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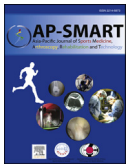

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Original article

Arthroscopic suture fixation in patients with a tibial intercondylar eminence fracture using a simple device to penetrate the anterior cruciate ligament

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Abstract

Displaced tibial intercondylar eminence fractures require early reduction and stable fixation to prevent nonunion, knee instability, and a lack of extension. Many types of surgical procedure are recommended including arthrotomy or an arthroscopic technique to stabilize the fracture segment using Kirschner wire, screws, staples, and suture fixation. However, contemporary arthroscopic techniques and devices can facilitate intra-articular surgery and have been applied to the treatment of this fracture. In our current report, we describe a simple suture fixation method under arthroscopy for the treatment of tibial intercondylar eminence fractures. We treated eight knees of eight patients. One patient had a Type II fracture and seven patients had a Type III fracture according to Meyer's classification. Following the arthroscopic inspection of concomitant injuries, debridement of hematoma, and reduction of the fragment, two nonabsorbable sutures (Ethibond No. 2, Johnson & Johnson, Somerville, NJ, USA) were advanced through the suture passer device, which is used to penetrate the anterior cruciate ligament (ACL) near to the insertion site of the displaced fragment. Two surgical sutures were pulled out by the suture retriever from the anterior proximal tibia hole and were fixed to the tibia cortex bone with a double-spike plate. At follow-up, radiographic examinations showed that bone union was achieved in all cases. All but one patient could resume normal activities with no restrictions and no ligamentous instability. All knees had a negative Lachman's test and showed a gain of stable ligament function by KT2000 arthrometer evaluation. One patient had an insignificant extension limitation and experienced slight pain after walking but these symptoms were minimal. In conclusion current arthroscopic surgery techniques for tibial intercondylar fractures can be easily performed and reproducibly achieve secure fixation and early mobilization of the knee.

Keywords: Anterior cruciate ligament; Arthroscopy; Intercondylar eminence fracture

Introduction

A tibial intercondylar fracture is an uncommon traumatic injury, that usually occurs in children and people of a younger age[1] as a result of sporting or traffic accidents.[1,2] A stable and minimally displaced fracture can be treated conservatively using closed reduction and a cast.[2–4] However, a displaced fragment may develop an overgrowth and obstruct knee extension *via* impingement of the femoral condyle.[2,5] To avoid these complications, surgery is usually indicated for patients with a displaced tibial intercondylar eminence fracture. Recently, arthroscopic surgery has been popular with the development of modern techniques and instruments for this procedure. In our present report, we describe a simple method of arthroscopic reduction and suture fixation of the tibial intercondylar eminence fracture using an ACCU-PASS Suture Shuttle and Suture retriever (Smith & Nephew, Andover, MA, USA). The purpose of this retrospective study was to evaluate the postoperative outcomes of arthroscopic surgery for a tibial intercondylar fracture.

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Materials and methods

We treated eight patients (5 males) with displaced tibial intercondylar eminence fractures by arthroscopic fixation between 2002 and 2008 at our institution. All patients gave written informed consent. Three cases were children (age range, 7–8 years) and the remaining five patients were adults (age range, 20–56 years). The mean age at the time of injury was 25 years. The injuries were right-sided and left-sided in four patients each. Routine anteroposterior and lateral radiography of the knees revealed tibial intercondylar eminence fractures. One patient showed a Type II fracture with 7 patients displaying a Type III fracture according to the Meyers's classification.[4]

Surgical technique

The patient was placed in the supine position with the injured knee flexed to 90°. The leg was placed in an arthroscopic leg holder and an arthroscopic examination was performed using a pneumatic tourniquet under general anaesthesia. After the removal of haemorrhaging and scar tissue under the bone fragment, the injured knee was assessed arthroscopically *via* a standard anteromedial and anteroletaral portal to examine concomitant meniscus injuries, damage to the cartilage, and interposed soft tissue between the fragment and tibial bony bed. There was one case of medial collateral ligament damage, which was treated by primary suture repair, but no knees with medial or lateral meniscus injury, or with serious damage to the cartilage. After the confirmation of anatomic reduction of the fragment on the articular surface, two nonabsorbable sutures (Ethibond No. 2, Johnson & Johnson, Somerville, NJ, USA) were inserted through the suture passing device (ACCU-PASS; Smith & Nephew, Andover, MA, USA) which was introduced from the medial or lateral arthroscopic portal (Fig. 1). These were used to penetrate the anterior cruciate ligament (ACL) near to the attachment of the fragment. An anteromedial 2 cm incision was made over the medial proximal tibia, and 2 × 2.4 mm K-wires were drilled through the ACL tibial drill guide from the proximal tibia into the joint (Fig. 2). In the three child cases, the K-wire was passed within the epiphysis of the proximal tibia under the fluoroscopic image using a freehand technique to avoid passing the epiphysis plate. The sutures were drawn from the epiphysis and fixed distally to the epiphyseal line.

