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Osteoarticular Allograft Transplantation of the Trochlear Groove for Trochlear Dysplasia

A Case Report

Nicholas N. DePhillipo, MS, ATC, OTC, Mitchell I. Kennedy, BS, Zachary S. Aman, BA, Gilbert Moatshe, MD, and Robert F. LaPrade, MD, PhD

Investigation performed at The Steadman Clinic and Steadman Philippon Research Institute, Vail, Colorado

Abstract

Case: A 21-year-old woman with recurrent lateral patellar instability caused by severe trochlear dysplasia and concomitant grade-IV trochlear chondromalacia was treated successfully with osteoarticular allograft transplantation of the entire trochlear groove.

Conclusion: The treatment of chronic lateral patellar instability caused by trochlear dysplasia can be challenging. When nonoperative treatment is unsuccessful, a sulcus-deepening trochleoplasty may be indicated. However, contraindications for a trochleoplasty include grade-IV chondromalacia of the patellofemoral joint. Even with this contraindication, an osteoarticular allograft transplant of the trochlear groove can serve as a salvage procedure to improve knee function.

Chronic patellar instability after a primary dislocation event is common, and reasons for recurrent dislocations are multifactorial[1]. Risk factors include trochlear dysplasia, insufficiencies in the medial stabilizing retinacular structures, increased tibial tubercle-to-trochlear groove (TT-TG) distance, and patella alta[2]. Trochlear dysplasia reportedly is present in 85% of patients with recurrent lateral patellar instability[3]. A sulcus-deepening trochleoplasty is recommended for patients in whom nonsurgical treatment is unsuccessful and who have chronic lateral patellar instability caused by a dysplastic trochlear groove[4-6]. Contraindications for a trochleoplasty include patients with open physes or diffuse patellofemoral osteoarthritis (Outerbridge grades III and IV)[7,8].

We describe a 21-year-old patient with severe trochlear dysplasia and concomitant grade-IV trochlear chondromalacia who underwent an osteoarticular allograft transplantation surgery (OATS) of the trochlear groove.

The patient was informed that data concerning the case would be submitted for publication, and she provided consent.

Case Report

A 21-year-old woman (height, 157.4 cm; weight, 90.7 kg; body mass index, 33.2 kg/m^2) presented with symptoms of left knee pain and patellar instability. She had a complex history of knee issues, including 2 prior knee surgeries. The first knee surgery had consisted of an arthroscopy, a chondroplasty of the patella, and medial patellofemoral ligament (MPFL) repair. The patient did well for approximately 2 years until she had an acute reinjury that caused lateral subluxation of the patella. The patellar instability had been addressed with a second procedure consisting of an MPFL reconstruction with use of a gracilis tendon allograft. The patient presented to our referral center approximately 5 months after the second knee surgery with substantial pain in the anterior aspect of the left knee and persistent lateral patellar instability.

On physical examination, the patient had full range of motion of the left knee and the patella, increased lateral subluxation of the patella, a mild effusion, and a positive patellar grind test with translation of the patella in the trochlear groove on the left side. There was a positive J sign of the patella, which occurred at approximately 30° of knee flexion. She had severe pain in the anterior aspect of the left knee with lunging and deep squatting. Radiographs showed Dejour type-B trochlear dysplasia[4] and patella alta with a Caton-Deschamps index[9] of 1.3 (Fig. 1). Magnetic resonance imaging (MRI) showed an articular chondral defect in the proximal aspect of the lateral trochlear groove and an intact MPFL reconstruction. Computed tomography (CT) demonstrated a TT-TG distance of 16 mm. The patient underwent diagnostic arthroscopy to further evaluate the size of the articular cartilage defect, which

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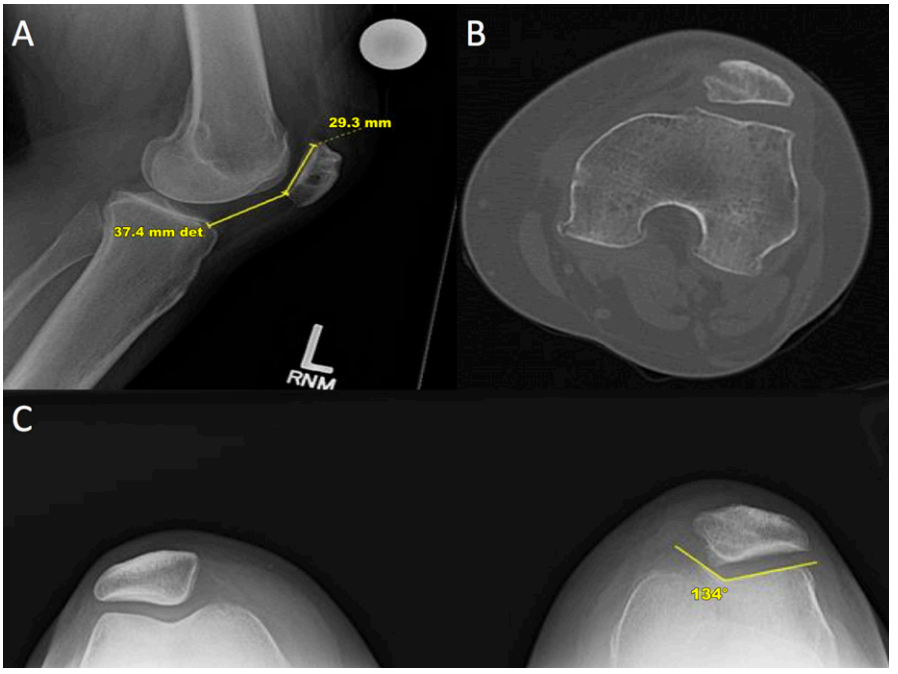

