Osteochondral Autograft Transfer for Capitellar Chondral and Osteochondral Defects

Shiv P. Patel, M.D., M.S., Ryan T. Conyer, M.D., and Theodore B. Shybut, M.D.

Abstract: Chondral and osteochondral lesions of the humeral capitellum, most notably osteochondritis dissecans, most commonly present in adolescent baseball players and gymnasts. A variety of surgical techniques can be used to address these lesions. Osteochondral autograft transfer has recently shown superior rates of return to sport. We describe osteochondral autograft transfer from the contralateral knee to treat a large full-thickness chondral lesion of the humeral capitellum. Osteochondral allograft backfill of the donor site is shown as well. This surgical procedure is technically demanding but very reproducible and maximizes return to play in patients while minimizing donor-site morbidity.

Capitellar chondral and osteochondral lesions, osteochondritis dissecans (OCD) in particular, occur most commonly in throwers and gymnasts. Repetitive microtrauma under valgus load of the lateral elbow with radiocapitellar compression is theorized to be the patho-mechanical cause of almost all OCD lesions.1 In competitive adolescent baseball players, the incidence of OCD lesions of the elbow is as high as 3.4%.2 Surgical treatments include simple debridement with removal of the unstable fragment in OCD lesions, but this method leaves many patients with residual pain.3,4 Cartilage preservation and restoration options include antegrade or retrograde drilling, marrow stimulation such as microfracture or abrasion arthroplasty, internal fixation of OCD fragments with a variety of implants or bone peg grafts, autologous chondrocyte implantation, and osteochondral autograft or allograft transfer.

Osteochondral autograft transplant (OAT) is the senior author’s (T.B.S.) preferred technique for large symptomatic chondral or osteochondral lesions in the humeral capitellum. Benefits of the OAT procedure include a high rate of return to play and minimal donor-site morbidity. We describe the operative treatment of a symptomatic capitellar chondral lesion using osteochondral autograft transfer from the supra-lateral femur, including osteochondral allograft backfill of the knee donor site in an attempt to minimize donor-site morbidity.

Surgical Technique

The patient is positioned supine on an operating table (Video 1). With the patient under anesthesia, examination of the right upper extremity is performed to confirm the office examination findings including range of motion and varus and valgus stability. The right upper extremity as well as the contralateral left lower extremity are prepared and draped in normal sterile fashion with a nonsterile tourniquet placed on the left lower extremity. The right arm is placed in a traction positioner.

After standard skin preparation is completed, the elbow is insufflated with normal saline solution after palpation of the lateral soft spot with an 18-gauge needle and intravenous tubing attached to a syringe (Fig 1). A proximal-medial portal is made by incising the skin, developing the portal tract with a clamp, and placing the scope sheath and obturator.
arthroscopy is then performed, viewing from medial and confirming a large central capitellar chondral defect (Fig 2). The arthroscope is removed. An Esmarch bandage is applied to exsanguinate the limb, and the tourniquet is inflated. A dorsal-posterior anconeus-splitting incision is used to access the defect with the elbow hyperflexed. Once the capsule is incised sharply, a large central full-thickness chondral lesion with unstable flaps at the margins is encountered. We find placing the arthroscope through the open incision to be a valuable maneuver during articular cartilage restoration surgery to view the defect (Fig 3). We use sizors of different diameters to determine the dimensions of the defect. In this case, a 10-mm sizer is selected. A guide pin is placed centrally within the defect using the cannulated alignment rod and then over-reamed to a depth of approximately 5 to 7 mm with a 10-mm reamer. The alignment rod is now seated in the socket, and the arthroscope is used to measure the depth of the socket on all 4 sides, measuring at the 3-, 6-, 9-, and 12-o’clock positions. The tourniquet is subsequently let down, and the wound is packed with saline solution—soaked sponge.

