Original Article

Arthroscopic treatment of displaced tibial eminence fractures using a suspensory fixation

Philippe Loriaut, Pierre-Emmanuel Moreau, Patrick Loriaut[1], Patrick Boyer

Abstract

Background: Avulsion fractures of the tibial intercondylar eminence are fairly common injuries requiring surgery for the optimal functional outcome. The purpose of this study was to assess the clinical and radiological outcomes of an arthroscopic treatment of displaced tibial intercondylar eminence fractures using a suspensory device.

Material and Methods: Five patients with type 2 and 3 displaced tibial intercondylar eminence fractures who received an arthroscopically assisted fixation using a double button device were enrolled from 2011 to 2012. Clinical assessment included the patient demographics, cause of injury, the delay before surgery, time for surgery, time to return to work and sport, the International Knee Documentation Committee (IKDC) and Lysholm knee scores. Stability was measured with the KT-2000 arthrometer with a force of 134 N. A side to side difference on the KT-2000 examination superior to 3 mm was considered as a significant and abnormal increase in the anterior translation. Radiological examination consisted of anteroposterior and lateral radiographs, as well as computed tomography (CT) scan of the affected knee. Clinical and radiological followup was done at 1, 2, 3, 6, and 12 months postoperatively and at final followup. CT-scan was performed before surgery and at 3 months followup.

Results: The median age of patients was 31 years. Mean followup was 27 ± 5.1 months. The average delay before surgery was 3 days. At final followup, the mean IKDC and Lysholm knee scores were, 93.9 and 94.5 respectively. All patients had a complete functional recovery and were able to return to work and to resume their sport activities. No secondary surgeries were required to remove hardware. No complication was noted. Bony union was achieved in all patients.

Conclusion: The arthroscopic treatment of displaced tibial intercondylar eminence fractures using a suspensory system provided a satisfactory clinical and radiological outcome at a followup of 2 years.

Key words: Anterior cruciate ligament, arthroscopic fixation, avulsion fracture, intercondylar eminence, knee joint, tibia
MeSH terms: Anterior cruciate ligament, knee joint, suture technique, arthroscopy

Introduction

Avulsion fractures of the tibial intercondylar eminence are fairly common injuries that occur in children and adolescents and are equivalent to anterior cruciate ligament (ACL) injuries in adults.[1] However, they can also occur although less frequently in adults. Displaced fractures are known to be subject to nonunion and knee instability requiring surgical management for optimal functional outcome.[2] Open arthrotomy techniques have been described to reduce and stabilize displaced fractures including cannulated screws, Kirchner-wires, and sutures.[3-5] However, most techniques were related to several complications such as implant breakage, loosening or migration, infection and nonunion.[6] Recently, arthroscopic techniques have been successfully proposed to decrease arthrotomy induced morbidity and improve functional outcome such as percutaneous crossed pin fixation, metal screws fixation, staple fixation and suture fixation.[7-15] Most of them are technically demanding and require hardware removal.

Department of Orthopaedic Surgery and Sports Traumatology, Pitié Salpêtrière Hospital, Pierre and Marie Curie University, 47 Boulevard de l'Hôpital, 75013 Paris, [1]Department of Ophthalmology, Quinze-Vingts National Ophthalmology Hospital, 28 rue de Charenton 75012 Paris, France

Address for correspondence: Dr. Philippe Loriaut, Department of Orthopaedic Surgery and Sports Traumatology, Pitié Salpêtrière Hospital, Pierre and Marie Curie University, 47 Boulevard de l'Hôpital, 75013 Paris, France.
E-mail: philippeloriaut@hotmail.com

Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.201706

How to cite this article: Loriaut P, Moreau PE, Loriaut P, Boyer P. Arthroscopic treatment of displaced tibial eminence fractures using a suspensory fixation. Indian J Orthop 2017;51:187-91.

