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Original article

Patellofemoral reconstruction for patellar instability with patella alta in middle-aged patients: Clinical outcomes

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ABSTRACT

Introduction: Although several surgical treatments for patellar instability with patella alta have been reported, the clinical outcomes and optimal surgical procedures for patellar instability with patella alta in middle-aged patients are still controversial. We hypothesized that optimal surgical procedures for patellar instability with patella alta in middle-aged patients may induce good clinical outcomes with better patellofemoral geometry.

Materials and methods: Twelve middle-aged patients with a mean age of 44 years (range: 40–55 years), who presented with patellar instability and patella alta, were treated with a combination of several surgeries, such as medial patellofemoral ligament (MPFL) reconstruction, trochleoplasty, lateral release, and three-dimensional transfer of the tibial tuberosity, based on a surgical algorithm. Patellar position and clinical outcomes were evaluated postoperatively. The mean follow-up time was 41.5 months (range: 24–72 months).

Results: Patellar position altered from 1.31 (1.21–1.53) preoperatively to 0.88 (0.69–1.06) postoperatively on the Caton-Deschamps Index ($p < 0.01$). The tibial tuberosity–trochlear groove (TT-TG) distance altered from 21.8 mm (20.1–25.8 mm) to 10.3 mm (5.1–14.7 mm), and patellar tilt ranged from 28.1° (21–40°) to 14.6° (5–28°), respectively ($p < 0.01$). Clinical outcomes on the Lysholm and Kujala scales improved from 43.1 and 38.4 to 86.7 and 78.3, respectively, at final follow-up ($p < 0.01$). Surgical treatment that included trochleoplasty resulted in better outcomes than other surgical combinations without trochleoplasty ($p < 0.05$). Sulcus angle and postoperative patellar tilt improved more in those who underwent trochleoplasty than in those who did not ($p < 0.05$).

Discussion: Surgical treatment for patellar instability with patella alta in middle-aged patients resulted in improved clinical outcomes. In particular, a combination surgery including trochleoplasty resulted in the greatest improvement in case of severe trochlear dysplasia.

Level of evidence: IV. Retrospective case series study.

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1. Introduction

Patellar instability after recurrent patellar dislocation is associated with patellofemoral dysplasia, such as patella alta, trochlear dysplasia, patellar dysplasia, and original malalignment [1,2]. Patellar instability and patellar dislocation occur most frequently in teenagers, and numerous surgical techniques have been described, including trochleoplasty, medial patellofemoral ligament (MPFL) reconstruction, and transfer of the tibial tuberosity [3].

Trochleoplasty is an established and accepted technique for the treatment of patellar instability to address a shallow or

absent trochlear groove [4]. Trochleoplasty was first described by Masse, who remodeled the trochlear groove [5], with good clinical outcomes [6–9]. If patellar stability is not restored, it can lead to articular cartilage injury, pain, decreased activity, and patellofemoral osteoarthritis (OA) [10]. MPFL reconstruction is another surgical approach to address patellofemoral instability. With regard to the factors that impact clinical outcomes following MPFL reconstruction, Enderlein et al. reported that age greater than 30, obesity, cartilage injury, and female sex are predictors of poor subjective outcome following surgery [11]. In previous studies, we have treated patellar instability with patella alta, using a three-dimensional (3D) transfer of the tibial tuberosity [12] and have shown that the clinical outcomes depend on the age of the patient at the time of surgery, which also correlates with cartilage damage [13]. The main problem with

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Table 1
Patient characteristics and radiological parameters.

Patients (M/F)	12 (2/10)
Age (y.o.)	44 (40–55)
BMI (kg/m ²)	24.4 (19.6–29.8)
FTA (°)	175 (169–180)
K/L grade	I; 2, II; 7, III; 3
Patellofemoral OA	I; 1, II; 5, III; 5, IV: 1
Follow-up (months)	41.5 (24–72)

BMI: body mass index; K/L: Kellgren–Lawrence; OA: osteoarthritis.

patellar instability during middle age is that most patients have already progressed to the point of secondary osteoarthritic changes, including osteophyte formation and cartilage erosion. These aging and osteoarthritic changes may prevent better patellofemoral congruity after general patellofemoral reconstruction surgery. Moreover, an additional option for trochleoplasty might be needed for improving patellofemoral geometry.

Although several surgical treatments for patellar instability have been reported, the optimal clinical approach for patellar instability with patella alta in middle-aged patients is still controversial. The purpose of this study was to clarify the optimal surgical approach for patellar instability with patella alta based on a surgical algorithm and to assess the effect of trochleoplasty in middle-aged patients. The hypothesis was that optimal surgical procedures for patellar instability with patella alta in middle-aged patients may induce good clinical outcomes with better patellofemoral geometry.

