ORIGINAL STUDY

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Is arthroscopic assisted double tibial tunnel fixation a good option for tibial eminentia fractures?

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Tibial eminentia fractures are avulsion fractures of the anterior cruciate ligament caused with additional injuries like meniscus tears or ligamentous injuries. Arthroscopic assisted internal fixation has become a preferred technique with the development of arthroscopic techniques. We aimed to present our results for arthroscopic assisted double tibial tunnel fixation in patients with displaced eminentia fracture. Twenty patients who were operated on for eminentia fracture between January 2010 and May 2014 were included in this study. All fractures were type II according to Meyers's classification. Eminentia was reduced with two nonabsorbable sutures through the ACL. Two tibial tunnels were created over the medial proximal tibia with a 2.4 mm cannulated drill. The two suture ends taken out of the 2 tibial tunnels were connected on the bone bridge between the tunnels. Patients were evaluated with Lysholm score, Tegner score, IKDC score and examined for clinical and radiological evidence of bony union. Quadriceps exercises were started on the third day. The patients were followed up with a locked knee brace in extension for 3 weeks after surgery and later patients were encouraged to mobilize as pain allowed. The preoperative Lysholm score was 75 ±3.3 and the postoperative Lysholm score was 94.5 ±3. Tegner score was 3.52±1.02 preoperatively and 6.84±1.099 postoperatively. International Knee Documentation Committee(IKDC) score was abnormal in all of the 20 patients preoperatively but normal postoperatively. The postoperative scores of the patients were statistically significant when compared with preoperative activity scores(p<0,0001). Tibial eminentia fractures may lead to pain, knee instability, malunion, laxity, or extension deficit. The technique we have described together with early rehabilitation may give good clinical results.

Keywords : Eminentia fractures, arthroscopic, double tibial tunnel, early rehabilitation.

INTRODUCTION

Tibial eminentia fractures (TEF) are avulsion fractures due to the pull of the anterior cruciate ligament (ACL). TEF was defined by Poncet in 1875[1] and mostly seen in pediatrics[2] as a result of sports[3] due to incomplete ossification of tibial eminence. It may also be caused by high-energy trauma in adults with additional injuries like meniscus tears or ligamentous injuries[4,5]. This injury accounts for 2% to 5% of all adult knee injuries[1,6]. Eminentia fractures may lead to pain, knee instability, malunion, laxity, or extension deficit due to the displacement of the fracture segment without anatomic reduction and fixation[7].

According to Meyers and McKeever classification system Type I is minimally displaced(<3mm), type II is minimally displaced with an intact posterior hinge, and type III represents a complete displacement of the fracture fragment[8]. Zaricznyj[9] described type IV which corresponds to displaced and comminuted fracture.

Current literature achieved a consensus about undisplaced fractures. Authors suggest conservative management with a knee cast or splint in extension or mild flexion for 6–12 weeks. Authors suggest surgical reduction for displaced fracture is still encouraged due to the high incidence of complications with non-operative treatment[10]. Arthroscopic assisted internal fixation has become a recommended technique with the development of arthroscopic techniques, especially for types III and IV and also non-reducible type II, and chronic displacement of type I injuries[11].

In our study, we aimed to present our results for technique of arthroscopic assisted double tibial tunnel fixation in patients with displaced eminentia fracture. Generally, there are lots of studies about intraarticular fixation of eminentia fractures arthroscopically in current literature, but the cases with fixation outside the joint with the help of double tibial tunnel with large patient data and good results, as in our study, have not been reported yet as far as we know.

MATERIAL AND METHODS

Twenty patients with eminentia fracture between January 2010 and May 2014 were included The fracture mechanism was a sport-related injury for 16 patients and car accident-related injury for 4 patients. All patients were male. The mean age was 32.4 (range 22-44). The time from the injury to the arthroscopic operation was 3-7 days (mean 5 days). All fractures were type II according to Meyer's classification(Figure 1). All patients were followed up for 3 years. 6 patients had a lateral meniscus tear and 4 had chondral lesions at the medial femoral condyle additionally. We did the meniscal repair using inside-out suture repair and applied microfracture to chondral lesions during the arthroscopic procedure.

The patients were followed with a locked knee brace in extension for 3 weeks postoperatively. Patients were evaluated with Lysholm score, Tegner score, International Knee Documentation Committee (IKDC) score and examined for clinical and radiological evidence of bony union at final follow-up. An informed consent form was signed by all patients, and the institutional review board approved our study. All reported research involving "Human beings" was conducted in accordance with the principles set forth in the Helsinki Declaration 2008.

