tibial-side avulsion fracture with radiographic evidence of greater than 3 mm of upward displacement and/or with grade II (5 to 10 mm of translation) or III (>10 mm of translation) findings on the posterior drawer test at 90° of knee flexion on clinical evaluation or examination under anesthesia. Associated meniscal, chondral, anterior cruciate ligament (ACL), or collateral ligament injuries were not grounds for exclusion. Cases with fractures of the proximal tibia or distal femur, open injury, or associated neurovascular injury were excluded from the study.

All avulsion injuries were confirmed with radiography (Fig 1), computed tomography scan, or magnetic resonance imaging (MRI). Computed tomography scans were used to assess the size, comminution, and displacement of the fracture fragment. MRI was obtained in cases in which collateral ligament or posterolateral corner injury was suspected.

Clinically, each patient was assessed preoperatively and under anesthesia using the Lachman and anterior and posterior drawer tests to evaluate for cruciate injury, as well as varus and valgus stress tests both in extension and at 30° of flexion to assess the competence of the collateral ligaments. The dial and external rotation recurvatum tests were also performed to evaluate posterolateral corner injuries.

Surgical Technique

In the operating room, the injured knee was examined with the patient under anesthesia and laxity elicited was documented. Both the open and arthroscopic methods used were modified from the description in the literature and verified on cadaveric dissection to be safe.

Open Posterior Approach. We used the modified small-incision posterior approach, modified from the description of Nicandri et al.[11] Patients were positioned in the prone or lateral decubitus position with the injured knee up on the operating table. A transverse incision, 3 to 4 cm long, was made across the knee flexion crease. The incision was then carried distally from the medial edge of the transverse component in line with the hamstring tendons to create an inverted L-shaped incision. The underlying small saphenous vein and medial sural cutaneous nerve were isolated and protected. The deep fascia was incised longitudinally along the lateral border of the medial head of the gastrocnemius. A plane was created just along the lateral border of the medial head of the gastrocnemius by blunt dissection with the fingers until the posterior knee capsule was visible. The popliteal neurovascular bundle was not dissected but was protected en masse with the lateral head of the gastrocnemius with a blunt retractor. Aggressive retraction must be avoided. The posterior knee capsule and oblique popliteal ligament were identified, and a vertical incision was made on the capsule to expose the avulsed bone fragment. The fracture bed was cleared of clots, and the avulsed fragment was repositioned into the bed provisionally with a 1.5-mm Kirschner wire, followed by final fixation with a 40- to 45-mm-long 4-mm partially threaded cannulated screw (Synthes, West Chester, PA) with the washer directed toward the tibial tubercle (Fig 2). In case of comminution, 2 to 3 screws were used to fix each fragment separately. If not amenable to screw fixation, only the largest fragment was fixed with a screw and No. 5 Ethibond suture (Ethicon, Somerville, NJ), passed through the substance of the PCL, was tied with a screw. The reduction and hardware position were then checked with fluoroscopy. The disappearance of posterior laxity was also noted.

Fig 1. Preoperative lateral radiograph showing displaced posterior cruciate ligament (PCL) avulsion.

Arthroscopic Procedure. The patient was positioned supine on the operating table with the affected knee mounted on a knee holder (Arthrex, Naples, FL) at 90° of flexion. No pump was used to avoid fluid extravasation to the calf. High parapatellar anterolateral and anteromedial (AM) portals were created. Diagnostic arthroscopy was performed, and the status of the