

# Combined Tibial Tubercle Osteotomy and Medial Patellofemoral Ligament Reconstruction for Recurrent Lateral Patellar Instability in Patients With Multiple Anatomic Risk Factors

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**Purpose:** To report the outcomes for combined tibial tubercle osteotomy (TTO) and medial patellofemoral ligament (MPFL) reconstruction and assess for potential risk factors for recurrent instability and/or poor outcomes. **Methods:** The medical record at our institution was reviewed for patients treated with MPFL reconstruction and TTO for recurrent lateral patellar instability from 1998 to 2014. Preoperative imaging was assessed for trochlear dysplasia according to the Dejour classification (high grade = B, C, D) and the presence of patella alta using the Caton-Deschamps ratio ( $>1.2$ ). The indication for combined MPFL reconstruction and TTO was MPFL insufficiency and a lateralized tibial tubercle. Outcomes were determined by recurrent instability, return to sport, and Kujala and International Knee Documentation Committee (IKDC) scores. **Results:** Thirty knees in 28 patients (14 M, 14 F) with a mean age of  $22.6 \pm 9.1$  years (range, 13-51 years) were included with a mean follow-up of  $48 \pm 28$  months (24-123 months). Seventy-three percent (22/30) had high-grade trochlear dysplasia, and 63% (19/30) had patella alta. One patient had a postoperative dislocation and 1 had a subluxation event. The Caton-Deschamps ratio decreased by a mean of 0.2 ( $P = .001$ ), leaving 30% with postoperative patella alta. The mean postoperative scores were as follows: Tegner =  $5 \pm 2$ , Kujala =  $89 \pm 16$  (45-100), and IKDC =  $85 \pm 17$  (44-100). Eighty-three percent (15/18) returned to their preoperative sport. Female gender was a risk factor for lower IKDC (77.3 vs. 92.6,  $P = .01$ ) and Kujala (82.2 vs. 95.0,  $P = .03$ ) scores. Medialization greater than 10 mm was directly correlated to lower IKDC ( $P = .02$ ) and Kujala ( $P = .01$ ) scores. **Conclusions:** The combination of MPFL reconstruction and TTO in patients with trochlear dysplasia results in low recurrence of instability. Patients on average had good subjective outcomes and were able to return to sport. Female gender and tibial tubercle medialization greater than 10 mm were associated with worse outcomes. **Level of Evidence:** Level IV, therapeutic case series.

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Patellar instability is a debilitating condition that affects both activities of daily living and sports participation. Patellofemoral stability depends on the relation between the osseous and soft tissue anatomy in addition to dynamic muscular control and overall limb alignment. The medial patellofemoral ligament (MPFL) provides 50% to 60% of restraint against lateral subluxation from  $0^\circ$  to  $30^\circ$ .<sup>1</sup> The MPFL is disrupted with a patellar dislocation, and reconstruction has been shown to be effective in restoring stability in numerous studies<sup>2</sup>; stability is achieved through patellar engagement within the trochlear groove as flexion progresses. However, MPFL reconstruction alone is prone to failure when the tibial tubercle is abnormally lateralized.<sup>3</sup> A tibial tubercle to trochlear groove (TT-TG) distance greater than 20 mm is a well-accepted risk factor for patellar maltracking and subluxation.<sup>1</sup> Tubercle medialization with a tibial tubercle osteotomy (TTO) is an

effective distal procedure to stabilize the patella by decreasing the angle of patellar engagement.<sup>4</sup> The tubercle can also be distalized to correct patella alta<sup>5</sup> and anteriorized to decrease patellofemoral contact forces.<sup>6</sup> With smaller patients, lesser TT-TGs could result in a relatively higher amount of clinical lateralization and therefore also benefit from medialization.