Operations were performed under general anesthesia with the patient in the supine position. A tourniquet and leg holder were used. Standard high anteromedial and anterolateral portals were created allowing us to see and interfere with the entire fracture bed. Hemarthrosis was evacuated, and the knee joint was washed to obtain a good image. Diagnostic arthroscopy was performed. Intervention for associated meniscus tears was performed if needed. The ACL was carefully examined because the ligament laxity may cause plastic deformation if the associated partial intrasubstance tears are missed. The fracture fragment was examined with a probe, elevated, and then the fracture bed was cleared. Anterior horn of the meniscus or the intermeniscal ligament may impede reduction and needs to be manipulated to reduce the fractured tibial spine. Fat pad debridement and partial intermeniscal ligament excision were performed to clear visualization and to prevent these structures from entering the fracture line.

The reduction was achieved with trans patellar oriented Kirschner wire for provisional fixation. Keeping the knee in extension facilitates the reduction of the fracture fragment. A 2 cm anteromedial incision was made over the medial proximal tibia. The tibial guide used for anterior cruciate ligament surgery (Smith & Nephew Endoscopy®, Andover, MA) with a tip aimer set at 55 degrees was used to ease drilling from the medial side of the tibia. The tibial guide was oriented to help create two parallel tibial tunnels just anteromedially and anterolaterally to the fracture fragment. Tibial tunnels were created with a 2.4 mm cannulated drill.

A nonabsorbable suture (Ethibond No. 2, Johnson & Johnson®, Somerville, NJ, USA) from the medial portal was inserted with a suture passing device to shuttle through the most distal part between the

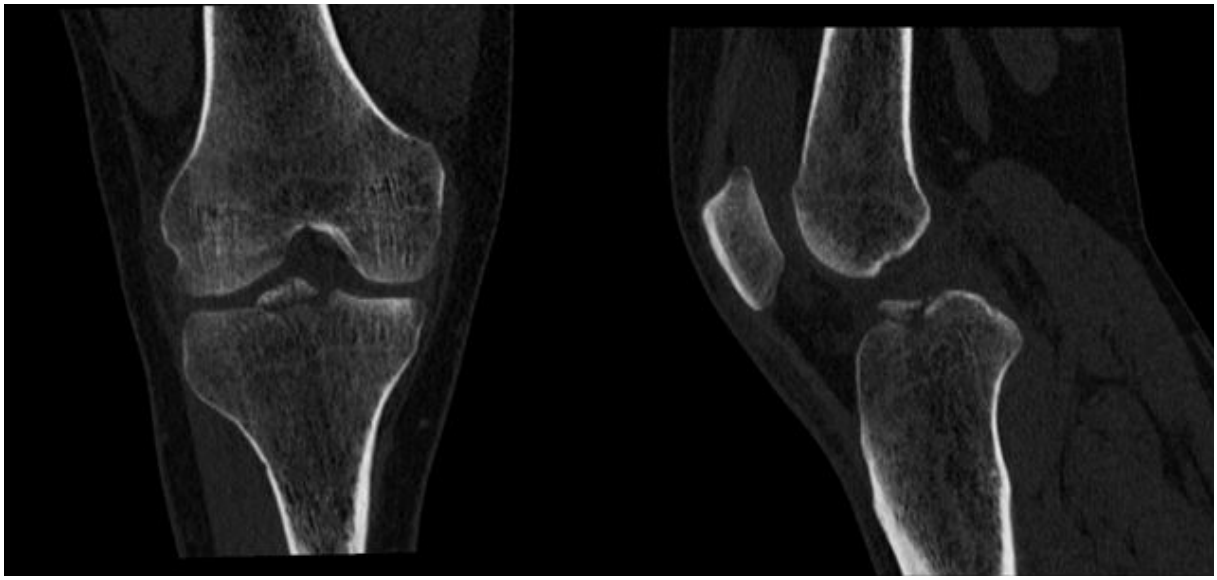

Fig. 1 — Preoperative X-ray of the one of our patients.

substance of ACL and eminentia. 2 free limbs of the suture were shuttled and retracted from the lateral tibial tunnel with a suture retriever to form a crossing pattern. Another colored suture was placed in the same way but this time from lateral to medial. Free limbs of the suture were retrieved from the medial tibial tunnel with a suture retriever to provide a cross pattern and thus the fracture was squeezed between the sutures. The 2 free-end pairs, were tightly attached over the bone bridge on the tibia and then they tightened each other to prevent the threads from loosening (Figure 2). Fluoroscopic images and postoperative radiographs were taken to confirm reduction.

