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Anteromedialisation tibial tubercle osteotomy for recurrent patellar instability in young active patients: A retrospective case series☆

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ABSTRACT

Introduction: Recurrent patellar instability can be a source of continued pain and functional limitation in the young, active patient population. Instability in the setting of an elevated tibial tubercle–trochlear groove (TT–TG) distance can be effectively managed with a tibial tubercle osteotomy. At the present time, clinical outcome data are limited with respect to this surgical approach to patellar instability.
Methods: A retrospective chart review was performed to identify all cases of tibial tubercle osteotomy for the management of patellar instability performed at our institution with at least 1 year of post-operative follow-up. Patient demographic information was collected along with relevant operative data. Each patient was evaluated post-operatively with their outcomes assessed utilising a visual analogue score of pain, patient satisfaction, Tegner Activity Scale and Kujala score.
Results: 31 patients (23 females and 8 males) with mean age of 27 years (17–43 years) and a mean BMI of 26.3 kg/m^2 (19.6–35.8) at time of surgery who underwent a tibial tubercle osteotomy as treatment for recurrent patellar instability were identified. The cohort had a mean follow up of 4.4 years (1.5–11.8 years). The mean pre-operative TT–TG distance was 18 mm (10–22 mm). The mean VAS pain score demonstrated a significant improvement from 6.8 (95% CI 6.1–7.5) at baseline to 2.8 (95% CI 1.9–3.7) post-operatively ($p < 0.001$). The Tegner score improved from 4.1 (95% CI 3.4–4.8) pre-operatively to 5.2 (95% CI 4.5–5.9) at the time of final follow up ($p < 0.04$). The Kujala score for anterior knee pain improved postoperatively from 62 (95% CI 55.4–68.7) to 76.5 (95% CI 69.5–83.5) at final follow up ($p < 0.001$). 26 of the 31 patients (83.8%) had good to excellent Kujala scores. 27 of 31 patients (87.1%) reported that they would undergo the procedure again if necessary.
Conclusion: For the management of recurrent patellar instability in the setting of an increased tibial tubercle–trochlear groove distance, a corrective tibial tubercle osteotomy is an effective treatment modality to reliably prevent patellar instability while reducing pain and improving function in this cohort of young, active patients.

Introduction

Recurrent patellar instability can be a source of continued pain and functional limitation in the young, active patient population. Acute patellar dislocations are one of the most common knee injuries, encompassing 2–3% of all knee injuries [1] and occurring in 5.8 per 100,000 individuals [2,3]. These are associated with acute trauma, frequently from sporting and physical activities occurring while in terminal extension with an axial–valgus stress on the knee during rotation [4]. Recurrence rates have been reported to be as high as 15–44% following nonoperative management and often surgical intervention is required [5].

Many soft tissue procedures have been described for the management of recurrent patellar instability including lateral release [6], medial imbrications [7,8] and medial patellofemoral ligament (MPFL) reconstruction [9,10]. With careful indications, Shelbourne et al. [7] showed that medial imbrications can successfully re-establish normal patellofemoral alignment and an 87% rate of return to preinjury activity level. Recently, MPFL reconstruction has become popular as a first-line treatment for patellofemoral instability [11,12].

However, instability in the setting of an elevated tibial tubercle–trochlear groove (TT–TG) distance can be effectively

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managed with a tibial tubercle osteotomy with or without an associated medial patellofemoral ligament reconstruction. As our understanding of patellofemoral biomechanics has evolved, tibial tubercle transfer procedures have improved as well. From the original description by Hauser in 1938 [13] to the current modified Fulkerson method [14,15], these transfers have been progressively more effective in resolving instability. We present our outcomes on consecutive patients who underwent tibial tubercle osteotomy for patellar instability.

Materials and methods

After obtaining IRB approval, a retrospective chart review was performed to identify all cases of tibial tubercle osteotomy performed by three fellowship trained surgeons at our institution with at least 1 year of post-operative follow-up. Exclusion criteria included neurological deficit and previous osteotomy. Inclusion criteria included patients over the age of 18 at time of consent treated with tibial tubercle osteotomy for the management of recurrent patellar instability. Between 2002 and 2013, 34 patients were identified who met all inclusion and exclusion criteria. Four patients were unable to be reached for follow up evaluation and were excluded from the study.

Patient demographic information including age at the time of surgery, gender, and body mass index (BMI) was collected along with relevant operative data including concomitant procedures and intraoperative complications. TT–TG distance was also collected from patients' charts. Each patient was evaluated post-operatively with their outcomes assessed utilising a visual analogue score of pain (VAS), the Tegner Activity Scale and the Kujala score for anterior knee pain [16]. Additionally, patient satisfaction with their operative outcome was evaluated by asking whether or not they would have the procedure again if necessary. Data analysis was performed using the Student's *T*-test for the Kujala, Tegner, and VAS. Pearson's chi-squared test was performed for the TT–TG distance. Subgroup analysis was compared using an Analysis of Variance (ANOVA). p Values <0.05 were considered significant.