2. Materials and methods

2.1. Enrollment

From 2008 to 2015, we operated on 42 patients (47 knees) for recurrent patellar instability at our institution. The inclusion criteria for this study were patellar instability with patella alta and age from 40 to 70 years. We excluded 28 patients (32 knees) who were younger than 40, one patient (one knee) older than 70, and 2 patients (2 knees) who were older than 40, but did not have patella alta. Ultimately, 12 patients (2 males and 10 females) were analyzed in this study. The mean age was 44 years (40–55 years) and the mean body mass index (BMI) was 24.4 kg/m² (19.6–29.8 kg/m²). The mean femorotibial angle (FTA) was 175° (169–180°). On the Kellgren–Lawrence Scale, 2 patients had grade I knee OA, 7 had grade II, and 3 had grade III OA. Meanwhile, 1 patient had stage I patellofemoral OA, 5 had stage II, 5 had stage III, and 1 had stage IV OA, based on Iwano's classification [14]. The mean time to final follow-up was 41.5 months (24–72 months) (Table 1). This study was performed in accordance with a protocol approved by the institutional review board of Osaka Medical College (no. 1291).

2.2. Surgical algorithm for patellar instability with patella alta

Surgical treatment was selected based on our algorithm (Table 2). Patellar height was evaluated using the Caton–Deschamps Index [15,16], trochlear dysplasia was classified using the Dejour classification [17], and lateral shift was evaluated on plain radiographs using a skyline view at 30° and 60° of knee flexion. Malalignment of the patella and lower extremity was evaluated by patellar tilt and tibial tuberosity–trochlear groove (TT–TG) distance with CT scan [16,18]. Based on this composite evaluation, a combination of surgical procedures such as transfer of the tibial tuberosity, MPFL reconstruction, medial plication, release of the lateral retinaculum, and trochleoplasty for sulcus deepening were selected.

2.3. Surgical technique

Three-dimensional transfer of the tibial tuberosity has been described previously [12]. Briefly, an anteromedial to posterolateral osteotomy of the tibial tuberosity was performed and the tibial tuberosity was transferred to an anteromedial and distal position based on the degree of patella alta and TT–TG distance to restore normal patellar position. Trochleoplasty was performed in two ways. Sulcus-deepening osteotomy was performed when the articular cartilage had an International Cartilage Repair Society (ICRS) cartilage grade lower than grade II [19]. When the cartilage had already eroded at the patellofemoral joint, a v-shaped sulcus-deepening osteotomy was performed. After removing the osteophytes, the location and depth of the sulcus-deepening osteotomy was determined according to (a) the length of the lateral facet and (b) the cleft of the patella, respectively (Fig. 1A and B). After creating the lateral facet, the new joint surface was coated with bone wax to prevent bleeding and arthrofibrosis. When the cartilage was preserved at the medial facet (Fig. 1C), sulcus deepening was performed according to Dejour's procedure [19] and fixed with fiber wire (Fig. 1D). Postoperative X-ray was shown in Fig. 1D.

MPFL reconstruction was performed using the gracilis tendon [20,21]. The tendon was fitted with No. 0 FiberWire non-absorbable suture baseball stitches (Arthrex, Naples, FL, US) at each end. After making a bone tunnel on the femoral side, the gracilis was fixed to the lateral femoral cortex with an Endobutton CL (Smith & Nephew, Memphis, TN, US). Subsequently, it was fixed to 2 holes in the patella, using 4.75 mm SwiveLock (Arthrex) with a tension of 10 N, using a tension meter at 30° of knee flexion based on biomechanical analysis [22]. The surgical procedures for all cases are shown in Table 3. All cases involved 3D transfer of the tibial tuberosity due to patella alta. Five patients had Dejour type A trochlear dysplasia, 2 had type B, 3 had type C, and 2 had type D. Four patients with Dejour type B and D dysplasia were treated with trochleoplasty. Three patients with patellar instability displayed a lateral shift at 60° on a skyline view and were treated with MPFL reconstruction. The remaining 9 patients underwent medial plication. Lateral release was performed in all cases.

2.4. Rehabilitation

All surgical procedures were allowed the same protocol; Passive ROM exercise was allowed from the first day after surgery. Fifty percent weight-bearing was started 2 weeks after surgery and full weight-bearing was permitted 4 weeks after surgery.

2.5. Assessment method

Patellar position and clinical outcomes were compared pre- and postoperatively. Patellar position was measured using the Caton–Deschamps Index, TT–TG distance, and patellar tilt, and the clinical outcomes were evaluated using Lysholm and Kujala scores.

2.6. Statistical analysis

Pre- and postoperative results were compared using a paired *T*-test and JMP Pro software (version 11.2.0, SAS, Cary, NC, US). A comparison of clinical outcomes was performed using the Mann–Whitney *U* test. A *p*-value of <0.05 was considered statistically significant.

3. Results

Postsurgical patellar position was located from 1.31 (1.21–1.53) to 0.88 (0.69–1.06) on the Caton–Deschamps index, with a TT–TG distance of 21.8 mm (20.1–25.8 mm) to 10.3 mm (5.1–14.7 mm),

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