RESULTS

Patients were followed with a knee brace locked in extension after surgery. The drain was removed on the second postoperative day and on the third-day patients were encouraged to mobilize as pain allowed and quadriceps exercises were started. Follow-up radiographs were taken to show that all patients had radiological union of the eminentia fracture (Figure 3).The preoperative Lysholm score was 75 ±3.3 and the postoperative Lysholm score was 94.5 ±3. Tegner score was 3,52±1.02 preoperatively and 6.84±1.099 postoperatively. IKDC score was abnormal in all of 20 patients preoperatively but normal postoperatively. The postoperative scores of the patients were statistically significant when compared with preoperative activity scores($p<0,0001$).

DISCUSSION

Tibial eminence fractures include bone avulsion from the insertion of the ACL at the tibial eminence. Treatment options include either operative or non-operative methods according to the displacement. Tibial eminence fractures have been classified according to Meyers and McKeever classification system[8]. There is minimal displacement in Type 1 injuries. Type 2 accounts for one-third or half of the eminence elevation, Type 3 defines the complete separation of the elevated fragment from the tibial bony bed, and Type 4 is used for comminuted fractures. Type 2 and others are displaced fractures and they have the risk for nonunion or malunion and consequently knee extension loss[12]. Conservative treatment is the only choice for Type 1 fractures. Current literature has achieved a consensus on conservative management with a knee cast or splint in extension or mild flexion for 6–12 weeks for undisplaced fractures but there is no consensus on the treatment of type 2 fractures. Either operative or non-operative treatment is acceptable for this type of fracture. There is a clear surgical indication for Type 3 and Type 4 fractures[13].

Surgical options for displaced tibial spine fractures include closed reduction and cast immobilization, open reduction and internal fixation, arthroscopic assisted reduction, and internal fixation. Open surgery has a higher risk of developing postoperative knee stiffness, higher postoperative pain, and a longer hospital stay compared with arthroscopic methods[10].

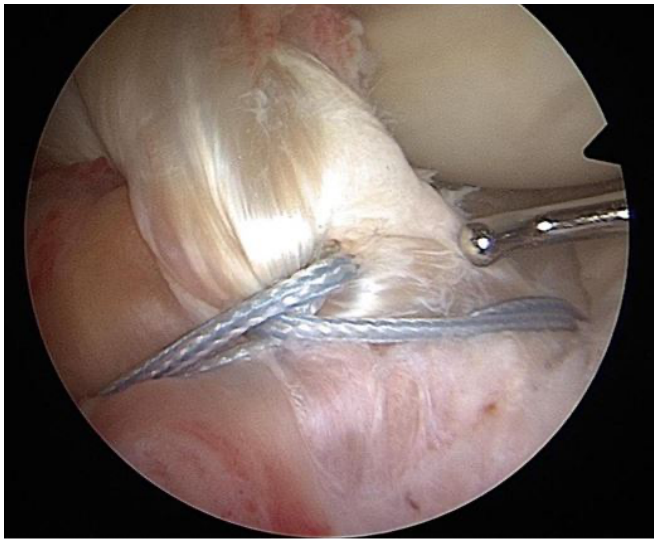

Fig. 2 — Ethibond No. 2 from medial portal were inserted with suture passing device to shuttle through the most distal part between substance of ACL and eminentia to form a neckwear knot around the ACL adjacent to the fracture fragment.