Fig. 1

Figs. 1-A, 1-B, and 1-C Preoperative diagnostic imaging. **Fig. 1-A** The lateral radiograph demonstrates patella alta with a Caton-Deschamps index of 1.3. **Fig. 1-B** Axial CT demonstrating severe trochlear dysplasia. **Fig. 1-C** The sunrise view displays the trochlear dysplasia with a sulcus angle of 134°.

showed a full-thickness osteochondral trochlear groove defect consistent with an Outerbridge grade-IV lesion[10] of the entire articulating surface of the trochlea (Figs. 2-A and 2-B). The articular cartilage of the patella was essentially normal. During the examination under anesthesia and the arthroscopy, it was determined that the MPFL reconstruction graft was still functional.

In order to address the patient's grade-IV chondromalacia and the lateral patellar instability that was caused by substantial trochlear dysplasia and patella alta, we performed a procedure with a fresh osteoarticular allograft transplanted to the trochlear groove (Fig. 2-C) and a concurrent tibial tubercle osteotomy to assist with the lateral patellar subluxation. The patient was not a candidate for a trochleoplasty because she had diffuse grade-IV chondromalacia of the trochlea.

Because the previous MPFL reconstruction was believed to still be functional, a lateral arthrotomy initially was made to approach the tibial tubercle. After visualization and outlining of the tibial tubercle, the periosteum was elevated; drill holes were placed for a length of 3 cm along the medial and lateral

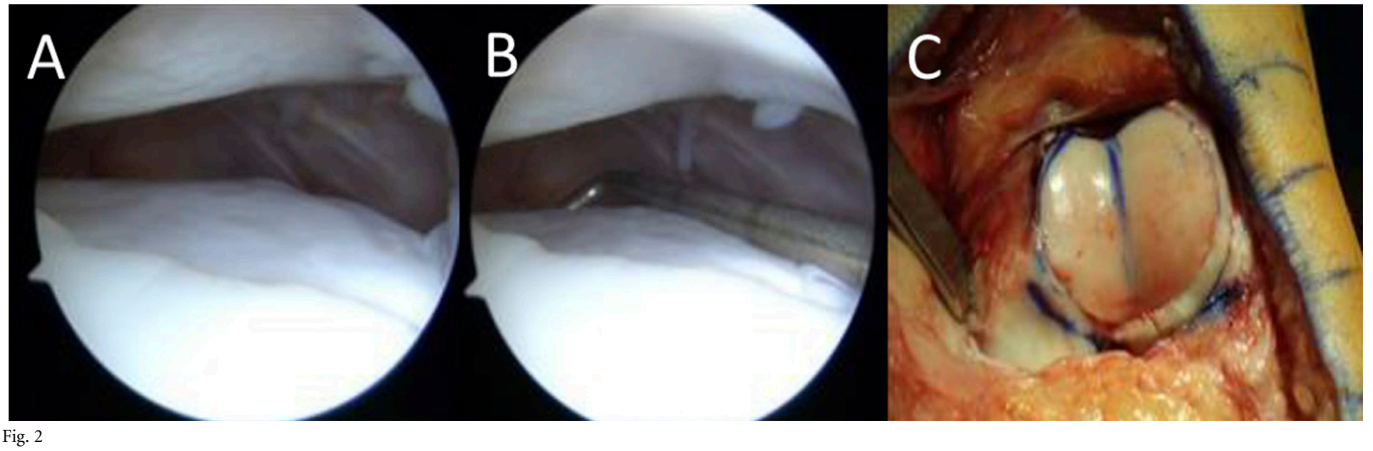

Fig. 2

Figs. 2-A, 2-B, and 2-C Full-thickness Outerbridge grade-IV chondromalacia of the left trochlea in a 21-year-old woman with trochlear dysplasia. **Fig. 2-A** Intraoperative arthroscopic image showing complete loss of cartilage of the trochlea with exposed subchondral bone. **Fig. 2-B** An intraoperative image with an arthroscopic probe that has a width of 5 mm at its tip, which helps demonstrate the size of the chondral defect. **Fig. 2-C** Postoperative image of the osteoarticular allograft transplant to the left trochlea. The allograft is in place, filling the entire trochlear groove.

