Technical Note

Patellar Fresh Osteochondral Allograft Transplantation

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Abstract: Chondral defects of the patellofemoral joint remain a difficult-to-treat pathology with limited long-term results. Currently available techniques to treat large or unipolar chondral defects of the patella include autologous chondrocyte implantation and osteochondral allograft transplantation. Despite the recent advances in orthobiologic adjuncts, there is no single gold-standard surgical approach to this difficult-to-treat pathology in patients who are frequently young, active, and demanding on their bodies. We describe a technique for osteochondral allograft transplantation to the patella for an isolated patellar chondral lesion (unipolar).

Chondral lesions of the patellofemoral joint are notoriously difficult to treat because of the strain and stress of the environment seen in routine daily activities. Focal defects of the patellar cartilage can lead to altered mechanics and the early formation of osteoarthritis within the patellofemoral joint. These lesions are common because they are seen in 36% of all knee arthroscopies, and the patellofemoral joint is the second most prevalent location of cartilage injury to the knee.[1] As a result, early and effective management of these lesions is desired to reduce patient morbidity.

The articulation of the patella within the trochlea is a unique environment with the thickness of the cartilage containing the greatest depth in the body (average depth of approximately 4 mm).[2] The patella is composed of 2 facets, with most knees having a smaller and convex medial patellar facet compared with the larger and concave lateral patellar facet.[3] The greatest compressive forces occur between 60° and 90° of flexion and move proximally on the patella as flexion increases.[4] Patients will often complain of anterior activity-related knee pain with flexion but can also have intermittent sharp pain that can represent an unstable cartilage lesion.[5,6]

Multiple surgical interventions have been described to address cartilage lesions of the patellofemoral joint with variable success. Furthermore, cartilage restoration procedures (microfracture, autologous chondrocyte implantation, particulated juvenile cartilage transplantation, osteochondral autograft transplantation, and osteochondral allograft [OCA] transplantation) are often coupled with osteotomies that unload the patellofemoral joint.[7] This article focuses on the use of OCA transplantation, which is typically reserved for large lesions (>4 cm^2) or for salvage-type operations.[8]

Surgical Technique

The technique is shown in detail in Video 1. Pearls and pitfalls of this technique are described in Table 1.

Indications and Contraindications

Precise patient selection is crucial to the success of the described surgical procedure. The main indication for this procedure is a contained patellar cartilage defect with healthy cartilage in the trochlear groove. In addition, overall knee alignment and patellar tracking should be noted to consider as potential additional forces putting increased stress on the patellofemoral joint. In patients with bipolar lesions of the patella and trochlear groove, isolated patellar osteoarticular allograft transplantation is not appropriate. Patients with posterior cruciate ligament deficiency place increased

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Table 1. Pearls, Advantages, and Pitfalls

Pearls and Advantages
Size-matched grafting
Match up median ridge of patella
Restoration of hyaline-like cartilage
Minimize depth of bony reaming to ensure healing
Pitfalls
Poor blood supply to patella compromises graft integration
Reaming too deeply increases risk of fracture
Need to assess whether unloading tibial tubercle osteotomy is required

stress on the patellofemoral joint and would not be good candidates for this procedure in isolation.

Preoperative Planning

Patients' histories are notable for anterior knee pain that is worse with knee flexion. Prior patellar dislocations or instability may contribute to the articular injury. The examination will often show patellofemoral crepitus and may show patellar apprehension. Radiographs should be obtained including full—leg length, anteroposterior, lateral, and sunrise views of the painful knee. The full—leg length view is helpful to identify any coronal-plane malalignment that may need to be addressed at the time of surgery. The lateral view may help to identify the lesion, but patella alta or baja should be noted as well. The sunrise view allows further identification of the lesion and assessment of patellar tracking in the trochlear groove. Advanced imaging with magnetic resonance imaging (MRI) allows identification and sizing of the patellar articular injury and assessment of the trochlear cartilage. Loose bodies should also be recognized on MRI. Additional procedures that may be appropriate in this patient population include anteromedialization of the tibial tubercle to unload the lateral patellar facet, proximal tibial osteotomy to correct varus malalignment, medial and lateral patellofemoral ligament reconstruction for patellar instability, and distal femoral osteotomy for genu valgum alignment.

Patient Positioning and Anesthesia

The patient is placed in the supine position on the operating table. After the induction of general anesthesia, a bilateral knee examination is performed to evaluate for any concurrent ligamentous instability and to assess knee range of motion. A well-padded high-thigh tourniquet is subsequently placed on the operative leg, and the contralateral leg is confirmed to be well padded to prevent iatrogenic pressure injury.

