Femoral Trochleoplasty for Recurrent Patellar Dislocation: Treating the Underlying Trochlear Dysplasia

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Abstract
The patellofemoral joint presents a complex biomechanical interaction involving soft tissues and bony structures to maintain joint stability. The most relevant factor is trochlear dysplasia which is present in 85% of patients. Femoral trochleoplasty is a surgical procedure to recreate the trochlear groove. This case report describes a young patient who had all clinical factors of patellar instability and trochlear dysplasia. Radiology studies showed trochlear dysplasia type C according to the Dejour classification. The patient underwent a trochleoplasty with an elevated flap of cartilage and subchondral bone as described by Ryzek and Schöttle [J Knee Surg]
2015;28(4):297–302], associated with the reconstruction of the medial patellofemoral ligament. Femoral trochleoplasty is a surgical procedure to recreate the trochlear groove by removing subchondral bone to create a new trochlear sulcus, while respecting the kinematics and biomechanics of the patellofemoral joint.

**Introduction**

The patellofemoral joint presents a complex biomechanical interaction involving soft tissues and bony structures to maintain joint stability. Static stabilizers (bone and cartilage), passive stabilizers (ligaments and articular capsule), and finally active stabilizers (muscles and tendons) all interact to provide patellofemoral stability [1–3]. Four important factors for instability and anterior knee pain are trochlear dysplasia, quadriceps dysplasia, patella alta, and a distance between the tibial tuberosity and the trochlear groove (TT-TG) >20 mm.

The most relevant factor in recurrent patellar dislocation is trochlear dysplasia which is present in 85% of patients [2]. Dejour and Saggin [4] classified it into 4 types with higher degrees of dysplasia correlating with early patellar dislocation/subluxation [5]. In trochlear dysplasia, the patella cannot engage properly and tends to track laterally in knee extension or early flexion [3].

Radiological evaluation of the patellofemoral joint includes anteroposterior, lateral, and skyline (30°) plain X-rays and a CT scan. Sometimes, an MRI is also needed to better evaluate soft tissue and cartilage lesions [6].

Femoral trochleoplasty is a surgical procedure to recreate the trochlear groove by removing subchondral bone to create a new trochlear sulcus, while the kinematics and biomechanics of the patellofemoral joint can be restored without damages to the cartilage surface [7]. Other procedures can be employed to address concomitant pathologies.

**Case Report**

A 23-year-old Caucasian man, referred by a physician assistant, presented with a history of bilateral patellar instability and recurrent dislocation of the right knee. He had been treated conservatively with nonsteroidal anti-inflammatory drugs and physical therapy for months, but residual laxity and patellofemoral instability remained. The complaints were anterior knee pain for initial gait and walking upstairs and downstairs. He had stopped doing sports. Clinically, he presented the major signs of objective patellar instability bilaterally [8]: abnormal patellar tracking with "J" sign, patellar apprehension test positive, and patellofemoral pain.

Lateral radiographs of the right knee confirmed a patella alta (Caton-Deschamps index 1.21), a crossing sign, and a type C trochlear dysplasia (Fig. 1). CT scan assessment demonstrated a normal TT-TG distance (10 mm) with a flat and incongruent trochlea (International Cartilage Regeneration and Joint Preservation Society [ICRS] grade 1a).

At surgery, we observed good patellar cartilage status (Outerbridge I), normal femorotibial joint cartilage, and no ligament or meniscus injuries. Trochleoplasty was done through a lateral approach, an elevated flap of cartilage and subchondral bone, and shaving the new sulcus with a burr as described by Ryzek and Schöttle [9] (Fig. 2a, b). The fixation was performed using 3-point anchors linked with absorbable #2 Vicryl (Fig. 3a, b).
Medial patellofemoral ligament (MPFL) reconstruction was performed according to Schöttle et al. [10] using a gracilis tendon allograft (Hema-Quebec, Quebec City, QC, Canada) and 2 SwiveLock screws (Arthrex Inc., Naples, FL, USA) on the medial patellar edge and a 6-mm BioComposite interference screw (Arthrex Inc.) on the femur.