Approximately 85% of patients with recurrent patellar instability have some degree of trochlear dysplasia.<sup>7</sup> The severity of trochlear dysplasia has been associated with worse subjective outcomes despite adequate correction of instability.<sup>8</sup> Although some authors cautiously recommend trochlear groove deepening or lateral facet elevation for cases of severe dysplasia,<sup>5</sup> correction of tubercle malalignment may be sufficient compensation to avoid the morbidity associated with trochleoplasty.<sup>9</sup> Furthermore, the long-term outcomes for this more invasive procedure are currently lacking.<sup>10</sup>

MPFL reconstruction and TTO have been independently reported to be effective in reducing instability episodes, but information on combined treatment is sparse, especially in the setting of multiple instability risk factors such as trochlear dysplasia. The purpose of this study was to report the outcomes for combined TTO and MPFL reconstruction and assess for potential risk factors for recurrent instability and/or poor outcomes. We hypothesized that patients who undergo MPFL reconstruction with TTO would have satisfactory outcomes and low rates of recurrent patellar instability despite the presence of trochlear dysplasia.

## Methods

The local institutional review board approved this retrospective study (IRB 15-000601) and informed consent was obtained from all patients. The medical record at the institution was reviewed for patients treated with simultaneous TTO and MPFL reconstruction by a sports medicine trained surgeon between 1998 and 2014. All patients had failed a comprehensive nonoperative program and were required to have a minimum of 2-year follow-up for outcome scores. Exclusion criteria included previous TTO and trochleoplasty. The records were reviewed for preoperative data including the age at the time of surgery, body mass index (BMI), dislocation history, previous operations, and Tegner score. Preoperative radiographs were reviewed for patellar tilt and height as well as sulcus and congruence angles. Patellar height was determined using a Caton-Deschamps ratio (CDR) with patella alta defined as a ratio greater than 1.2. The presence of trochlear dysplasia was determined based on true lateral radiographs and axial magnetic resonance imaging (MRI) or computed tomography (CT) slices. The Dejour classification was used to define no, low (A), or high grade (B, C, D) dysplasia.<sup>11</sup> Given the good interobserver reliability reported for this dichotomous classification,

radiographs and axial images were reviewed by a single orthopedist.<sup>11</sup> Preoperative TT-TG distance was determined from CT when available or MRI axial images. Measurements were performed by a musculoskeletal radiologist. Postoperative radiographs were reviewed for patellar height. Degenerative changes were not assessed. Operative chart data included MPFL graft type, amount and direction of TTO movement, cartilage status at the time of arthroscopy using Outerbridge scoring,<sup>12</sup> and concomitant procedures. Postoperative chart data included osteotomy union, Tegner score, return to sport, surgical complications, instability, and reoperations.

Subjective patient outcome was obtained via Kujala and International Knee Documentation Committee (IKDC) scores based on the most recent follow-up for all patients.

All surgeries were performed arthroscopically assisted by 1 of 3 specialized sports medicine orthopaedic surgeons at an academic medical center. The indications for the procedure were chronic lateral patellar instability that had failed nonoperative management in the setting of MPFL insufficiency and a lateralized TT defined as a TT-TG > 20. A TT-TG > 15 was a relative indication in the presence of lateral patellar chondromalacia to allow simultaneous anteriorization.<sup>13</sup> All patients had a similar MPFL reconstruction procedure and TTO. Our method for MPFL reconstruction has been described previously.<sup>2</sup> The specific MPFL graft type and fixation method were chosen according to surgeon preference. The TTO was performed first, and the tubercle was medialized until the patella tracked centrally. The TT was anteriorized if the patient had evidence of lateral patellar chondromalacia and was distalized if patella alta caused delayed patellar engagement. MPFL reconstruction was then performed to add a restraint against lateral instability. The final amount and direction of TT movement was based on surgeon assessment and individual patient anatomy. A lateral release was performed if a tight lateral retinaculum created tension on the MPFL reconstruction or prevented patellar tilting to neutral.

## Postoperative Rehabilitation

Patients followed a standardized postoperative rehabilitation protocol with regularly scheduled office visits. In the first 2 weeks after surgery, patients were partial weight-bearing and performed range of motion exercises with active flexion and passive extension. Progression to full weight bearing was permitted 6 weeks after surgery. Return to sport training was initiated at 4 months with a goal of unrestricted return to play by 6 months. Ultimate time for sport clearance was based on obtaining symmetric lower extremity strength and having satisfactory performance on functional tests. Patients were seen for regularly scheduled follow-up in monthly intervals for the first year and then on an annual basis unless complications arose.

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