Surgical Approach

A longitudinal incision is made over the extensor mechanism. A decision is made to perform a medial or lateral parapatellar arthrotomy based on the location of the patellar cartilage lesion (in our case, a lateral arthrotomy was performed for a lesion of the lateral facet). This allows for eversion of the patella. The cartilage defect is identified and marked with indelible ink (Fig 1). It is then sized with provided dowels (Arthrex) to encompass the lesion. A centering guide pin is drilled perpendicular to the patella and in a bicortical manner through the center of the dowel. The patella is then scored around the lesion followed by the use of a reamer to a depth of 7 to 8 mm (Fig 2). Irrigation is used to reduce the risk of thermal osteonecrosis to the surrounding tissue, which can delay or prevent bony integration of the graft. This recipient site is then dilated. A measuring stick is used to determine the precise depth at the 12-, 3-, 6-, and 9-o'clock positions. The 12-o'clock position is marked with methylene blue. The aforementioned depths are recorded for later matching with the donor osteoarticular allograft.

On the back table, the donor osteoarticular allograft is prepared. The same area on the donor patella is identified to best match the curvature and cartilage thickness of the recipient site, and the 12-o'clock position is marked with ink to later match with the recipient site. Next, the donor patella is well fixed in the graft-holding device (Arthrex). A plug of the same size and diameter is created. This donor plug is then measured for depth to match the recipient site exactly.

Once the donor osteoarticular graft has been appropriately sized, a pulsatile irrigator is used on the subchondral bone of the graft in a safe manner to remove all blood products. The graft is then appropriately oriented in the recipient site and the 12-o'clock positions are aligned. It is impacted in place to be flush with the surrounding cartilage (Fig 3). The wound is then thoroughly irrigated, the patella is reduced, and the arthrotomy is closed with nonabsorbable suture.

Postoperative Protocol

Postoperatively, the patient will be non—weight bearing for 8 weeks with no limitations on passive

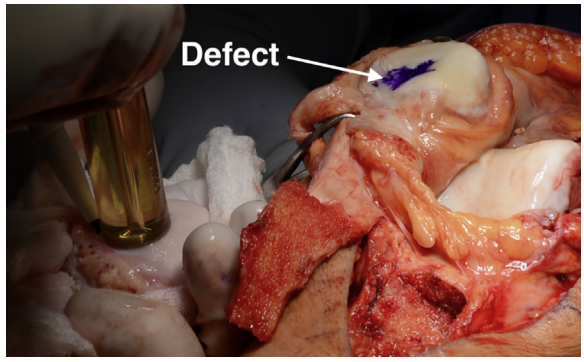

Fig 1. From the anterior view, the entire cartilage defect is first marked with indelible ink, and the allograft sizer is placed at the recipient site to ensure complete coverage, followed by placement at the matched donor site shown here (lateral patellar facet in this case). A circular mark is placed around the sizer at both sites to guide both the harvest from the donor site and the preparation for the graft at the recipient site.

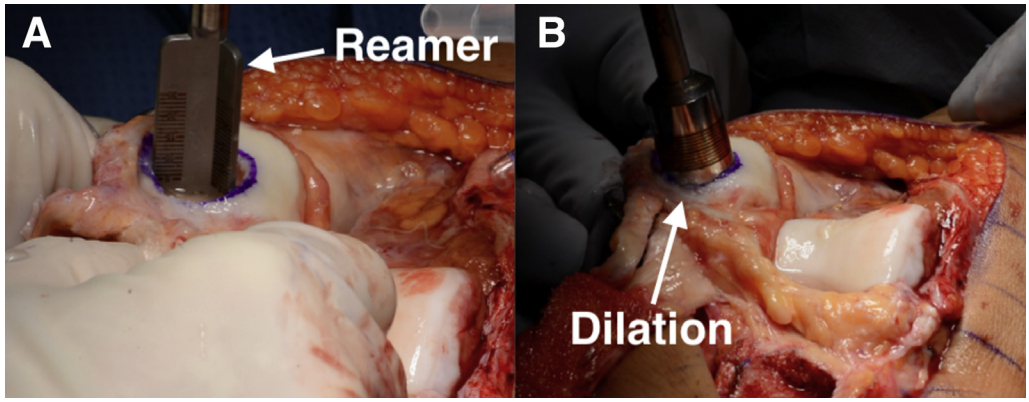

Fig 2. From the anterior view, the recipient bed must first be prepared by reaming to a depth of 7 to 8 mm at a minimum (A), followed by dilation of the site to the equivalent depth (B).