The purpose of the study was to report the clinical and radiological outcomes of a simple arthroscopic technique for the reduction and fixation of displaced tibial intercondylar eminence fractures using a double button device (TightRope System: Arthrex, Naples, FL, USA) at a followup of 2 years.

Materials and Methods

Five patients diagnosed with displaced tibial intercondylar eminence fractures were treated in our institution from 2011 to 2012. Data were analyzed retrospectively by an independent observer. Patient records were reviewed for the following inclusion criteria: Patients with radiological evidence of a displaced type 2–3 fractures of the tibial intercondylar eminence who received arthroscopically-assisted fixation using a double button device (TightRope: Arthrex; Naples, FL, USA) and completed the entire examination schedule at a minimal followup of 2 years. [Figure 1] Patients with other types of fracture (1 and 4), with an associated meniscal injury diagnosed during the arthroscopic procedure or with an incomplete evaluation at final followup were excluded.

Clinical assessment included the patient demographics, cause of injury, the delay before surgery, time for surgery, time to return to work and sport, the International Knee Documentation Committee (IKDC) and Lysholm knee scores. Stability was measured with the KT-2000 arthrometer (Medmetric, San Diego, CA, USA) with a force of 134 N. A side-to-side difference on the KT-2000 examination superior to 3 mm was considered as a significant and abnormal increase in the anterior translation. Radiological examination consisted of antero-posterior and lateral radiographs, as well as computed tomography (CT)-scan of the affected knee preoperatively and postoperatively. Clinical and radiological followup occurred at 1, 2, 3, 6, and 12 months postoperatively and at final followup. CT-scan was performed before surgery and at 3 months followup. The median age of patients was 31 years (range 21–52 years). According to Meyers and McKeever's classification,[16] there were three type 2 and two type 3 fractures. The average delay before surgery was 3 days (range 1–8 days).

Operative procedure

The surgical procedure was performed under general anesthesia, in tourniquet and in supine position with knee in 90° of flexion. The main steps of the surgical procedure are summarized in Figure 2. Standard anterolateral and anteromedial arthroscopy portals were used. A lavage was first performed to remove blood clots or loose osteochondral fragments. A complete diagnostic arthroscopy was then conducted to confirm the ACL avulsion and to examine possible associated lesions (meniscal injuries). The ACL avulsion was examined with an arthroscopic probe and a soft tissue debridement was carefully performed with a shaver in order to expose the fracture site [Figure 3]. This should be done carefully to avoid iatrogenic displacement of the fragment. The anterior horn of the medial meniscus or the transverse meniscal ligaments were trapped within the fracture site. Therefore, retraction with a probe or

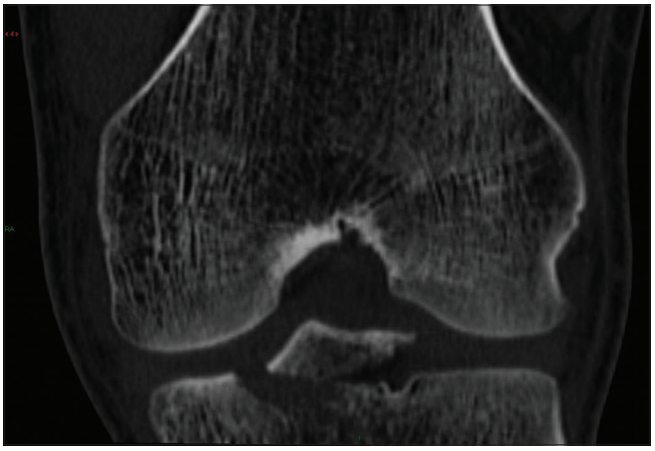

Figure 1: Computed tomography scan of knee joint showing displaced tibial eminence fracture