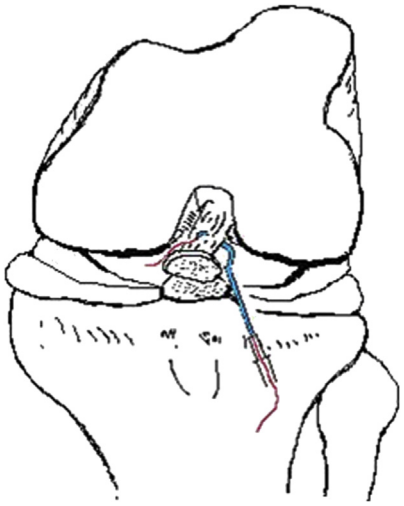

Fig. 1. Athroscopic insertion of the ACCU-PASS suture shuttle. To advance two strings of nonabsorbable thread, a 45°-curved needle was inserted using an arthroscopic technique.

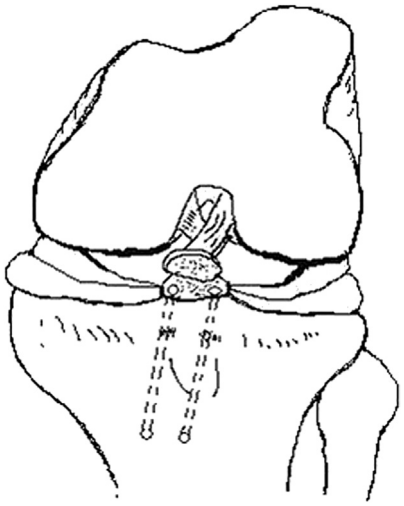

Fig. 2. Insertion of Kirchner wire. An anteromedial 2 cm incision was made over the medial proximal tibia, and 2 × 2.4 mm K-wires were drilled through the anterior cruciate ligament tibial drill guide from the proximal tibia into the joint.

The osteochondral fragment was confirmed to be reduced with the aid of a probe inserted through an anterior portal. Two sutures were retrieved through the tibial tunnel using a Suture retriever (Smith & Nephew), passed through the drilled holes of the tibia (Fig. 3) and finally fixed to the cortex using a Double-Spike Plate (DSP) Fixation Device (Smith & Nephew) maintaining a tension of 40 lb (Fig. 4).

Rehabilitation program

After surgery, patients were instructed to wear a hinged knee brace which was adjusted to limit extension to 20° for 6 weeks. Full weight bearing was allowed immediately, and after 6 weeks full knee extension was allowed. Patients were permitted to engage in sporting activities or heavy labour from 3 months postsurgery.

Evaluation

The average follow-up time was 23 ± 17 months (12–59 months). After the operation, bone plain radiography was performed every month to confirm bone union. At the final follow up time all knees were evaluated using various tests including a radiological assessment for consolidation of the fracture, a range of motion test, a Lachman test, and an anterior drawer test. Six patients were evaluated for anterior translation of the tibia using a KT-2000 arthrometer (Med Metric, San Diego, CA, USA). All patients were assessed according to the Lysholm functional rating score.