We then turn our attention to the patient’s left knee. An Esmarch bandage is used to exsanguinate the extremity, and the tourniquet is insufflated. Concomitantly, in preparation for autograft harvesting, a 10-mm fresh, precut osteochondral allograft is opened on the back table and washed with pulsatile lavage to remove marrow elements. We make a short supra-lateral longitudinal incision. This is carried down through the capsule to the non–weight-bearing portion of the distal femur. Using the Arthrex Autograft Transplant System...
and the needle is injected into the joint about the osteochondral graft, partially closed; bone marrow concentrate is then delivered using a graft tube to insert it into the socket. We gentle use a tamp to terminally seat the graft with a tamp. Once completed, the tourniquet is let down and the wound is packed with saline solution soaked gauze. The right elbow is then splinted at 90° of flexion with neutral forearm rotation until the first clinical follow-up. At the first postoperative visit, a hinged elbow brace is placed and physically therapy is initiated, focusing on passive and active-assisted range of motion with no weight bearing for 6 weeks, with the goal to a return of full range of motion. A gentle strengthening program is started at 6 weeks, with no throwing or push-ups allowed until 3 months. Repetitive loading exercises, such as overhead throwing or handstands, are not permitted to begin until at least 3 to 4 months postoperatively. A full return to athletic ability is expected to take 6 to 9 months.

**Discussion**

Capitellar chondral and osteochondral lesions, OCD in particular, occur most commonly in throwers and gymnasts. Repetitive microtrauma under valgus load of the lateral elbow with radiocapitellar compression is theorized to be the patho-mechanical cause of almost all OCD lesions.1 In competitive adolescent baseball players, the incidence of OCD lesions of the elbow is as high as 3.4%.2 First-line nonoperative treatment with rest and avoidance of exacerbating activities results in improvement in the vast majority of cases, with reported success rates of greater than 80%.3 Operative treatment of these lesions is indicated in patients with failed nonoperative treatment or more advanced lesions, particularly at skeletal maturity. Absent a viable osteochondral fragment amenable to repair, placed into a posterior slab splint, and the patient is awoken from anesthesia.

**Pearls**

- Diagnostic arthroscopy can be helpful prior to the open portion of the procedure.
- A cannulated alignment rod should be used to help with central orthogonal pin placement.
- The arthroscope should be used to view 3-, 6-, 9-, and 12-o’clock depth measurements of the recipient socket (and later to confirm flush graft placement).
- Grafts may be soaked in bone marrow aspirate concentrate as a biological augmentation.
- Orthogonal autograft harvest is essential. The surgeon should take time with this step.

**Pitfalls**

- The recipient socket in the capitellum should be reamed slowly to avoid excessive socket depth; irrigation should be performed during reaming.
- The surgeon should be sure that osteochondral autograft harvest is performed proximal to the sulcus terminalis to ensure that non-weight-bearing cartilage is harvested.
- The surgeon should ensure orthogonal placement of instruments during creation of the recipient socket and during autograft harvest.
Advantages
- Best rate of return to sport in limited available literature
- Hyaline cartilage fill of articular cartilage pathology
- Excellent initial stability of graft to elbow range of motion
- Grafts show excellent long-term incorporation
- Cost-effective (if no donor-site allograft backfill)

Disadvantages
- Potential donor-site morbidity
- More invasive than arthroscopy
- Highly technical procedure
- Additional cost if backfilling donor site with allograft
- Lesion location and/or orientation may limit ability to treat with OAT

OAT, osteochondral autograft transfer.

Table 2. Advantages and Disadvantages of Arthroscopically Assisted Osteochondral Allograft Transfer for Capitellar Defect

Advantages
- Best rate of return to sport in limited available literature
- Hyaline cartilage fill of articular cartilage pathology
- Excellent initial stability of graft to elbow range of motion
- Grafts show excellent long-term incorporation
- Cost-effective (if no donor-site allograft backfill)

Disadvantages
- Potential donor-site morbidity
- More invasive than arthroscopy
- Highly technical procedure
- Additional cost if backfilling donor site with allograft
- Lesion location and/or orientation may limit ability to treat with OAT

OAT, osteochondral autograft transfer.

surgical treatments include arthroscopic debridement, marrow stimulation, osteochondral allograft transplant, OAT, and autologous chondrocyte implantation.4