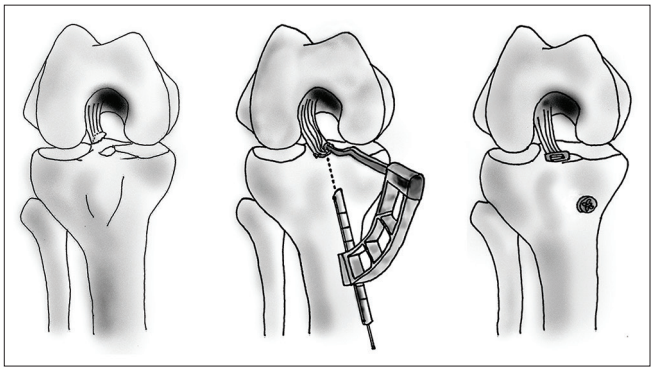

Figure 2: A line diagram showing surgical technique (summarized)

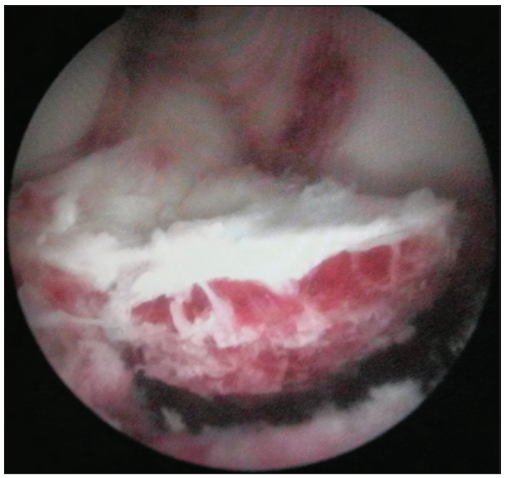

Figure 3: Arthroscopic view showing examination of the anterior cruciate ligament avulsion and soft tissue debridement in order to expose the fracture site

debridement of the interposed tissues was performed so as to allow fracture reduction [Figure 4]. A small skin incision was made 2 cm distally and 1 cm medially to the tibial tuberosity. Dissection was made down to the antero-medial tibia and the sartorius fascia. A drill guide was introduced through the antero-medial portal and positioned over the tibial eminence to maintain the reduction and to pull the ACL. The external part of the guide was placed anteriorly to the hamstring tendons identified by palpation.

A 2 mm Kirschner-wire was drilled through the guide from the external cortex of the tibia to the reduced tibial eminence through the inferior ACL fiber [Figure 5]. A 4 mm hole was then created with a cannulated drill [Figure 6]. A guide wire was passed through the drill and retrieved through the antero-medial portal. The TightRope system was inserted through the tunnel using the guide wire. The first button was flipped over the surface of the tibial eminence and the second one over the external cortex of the tibia [Figure 7].

Finally, the fracture was reduced under direct visualization, and the sutures were tied over the external cortex pulling down the avulsed fragment so as to tighten the ACL. Fluoroscopy was performed to confirm reduction and accurate position of the button. Patients were immediately placed in a removable knee brace locked in extension.

The patellar mobilization, quadriceps isometric strengthening exercises started early. Patients were allowed immediate full weight bearing. Cycling and swimming were allowed at 8 weeks, running and progressive return to athletic activities at 16 weeks.

Results

The median age of patients was 31 years (range 21–52 years). Mean followup was 27 ± 5.1 months (range 24–30 months).