range of motion. A continuous passive motion machine is used for the first 8 weeks postoperatively, with initial range of motion from 0° to 60°; the patient is then allowed to gradually increase weight bearing as tolerated. Radiographs are repeated at 8 weeks postoperatively to evaluate for bony incorporation and to clear the patient to begin weight-bearing progression starting at 25% of body weight and increasing by 25% of body weight each week over a 4-week period. At 12 weeks, plain radiographs are repeated, and the patient is cleared to discontinue crutch use if evidence of adequate bony incorporation is noted. A generalized strengthening protocol is initiated at 3 months postoperatively. Return to sports and full activities is allowed after sufficient evidence of radiographic incorporation around the OCA transplantation is noted, physical examination findings are normal, and a functional sports test is passed at 12 months postoperatively.

Discussion

This article focuses on the use of a single OCA plug to treat a focal unipolar defect of the patella. Large defects of the patella require the use of either autologous chondrocyte implantation or OCA plugs to successfully restore cartilage morphology and attempt to restore smooth articulation. The advantages of using a large OCA are that it provides size-matched specimens to effectively restore the native morphology of the patella and is less expensive than alternative methods. Disadvantages to this technique include lack of graft availability and variable results at long-term follow-up.

In the largest case series to date, OCA transplantation for patellar defects has been shown to have good survivorship at 5- and 10-year follow-up with dwindling successful survival rates at 15 years (78% at both 5 years and 10 years and 55.8% at 15 years).[9,10] However, pain and function improved from those at last follow-up, and 89% of patients were satisfied or extremely satisfied with the results of the OCA transplantation. Multiple smaller series have shown variable results with survivorship ranging from 57% to 100% at long-term follow-up and variable improvement in pain and function.[8,11,12]

Although not specific to OCA transplantation to the patella, Osteochondral Allograft MRI Scoring System (OCAMRISS) scores were recently used to evaluate cartilage and graft integration after the use of OCA

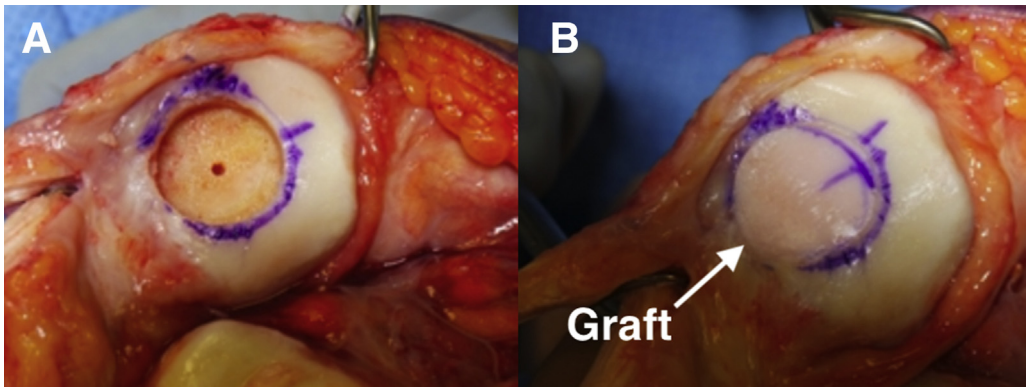

Fig 3. (A) From the anterior view, the prepared recipient site is shown with a circumferential cancellous bed with stable peripheral borders. The final graft is impacted with an allograft introducer with a laparotomy pad placed over the introducer to prevent traumatic placement. (B) From the anterior view, the graft is rotated until the ideal contour of the donor graft is matched to the host site ensuring that no protrusion or excess recess of the graft occurs.

transplantation in the knee.[13] Wang et al.[14] found that at an average follow-up of 3.5 years, 85% of grafts showed satisfactory preservation of the articular contour with greater than 50% cartilage fill by volume and 90% of grafts had a cartilage surface that was flush or offset by less than 50% of its thickness from host cartilage. The described technique provides reproducible steps to minimize the risk of graft protrusion while maximizing press fit for primary graft stability.

Our technique optimizes reproducible surgical steps to prevent articular step-off while preventing graft subsidence. Although these grafts are used for salvage procedures, results at 10 years are promising (78%) for a difficult-to-treat pathology in patients who have disabling pain and limitations with daily activities.

This article describes OCA transplantation for large contained cartilage defects. OCA transplantation for unipolar chondral defects of the patella is an essential tool for surgeons when dealing with large chondral defects or those requiring salvage options because of a history of surgical procedures. With results of this technique limited to small case series and retrospectively collected data, studies that prospectively identify patients with isolated chondral defects that are followed longitudinally are required to evaluate the efficacy of this technique.

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