The senior author’s preferred treatment for large symptomatic lesions in overhead athletes is osteochondral autograft. Recent studies corroborate his experience, showing excellent postoperative outcomes for the OAT procedure. Matsuura et al.5 found a 100% return-to-play rate in throwing athletes with either capitellar- or radial-sided defects treated with the OAT procedure. Weigelt et al.6 showed graft viability at a mean of 7 years in all 14 patients treated with OAT included in their study. Because these surgical procedures are relatively uncommon, higher-level comparative studies are lacking. However, a recent meta-analysis comparing surgical treatments found that OAT had the highest rate of return to playing sports, at 94%.7

We believe the superior return-to-sport outcomes are the most important advantage of this technique, given that this surgical procedure is typically performed in competitive athletes. Additional advantages include hyaline cartilage fill of articular cartilage defects, as compared with marrow stimulation techniques, and excellent stability of the graft, permitting early postoperative motion. Excluding allograft backfill of the knee donor site, OAT is cost-effective, is performed in a single stage, and does not depend on allograft availability. Donor-site morbidity is a concern, so the senior surgeon often backfills harvest sites with allograft in competitive athletes. However, a meta-analysis by Logli et al.8 showed that among 444 patients, there was only 1 knee donor site–related complication, which was a superficial wound infection.

As noted, donor-site morbidity is a potential disadvantage of the described OAT technique. Although our experience is that donor-site morbidity is minimal, 1 study reported knee pain with activity at a rate of 7% in 190 patients who underwent the OAT procedure.9

Another significant consideration is the relatively high technical demand on the surgeon. Lesion location is also a limitation. The lesion must be central enough that orthogonal access can be obtained to prepare the recipient socket and deliver the graft. Likewise, lesions that extend to the lateral wall may be a challenge (Table 1). Arthroscopic procedures are less invasive (Table 2), but we believe the reported high rates of return to sport suggest the anconeus-splitting approach is well tolerated in athletes. OAT remains a superior surgical treatment for symptomatic chondral and osteochondral pathology of the capitulum, with excellent reported outcomes and rates of return to play for high-level athletes.

References
1. Lu Y, Li YJ, Guo SY, et al. Is there any difference between open and arthroscopic treatment for osteochondritis dissecans (OCD) of the humeral capitellum: A systematic review and meta-analysis. Int Orthop 2018;42:601-607.
2. Kida Y, Morihara T, Kotoura Y, et al. Prevalence and clinical characteristics of osteochondritis dissecans of the humeral capitellum among adolescent baseball players. Am J Sports Med 2014;42:1963-1971.
3. Baker CL, Romeo AA, Baker CL. Osteochondritis dissecans of the capitellum. Am J Sports Med 2010;38:1917-1928.
4. Maruyama M, Takahara M, Satake H. Diagnosis and treatment of osteochondritis dissecans of the humeral capitellum: A systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc 2017;25:2237-2246.
5. Matsuura T, Hashimoto Y, Nishino K, Nishida Y, Takahashi S, Shimada N. Comparison of clinical and radiographic outcomes between central and lateral lesions after osteochondral autograft transplantation for osteochondritis dissecans of the humeral capitellum. Am J Sports Med 2017;45:3331-3339.
6. Weigelt L, Siebenlist S, Hensler D, et al. Treatment of osteochondral lesions in the elbow: Results after autologous osteochondral transplantation. Arch Orthop Trauma Surg 2015;135:627-634.
7. Westermann RW, Hancock KJ, Buckwalter JA, Kopp B, Glass N, Wolf BR. Return to sport after operative management of osteochondritis dissecans of the capitellum: A systematic review and meta-analysis. Orthop J Sports Med 2016;4. 2325967116654651.
8. Logli AL, Bernard CD, O’Driscoll SW, et al. Osteochondritis dissecans lesions of the capitellum in overhead athletes: A review of current evidence and proposed treatment algorithm. Curr Rev Musculoskelet Med 2019;12:1-12.
9. Bexkens R, Ogink PT, Doornberg JN, et al. Donor-site morbidity after osteochondral autologous transplantation for osteochondritis dissecans of the capitellum: A systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc 2017;25:2237-2246.