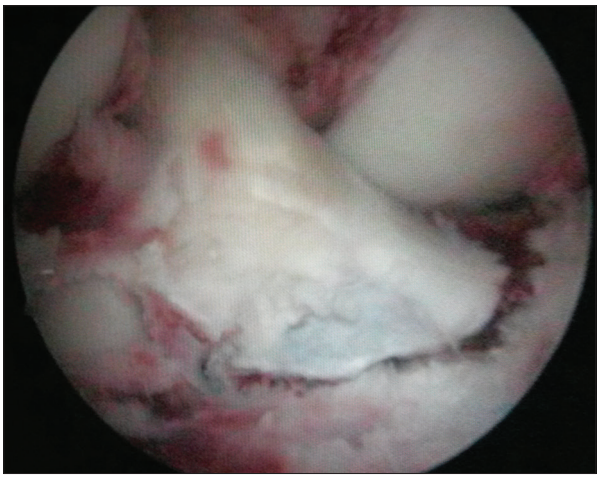

Figure 4: Arthroscopic view showing reduction of the fracture

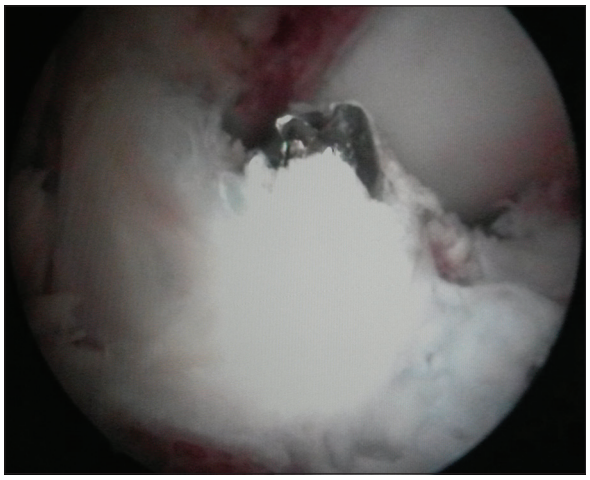

Figure 6: Arthroscopic view showing that a tunnel was then created with a cannulated drill

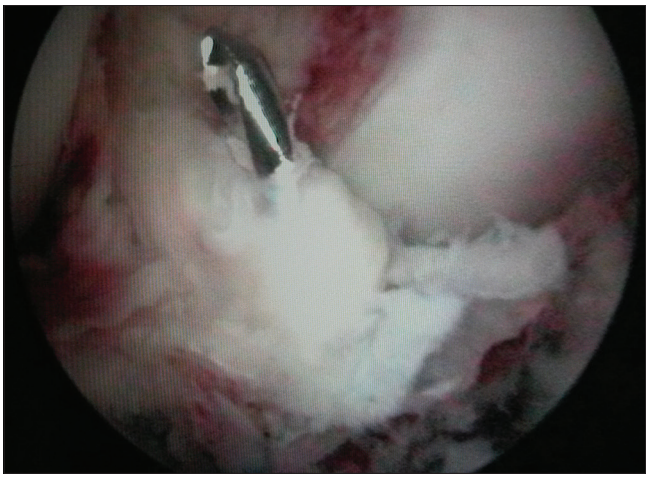

Figure 5: Arthroscopic view showing drilling of a Kirschner-wire through the guide from the external cortex of the tibia to the reduced tibial eminence through the inferior anterior cruciate ligament fiber

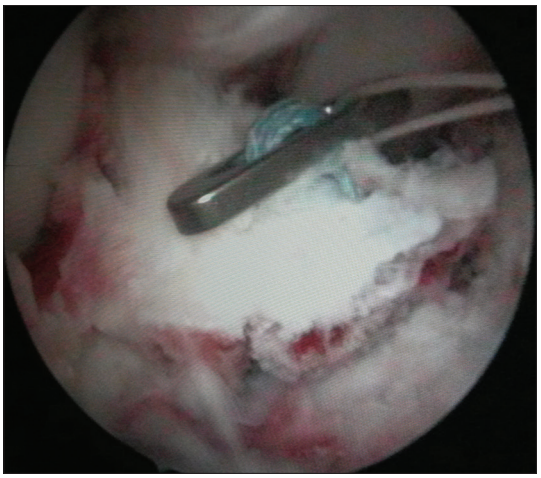

Figure 7: Arthroscopic view showing that the suspensory system was inserted through the tunnel using a guide wire, then was flipped over the surface of the tibial eminence

At the final examination, Lachman's test and pivot shift tests were negative in all patients. The mean difference in KT-2000 arthrometer with the contralateral knee was 1 ± 1.2 mm.