Surgical technique

The anteromedialisation tibial tubercle osteotomy procedure (AMZ) was first described by Fulkerson in 1983 which moves the patella from tracking laterally and thus unloads the lateral patella. In our institution, the AMZ is performed using the Arthrex® T3 AMZ system.

We begin by making a longitudinal skin incision that extends from the inferior patellar pole to the tibial tuberosity. Subcutaneous flaps are developed and an incision is made lateral and medial to the patellar tendon. The Tuberosity Pin Guide is used to insert a guide pin perpendicular to the posterior wall of the tibia in the centre of the tibial tuberosity below the level of Gerdy's tubercle. The cutting guide is then positioned over the Tuberosity Pin. The Cutting Block is positioned medial to the tuberosity in a posteromedial to anteromedial orientation as it travels distally. Two T3 AMZ Breakaway Pins are then into the middle slots of the Cutting Block. At this time, the Horizontal guide and Tuberosity Pin are removed, leaving only the Cutting Block in position along the anteromedial aspect of the proximal tibia. After a final check, the collared breakaway pin is placed in the centre hole and the excess breakaway pins are snapped off. We protect the soft tissue of the patella tendon using a retractor and make appropriate cuts using a sagittal saw without fully detaching the tuberosity. Next, we remove the Cutting Block is removed, exposing the completed proximal osteotomy. The osteotomised tibial tuberosity is transferred medially along the plane of the cut the necessary distance to correct the patient's TT–TG distance to 10 mm. The transferred tibial tuberosity is fixed in position using two 4.5 mm cannulated bicortical screws (Figs. 1–3).

Results

31 patients (23 females and 8 males) with mean age of 27 years (range 17–43 years) and a mean BMI of 26.3 kg/m^2 (range 19.6–35.8 kg/m^2) at time of surgery who underwent a tibial tubercle osteotomy as treatment for recurrent patellar instability were identified. 3 patients had bilateral procedures. The cohort had a mean follow up of 4.4 years (range 5–11.8 years). Concomitant procedures included 10 associated MPFL reconstructions, 6 autologous chondrocyte implantations (ACI), 8 VMO plications, and 1 with both a MPFL reconstruction and an ACI (Table 1). If the MPFL was not torn on the preoperative MRI, it was not reconstructed and various soft-tissue procedures such as a lateral release or medial reefing were performed as needed. The mean pre-operative TT–TG distance was 18 mm (range 10–22 mm). Two patients had TT–TG distances in the normal range (10 mm and 12 mm, respectively) but were indicated secondary to patellar instability coupled with a chondral defect requiring ACI.

The mean VAS pain score demonstrated a significant improvement from 6.8 (95% CI 6.1–7.5) at baseline to 2.8 (95% CI 1.9–3.7) post-operatively ($p < 0.001$). The Tegner Activity Scale score improved from 4.1 (95% CI 3.4–4.8) pre-operatively to 5.2 (95%

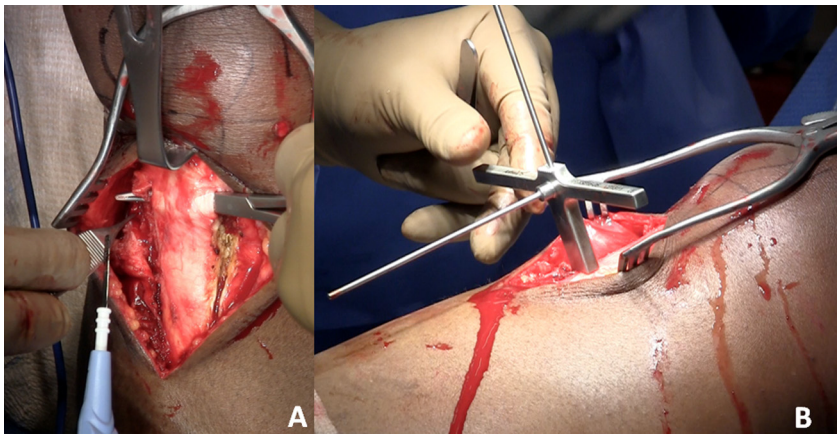

Fig. 1. The approach to the patellar tendon and tibial tubercle is carried through a 10 cm longitudinal incision, isolating the patellar tendon (A). A guide pin is initially placed perpendicular to the posterior wall of the tibia (B).