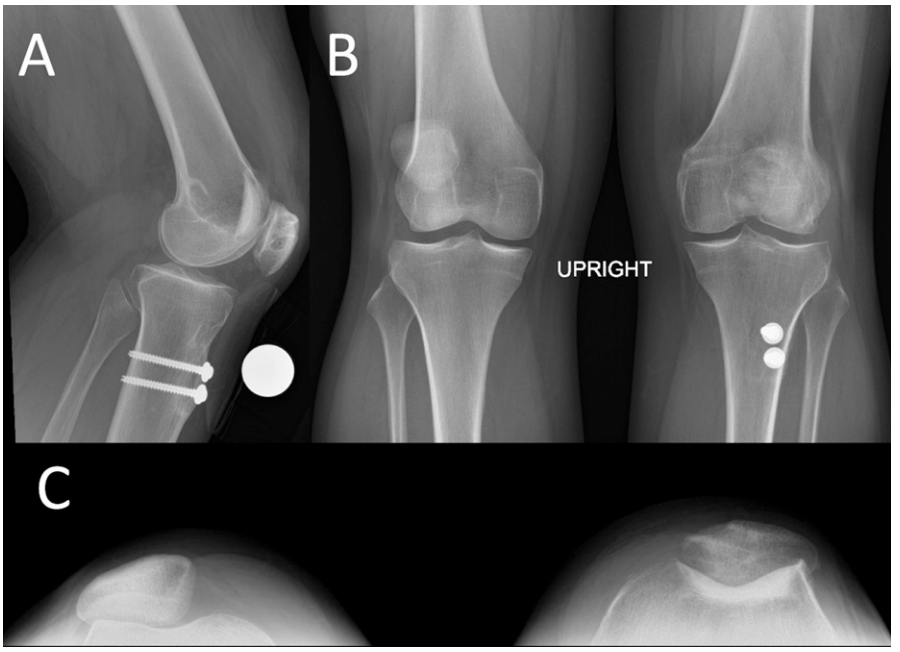

Fig. 3

Figs. 3-A, 3-B, and 3-C Postoperative radiographs 14 months after transfer of the OATS graft to the trochlear groove and a tibial tubercle osteotomy. **Fig. 3-A** Lateral view of the left knee demonstrating the corrected patella alta with a Caton-Deschamps index of 0.8. **Fig. 3-B** Anteroposterior view of both knees showing the maintained joint space. **Fig. 3-C** Sunrise view of both knees demonstrating full osseous incorporation of the OATS graft in the trochlear groove with no graft displacement.

cortices and connected using a small osteotome. A large osteotome was used to perform the tibial tubercle osteotomy, which was completed distally with a saw blade. To address the patella alta, 1 cm of the anterior aspect of the tibia was excised so that we could move and fixate the tibial tubercle 1 cm distally following the osteochondral graft transplantation. Because the TT-TG distance was measured to be 16 mm, medial realignment was not needed. Next, the area of the osteochondral defect was outlined, and we determined that a 35-mm-diameter trochlear graft implant was needed to incorporate both the dome-shaped type-B trochlear dysplasia and the 2-cm full-thickness osteochondral defect. Since the anatomy was unusual, care was taken to score, ream, and dilate the area, as well as to precisely measure the points along the depth gauge of the recipient site. On the back table, the same calculated area and location were matched on the allograft to reshape the trochlea. A graft harvester was used to harvest a 35-mm-diameter trochlear plug, which was meticulously sized to ensure that the graft would press-fit along the same points of the depth gauge that previously had been measured. Once the desired size was obtained, pulsatile lavage was used to remove all blood products from the subchondral bone of the donor graft prior to graft placement. The 35-mm-diameter donor graft was then gently tamped into position and press-fit into the recipient site. It fit anatomically, with no step-off areas. After graft implantation, the patella was observed to be stable when held in place with a towel clip. Finally, utilizing C-arm fluoroscopy, the tibial tubercle osteotomy was held in an anatomic position 1 cm distal from its original site with 2 guide pins, and was subsequently fixated with two 4.5-mm screws (44 mm in length) and washers.