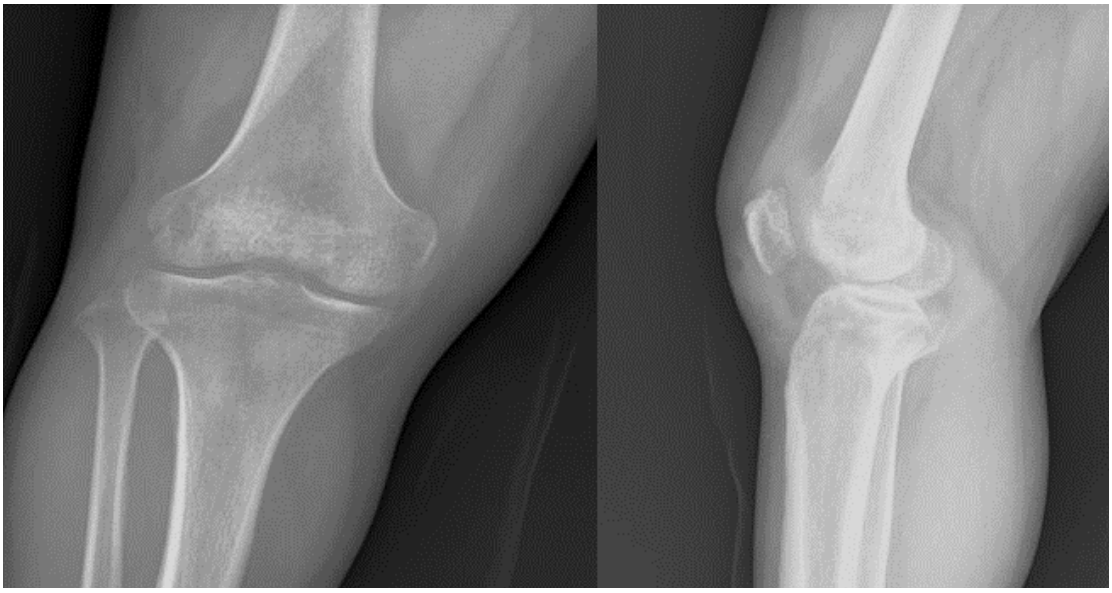

Fig. 3 — Postoperative view of one of our patients.

Arthroscopic assisted internal fixation became a preferred technique with the advances in arthroscopic devices and minimally invasive techniques especially for types III and IV, non-reducible type II, and chronic displacement of type I injuries[11,14].

There have been different techniques published about arthroscopic-assisted reduction and internal fixation like absorbable surgical suture of the fragment, fixation with a wire knot, fixation with a cannulated screw either antegrade or retrograde, staples, fixation with K-wire, stabilization using absorbable elements, etc. Generally, there are studies about intraarticular fixation of eminentia fractures in current literature[10,11], but the cases with fixation outside the joint with the help of a double tibial tunnel without fixation in the tibial tunnel have not been reported yet as far as we know.

Screws and suture fixations are currently the most used surgical techniques[10]. Fixation with a screw is contraindicated in small and multi-part fractures and may lead to fragmentation and further displacement[15]. The most important advantage of our technique is that it is applicable to all tibia eminentia fractures regardless of the degree of displacement because we fixate fracture combined with an amount of soft tissue at ACL's insertion site. Such a fixation causes direct compressive forces to be loaded onto the fracture fragment.

Berg[16] reported a case study he treated with the help of a double tibial tunnel like our technique. He performed surgery after 3 weeks to avoid arthrofibrosis, but unluckily he was faced with a loss of joint motion. He performed arthroscopy to one of his patients and discovered extensive intra-articular arthrofibrosis. He named this as "failure of arthroscopic treatment". Today, our views on arthrofibrosis have changed. There are studies suggesting that reconstruction performed within the first week after an injury can safely be performed without increased risk of arthrofibrosis[17-19]. On the contrary, long-term immobilization alone is considered to be a risk factor[17]. To prevent this complication and to achieve successful results, we performed early surgery and then mobilized patients on the postoperative third day to prevent this complication and to achieve successful results. The study of Berg differs from our study when considering both the time of surgery and the postoperative rehabilitation program.

The technique we described has some limitations. ACL tension needs to be well adjusted while applying this technique. If the ACL is fixed at a more proximal point, this may lead to shortening of the ACL and reduced knee motion. Another weak point of our study is the possibility of relaxation outside the tunnel. In order to prevent this, we firmly tied together the limb of the suture that came from the most medial of the tibial tunnel and the limb that came from the most lateral of the tibial tunnel. Then we tied the remaining two free ends firmly. We have tightened the free ends that remain on the knots at the end. Although, arguably, we did not compress the sutures in the tibial tunnel with additional fixation devices., we did not find any loosening of the sutures until we detected the fracture union radiologically.

Another limitation of our study is that only adult patients were included. Opening the tibial tunnels

to remain inside the epiphysis will prevent direct iatrogenic physeal injuries. More detailed studies are needed on this subject.

CONCLUSION

Tibial eminence fracture in an adult is not a benign disorder[16] and may lead to pain, knee instability, malunion, laxity,or extension deficit. The technique we have described together with early rehabilitation may give good clinical results.

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