Rehabilitation started within 2 weeks of surgery, with range of motion (ROM) and loading as tolerated. On the first follow-up visit (6 weeks postoperatively), the patient presented with minor pain (visual analogue scale 2/10), walking without crutches, functional ROM (−5°/120°), quadriceps weakness (4/5), and no “J” sign. At 5 months of follow-up, he presented no subjective or objective patellar instability, improved quadriceps force (5/5), visual analogue scale <2/10, and complete ROM (0/135°), and he had returned to regular work and physical activities. Radiological evaluation 6 months postoperatively showed an improved patellotrochlear congruence of the trochlear groove when comparing patellofemoral angles [11] before and after surgery: sulcus angle (168°/143°); patellar tilt angle (10°/4°); lateral patellofemoral angle (−2°/6°); congruence angle (9°/−2°), and lateral patellar displacement (7 mm/1 mm). The trochlear osteochondral flap presented bony consolidation without chondrolysis and mild cartilage loosening (ICRS grade 2).

Discussion

Patellofemoral instability is more frequent in teenagers and young adults. Trochlear dysplasia modifies knee biomechanics, resulting in patellar maltracking, instability, and late osteoarthritis [12].

The main goal of trochleoplasty is to create a deeper sulcus in the trochlear groove, thus restoring patellofemoral anatomy to improve articular congruence and patellofemoral tracking [13]. This can be observed clinically as the disappearance of the “J” sign. Associated procedures, including cartilage repair, patella alta correction, and MPFL reconstruction, should all be identified and planned before surgery.

According to Banke et al. [3], an improvement in all scores (International Knee Documentation Committee [IKDC], Lysholm Knee Scoring Scale, and Knee Injury and Osteoarthritis Outcome Score [KOOS]) is observed after treatment for chronic patellofemoral instability with sulcus-deepening trochleoplasty combined with MPFL reconstruction. McNamara et al. [14] described 83% of satisfaction in patients submitted to a combined procedure of trochleoplasty and MPFL reconstruction.

Severe trochlear dysplasia and related patellofemoral instability are both corrected by deepening trochleoplasty procedures. Short- and long-term functional outcomes improve after surgery, but the issue of preventing long-term osteoarthritis remains unresolved in these patients [15]. Mild to severe degenerative changes appear in 73% of patients, and patellofemoral pain increases in 33.4% of patients as reported by von Knoch et al. [16]. On the other hand, the natural history of untreated trochlear dysplasia shows an evolution towards patellofemoral osteoarthritis and chronic pain [17].

Trochleoplasty is a complex procedure and can be very daunting to perform. It can lead to various complications. Camathias et al. [18] described recurrent patellar dislocations associated with isolated trochleoplasty outcomes. Precise planning is needed before the surgery to avoid uncommon complications, such as articular surface damages, overcorrection, and recurrent instability [11].
Conclusion

This case report demonstrates that trochleoplasty is a very effective procedure for correcting trochlear dysplasia associated with patellofemoral instability, recurrent dislocation, and anterior knee pain. Careful preoperative planning should be done to determine concomitant procedures. When performed in conjunction with specific soft-tissue procedures like MPFL reconstruction, it can often eliminate patients’ instability and the risk of dislocation under normal circumstances.

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Fig. 1. Preoperative imaging. Lateral knee X-ray showing patella alta with Caton-Deschamps index 1.21 and trochlear dysplasia with a crossing sign and a double contour (arrows) (a); axial CT scan presenting a flat trochlear groove (b) and intra-operative arthroscopic trochlear view (c).
Fig. 2. Surgical procedure through a lateral approach and peripheral osteotomy (a); shaving and deepening of subchondral bone (b) and external view of the new trochlear groove fixed with Vicryl #2 (c).
Fig. 3. Postoperative imaging. Lateral knee X-ray showing the new trochlear anatomy without crossing sign or double contour (a); axial CT scan presenting a deep trochlear groove, preserved cartilage, and a well-aligned patella (b) and arthroscopic view showing the final result of a deep, anatomical trochlear groove with Vicryl #2 fixation (c).