At final followup, the mean IKDC and Lysholm knee scores were, 93.9 (range 89–95) and 94.5 (range 91–97) respectively. All patients had a complete functional recovery and were able to return to work and to resume their sports activities after 6 weeks and 7 months respectively. No secondary surgeries were required to remove hardware. No intraoperative or postoperative complications were reported. Fractures were adequately reduced, and no secondary displacement or fixation loosening occurred during followup. Bony union was achieved in all patients within 3 months [Figure 8].

Discussion

The main finding of this study was that arthroscopic stabilization of displaced tibial intercondylar eminence fractures achieved satisfactory outcomes with a minimum followup of 2 years. Patient satisfaction was high with good functional recovery. We did not observe any intra operative or postoperative complications.

Since tibial intercondylar eminence fractures are fairly common, various surgical techniques have been reported in the past. Open reduction and internal fixation with suture or metal hardware was performed with an arthrotomy induced morbidity.[3,5,6] This stimulated the emergence of arthroscopic procedures. In the literature, several studies have reported arthroscopic treatment of displaced tibial intercondylar eminence fractures.[8-13] Nevertheless, arthroscopic treatment with cannulated screws or pull out sutures may be responsible for mechanical complications especially secondary displacement.[16-19]

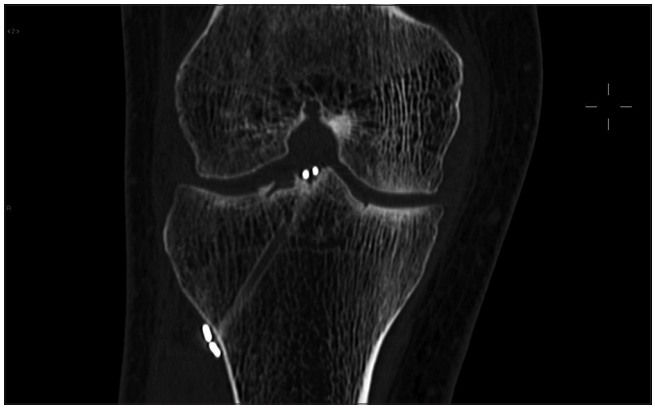

Figure 8: Computed tomography scan of knee joint showing bony union at 3 months

The tightrope device has been initially proposed to treat ankle diastasis, acromio-clavicular dislocation and distal clavicle fracture.[20-22] Wardle described a technique using the same device for proximal ACL avulsion.[23] Our results also seem consistent with a previous series using the same device.[24] Indeed, the endobutton system allowed good compression with a strong holding power. According to Hapa *et al*. in a biomechanical study with cycling loading conditions in an ovine model, endobutton fixation of tibial eminence fracture provided significantly greater initial fixation strength, less displacement than suture anchor fixation or fixation with various high strength sutures.[14] Moreover, the inferior ACL fibers are pulled down by the suture tightening, which helps to maintain normal ACL tension.

Advantages of this technique also included low morbidity, the ability to diagnose and treat concomitant injuries, anatomic reduction of the fragment and stabilization in a limited surgical time and early rehabilitation with full weight bearing. Last but not least, there was no need for device removal. Nevertheless, the described technique requires a transphyseal tunnel and should not be used in pediatric populations with immature growth plate.

To the best of our knowledge, it is the first prospective study that investigates the arthroscopic treatment of displaced fractures of the tibial intercondylar eminence using a double button device with a minimum followup of 2 years.

This study had some limitations, including a relatively short followup and a small sample size. The absence of control group does not allow firm conclusions. In addition, this procedure is technically demanding. Surgery should not be delayed more than 1-week after the injury in order to achieve an accurate reduction of the fracture. Since there is no validated scoring system to assess the results of the treatment of the displaced tibial intercondylar eminence fractures, the IKDC score was used in combination with the Lysholm knee score and considered as the best available scoring system.

Conclusion

The arthroscopic treatment of displaced tibial intercondylar eminence fractures using a double endobutton device provides a satisfactory functional outcome. In addition, this minimally invasive procedure does not require device removal and allows early weight bearing and rehabilitation.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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