After the surgery, the patient remained non-weight-bearing for 8 weeks; ambulation was permitted on crutches, and a knee immobilizer was worn at all times. Physical therapy started 24 hours following the procedure, with emphasis on early patellar and knee range of motion, edema control, and quadriceps-muscle activation. A continuous passive motion device was utilized for 8 weeks to stimulate articular cartilage nutrition to the OATS graft. The patient progressed from using crutches by week 12, and slowly increased strengthening exercises. At 14 months postsurgery, she presented to our clinic with no pain and full range of motion of the patella and the knee, and there was no evidence of an effusion or lateral patellar instability on physical examination. Radiographs showed corrected patella alta and trochlear dysplasia, with full osseous incorporation and healing of the osteoarticular allograft and no signs of graft displacement (Figs. 3-A, 3-B, and 3-C). The Lysholm, Tegner, and International Knee Documentation Committee (IKDC) scores had improved from 28 preoperatively to 84 postoperatively, from 3 to 7, and from 34 to 76, respectively. The patient was released for full activities at that time.

Discussion

This report demonstrates the unique case of an OATS of the entire trochlear groove for treatment of severe trochlear

dysplasia. The patient was not a candidate for a sulcus-deepening trochleoplasty because of the presence of grade-IV chondromalacia of the trochlea.

Trochlear dysplasia is a difficult problem to treat, with surgical options often limited to a trochleoplasty. However, contraindications for a trochleoplasty include grade-IV patellofemoral chondromalacia. This presents an even more challenging problem for clinicians, especially in a young patient. Osteoarticular allograft transplants are indicated for large (>4 cm^2) focal osteochondral defects[11]; however, to our knowledge, there has been no description of an OATS procedure for replacement of the entire trochlear groove in the knee. We have described the case of a successful OATS to the trochlea as a salvage-type procedure in a young patient who had chronic lateral patellar instability due to severe trochlear dysplasia and grade-IV chondromalacia of the patellofemoral joint.

Outcomes of OATS procedures in the knee are well documented[12-14]. Improved patient- reported outcomes after OATS in the knee and good survival rates (up to 78%) for up to 10 years were reported in a recent systematic review[15]. Reported failure rates vary in the current literature, and are dependent on anatomic location; the lowest failure rates were reported in femoral condyle transplants, ranging from 0% to 22%[16,17]. Gracitelli et al.[12] reported on survivorship of 28 knees with isolated patellar chondral defects, noting improvements of both pain and function in nearly 90% of their patients. The reported allograft survivorship at follow-up was 78% at 5 and 10 years, and 56% at 15 years[12]. This suggests that OATS can provide an acceptable option for salvage treatment, even with patellar chondral defects. Vansadia et al.[18] reported a similar procedure involving a 31-year-old woman with trochlear dysplasia, chondromalacia of the trochlear groove, and recurrent lateral patellar dislocations, which did not improve with a nonoperative approach. They proceeded with an OATS for the treatment of trochlear dysplasia, combined with an MPFL reconstruction and a tibial tubercle osteotomy to address the underdeveloped medial restraint and to correct the abnormal geometry. Our patient's symptoms were analogous, but our treatment protocol differed, with the utilization of the OATS procedure for the entire trochlear groove and without utilization of an MPFL reconstruction, which was not necessary because the prior MPFL reconstruction was confirmed to be intact during the examination under anesthesia and arthroscopy. The presence of grade-IV chondromalacia of the trochlea in our patient and in the patient described by Vansadia et al.[18] disallowed treatment using a sulcus-deepening trochleoplasty; an OATS procedure was used for correction of the symptoms of dysplasia and chondromalacia. Vansadia et al. reported a substantial improvement in pain, range of motion, and function[18]; our patient had substantial improvement in pain and function at >1 year postoperatively, and radiographs confirmed full osseous incorporation and healing of the osteoarticular allograft.

In summary, the treatment of chronic lateral patellar instability caused by trochlear dysplasia can be challenging. This case report describes a viable surgical option for the treatment of trochlear dysplasia in the presence of grade-IV trochlear chondromalacia in patients who have had unsuccessful nonoperative treatment. An osteoarticular allograft transplant of the trochlear groove may be considered as a salvage procedure in select patients in whom a sulcus-deepening trochleoplasty is contraindicated. ■

Nicholas N. DePhillipo, MS, ATC, OTC[1,2]
Mitchell I. Kennedy, BS[2]
Zachary S. Aman, BA[2]
Gilbert Moatshe, MD[2]
Robert F. LaPrade, MD, PhD[1,2]

[1]The Steadman Clinic, Vail, Colorado

[2]Steadman Philippon Research Institute, Vail, Colorado

E-mail address for N.N. DePhillipo: Ndephillipo@thesteadmanclinic.com
E-mail address for M.I. Kennedy: Mkennedy@sprivail.org
E-mail address for Z.S. Aman: Zaman@sprivail.org
E-mail address for G. Moatshe: Gmoatshe@thesteadmanclinic.com
E-mail address for R.F. LaPrade: drlaprade@sprivail.org

ORCID iD for R.F. LaPrade: 0000-0002-9823-2306

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