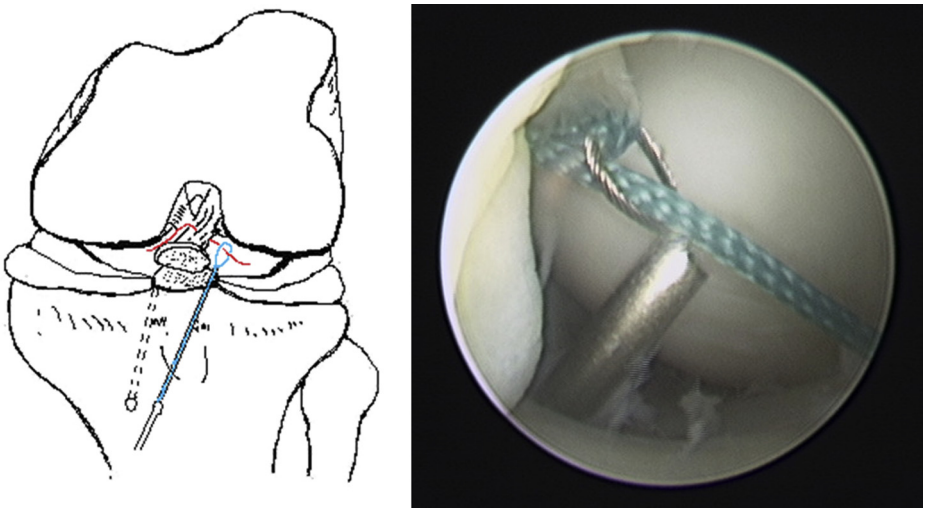

Fig. 3. Removal of sutures using a suture retriever. Two pieces of thread were placed on the loop of the suture retriever and drawn to the anterior tibial cortex.

Results

Patient demographic data and results are listed in Table 1. Radiological examination of the fractures demonstrated bony consolidation within 8 weeks for all cases. With the exception of one patient, all of our subjects could resume normal daily activities with no restrictions, ligamentous instability, or pain. At the final follow-up, the average Lysholm rating score was 97 (range, 88–100). One of our male patients who had a concomitant medial collateral ligament injury reported knee pain after intense physical activity. This patient did not have a full range of motion and showed a residual 10° flexion contracture, with a maximum flexion of 110°, and a relatively low Lysholm score (88) with atrophy of the thigh. He also complained of mild pain after walking, but these symptoms were minimal.

At the time of the latest follow-up, the average range of motion was 144° (range, 110°–150°) and all but the aforementioned male patient had regained full extension. The patient presented above had a more limited active knee extension. The symptoms and complaints in our study cohort were minimal however, and all eight knees had negative results in the Lachman test, anterior drawer test, and pivot-shift test. Six of these eight knees were evaluated using a KT-2000 arthrometer. The maximum manual side-to-side differences were 0.8 ± 1.6.

Discussion

Previously, displaced intercondylar eminence fractures were treated using open reduction and internal fixation methods.[1,4] However, advanced arthroscopic techniques and modern instruments can treat intercondylar eminence fractures without arthrotomy. Meyers[4] has previously documented the procedures for open reduction and internal fixation surgeries.

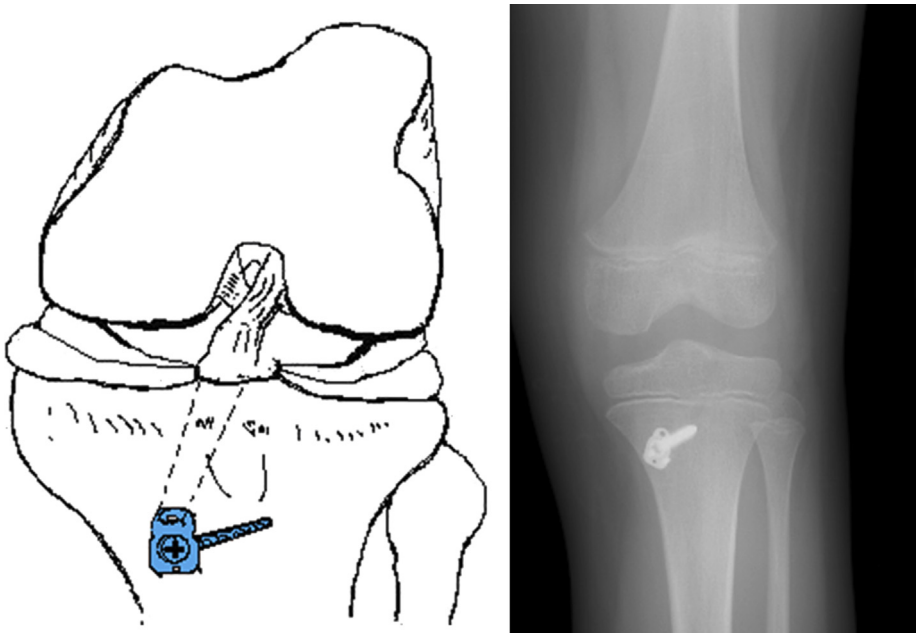

Fig. 4. Fixation of sutures. Sutures were fixed to the tibia by DSP.

