Technical Note

Osteochondral Autograft Transfer for Capitellar Chondral and Osteochondral Defects

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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. Diagnostic

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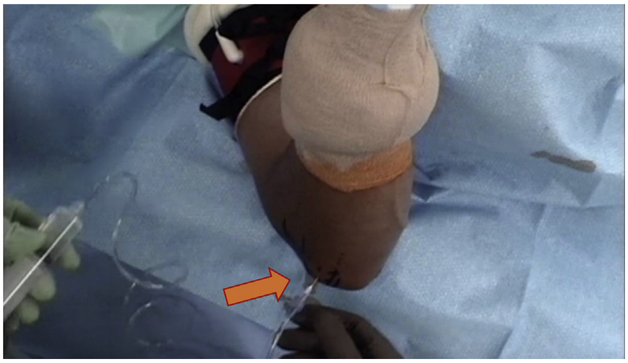

Fig 1. The patient is positioned supine on an operating table with a sterile tourniquet in place, as well as a stockinet and Coban wrap (3M, St Paul, MN) covering the hand. The traction positioner for the arm is not shown. The lateral soft spot of the right elbow (arrow) is palpated, and the elbow is accessed via a needle and insufflated with approximately 10 to 15 mL of normal saline solution, as shown.

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 sizers 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

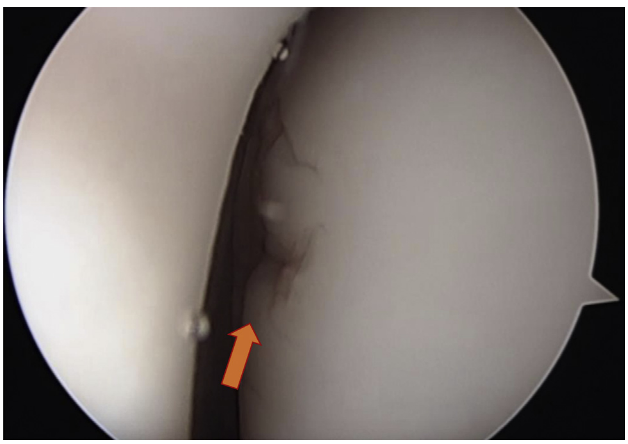

Fig 2. Patient's right elbow viewed through proximal anteromedial portal. The radial head is pictured to the left, and the capitulum, to the right. A lone central defect (arrow) is noted in the capitulum.

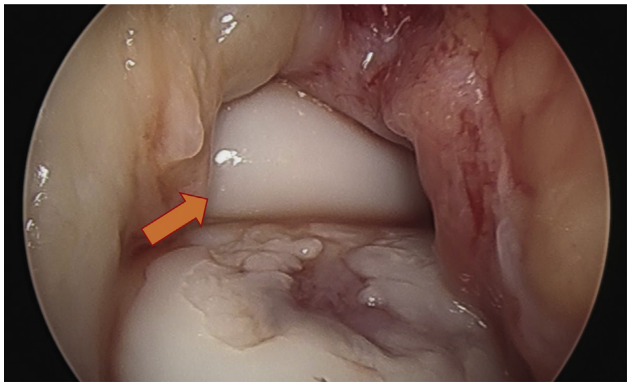

Fig 3. Arthroscopic image of right elbow using dry scoping technique with patient in supine position. The elbow is viewed from a posterior-dorsal incision while in a position of hyperflexion. The capitellar osteochondral defect is readily evident; also pictured is the radial head (arrow).

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

Fig 4. View of left knee with patient in supine position. By use of the Arthrex Autograft Transplant System, a short supra-lateral incision (arrow) is used to harvest a 10-mm autograft from the non—weight-bearing portion of the lateral distal femur.

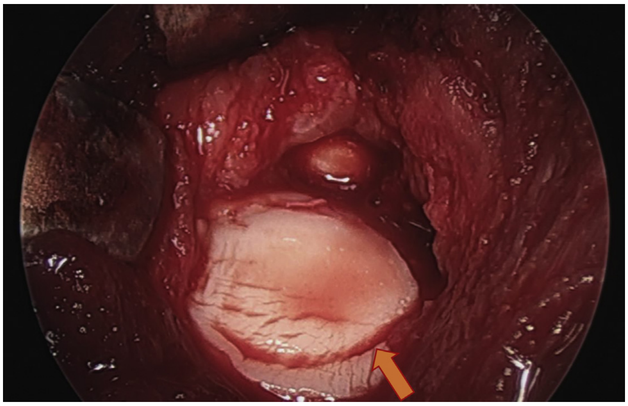

Fig 5. Arthroscopic image of right elbow using dry scoping technique with patient in supine position. The elbow is viewed from a posterior-dorsal incision while in a position of hyperflexion. Autograft (arrow) is seen with an excellent fit and fill in the recipient socket of the capitulum.

(Naples, FL), we harvest a 10-mm autograft plug (Fig 4). We then shape the allograft to a depth of approximately 5 to 7 mm and trim it to match the recipient socket depths on all 4 sides (again at the 3-, 6-, 9-, and 12-o'clock positions), taking care to note orientation. The osteochondral allograft is trimmed to match the dimensions of the femoral harvest site, and both the harvested autograft and prepared allograft are soaked in bone marrow concentrate. The allograft is seated into the femoral harvest site initially by manual press fit and then gently terminally seated to a flush fit with a tamp. The knee is gently ranged to confirm smooth range of motion. Thereafter, the capsule is meticulously closed and a needle is docked within the joint. A small aliquot of bone marrow concentrate is injected at the harvest site, and the needle is flushed with platelet-poor plasma. Once completed, the tourniquet is let down and the wound is packed with saline solution—soaked gauze.

We now return to the right elbow. The Esmarch bandage is applied for exsanguination, and the tourniquet is raised. We verify the depth measurements of the recipient socket. The prepared osteochondral autograft orientation is also verified. Bone marrow concentrate is placed at the base of the recipient site. The graft 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 good flush fit. Viewing with an arthroscope again confirms a good fit and fill under close inspection (Fig 5). The elbow is carefully ranged, confirming smooth range of motion. The capsule and anconeus are partially closed; bone marrow concentrate is then injected into the joint about the osteochondral graft, and the needle is flushed with platelet-poor plasma as it is withdrawn. The tourniquet is let down. Both wounds are then meticulously closed in a layered fashion, and sterile dressings are placed. The right elbow is then placed into a posterior slab splint, and the patient is awoken from anesthesia.

Rehabilitation

The elbow is 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 post-operatively. 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,

Table 1. Clinical Recommendations for Arthroscopically Assisted Osteochondral Allograft Transfer for Capitellar Defect

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.

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.

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