Table 1
Patient characteristics.

No.	Age, Sex	Type	Side	Mechanism	Follow-up (mo)	Lysholm score	KT2000[a]
1	28 M	II	R	Fall	12	97	1
2	56 M	III	R	Traffic accident	59	100	−1
3	8 F	III	L	Fall	12	100	N.A.
4	7 M	III	L	Bumped into someone hard	16	97	3
5	39 M	III	L	Traffic accident	16	88	1
6	8 F	III	R	Ski	26	97	N.A.
7	20 M	III	L	Traffic accident	12	97	−1
8	38 F	III	R	Ski	47	100	2

[a] KT2000 side-to-side difference.

Arthroscopy was first reported by McLennan et al[6] who treated Type III fractures with percutaneous pinning fixation with the aid of this technique. Van Loon[7] reported the use of arthroscopy to stabilized fractures with screws. In the late 1990s, several case review papers were published on the treatment of tibial intercondylar fracture by suture fixation under arthroscopy.[1,8–12] Kendall et al[1] treated displaced Type III fractures using a Vicryl pin (Ethicon, Edinburgh, Scotland) under arthroscopy and suggested that this approach had potential for future development. Medler et al[8] described two case reports in which the surgical technique used an ACL tibial guide. Matthews et al treated six patients (5 Type III and 1 Type II fractures) using a suture method. At 1-year follow up, none of these patients complained of instability and all had a good range of motion. Berg et al[12] treated two cases of comminuted fractures with a suture method under arthroscopy and evaluated these patients using a KT-1000 arthrometer. The joint stability outcomes in these cases were almost normal.

Arthroscopic treatments for intercondylar tibial eminence fractures have advantages over open surgery, including less morbidity in comparison with arthrotomy, easier debridement of intra-articular hematoma, feasible fracture inspection and removal of interposed tissue.[13–15] The alternative reported methods for stabilizing such fractures include screw fixation,[13] Kirchner wire,[14] and suture methods.[8,10,16,17] However, when the fracture is comminuted, the screw fixation becomes technically impossible[12] and posterior neurovascular complications are a real concern. In addition, sutures through the base of the ACL provide secure fixation.[16] Eggers has reported using biomechanical data that the suture fixation strength in the repair of tibial eminence fractures is superior to that of screw fixation.[18]

Su et al have reported on their use of a suture fixation technique using a 45° Arthrex lasso device and concluded that this device facilitated fixation within the substance of the ACL.[19] The ACCU-PASS suture has various types of configuration, and a 45°-curved tip device can pass a thread through the ACL at an ideal position. We used DSP[20] for the purpose of rigid fixation with equal tension in multi sutures in the ACL and so as not to rupture the suture at the distal edge of the bone tunnel of the tibial cortex. A key outcome of our presentation cases was no instability at follow-up. The disadvantages of suture fixation under arthroscopy include the complexity and time-consuming nature of this method.[16] However, the operative techniques we describe herein can readily facilitate penetration of the ACL in an ideal direction and position. The average operation time for our patients was 63 minutes. This time is not relatively short, but the procedures involved a well-trained surgeon and a trauma surgeon with less experience in arthroscopy. The main disadvantage of this method is the need for hardware to remain. Five of our cases under 20 years underwent a second operation to remove these devices. However, the presented cases in our current cohort had no growth problems, hardware failures or related pain.

A DSP is usually used for the purpose of ACL reconstruction surgery and has been reported to have excellent stability and maintenance of tension. Previously reported suture methods for the treatment of fractures typically involve knot-tying onto the anterior tibial surface. However, this technique may cause loosening or rupture of the nonabsorbable suture. Anderinto et al[21] treated 63 patients using conservative treatment, but reported that 14 knees (22%) developed symptomatic instability. Knee stiffness is common in surgically treated patients and it has been reported that rigid fixation is necessary to enable an early and aggressive rehabilitation. We believe that our surgical method presented herein can achieve rigid fixation although a tibial eminentia fracture is a relatively rare fracture and we cannot really compare our technique with other methods. Our presented method has the following advantages: (1) there is no intra-articular fixation device; (2) utility when the proximal fragment is small; and (3) can be applied in adults and in children.

In conclusion, we describe a method for treating a tibial intercondylar fracture that can be easily performed and reproducibly achieves secure fixation and early mobilization of the knee.

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