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ORIGINAL ARTICLE

Midterm results of osteochondral allograft transplantation to the humeral head

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Background: This study evaluated clinical outcomes of osteochondral allograft (OCA) transplantation for humeral head osteochondral defects. We hypothesized that patients with isolated humeral head disease would achieve favorable results and that patients with bipolar disease would experience inferior outcomes.
Methods: We identified patients who underwent humeral head OCA transplantation. Subjective questionnaire data were obtained preoperatively and at a minimum of 2 years postoperatively. Radiographs were evaluated for graft incorporation. Failure was defined by conversion to shoulder arthroplasty, American Shoulder and Elbow Surgeons score <50, or dissatisfaction with the surgical result.
Results: Twenty patients (65% male) met inclusion criteria. Patients were an average age of 24.8 ± 8.1 years. Eleven patients underwent concomitant glenoid surgery (microfracture or meniscal allograft resurfacing). Follow-up was available for 18 patients (90%) at mean of 67 months. All grafts incorporated except 2. Four patients underwent shoulder arthroplasty at mean of 25 months postoperatively (all after pain pump chondrolysis). Eleven of the 20 patients were satisfied (all dissatisfied patients underwent glenoid surgery). Significant improvements ($P < .001$) were seen for the visual analog scale (from 6.1 to 1.5), Simple Shoulder Test (from 32 to 73), American Shoulder and Elbow Surgeons score (from 39 to 76), and the physical component of the 12-Item Short Form Survey (from 38 to 48). Pain pump patients who did not progress to arthroplasty experienced inferior satisfaction (40% vs. 87.5%, $P = .04$) and a trend toward inferior outcomes compared with the rest of the cohort.
Conclusion: OCA transplantation is a viable option for young patients with isolated humeral chondral injury. Patients with bipolar disease or a history of intra-articular pain pump have increased failure and decreased subjective outcomes.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: osteochondral allograft; osteochondral defect; humeral head; shoulder; cartilage restoration; chondrolysis

Osteochondral defects involving the glenohumeral joint are less common than those in the knee or ankle; however, they are witnessed in 5% to 17% of patients undergoing shoulder arthroscopy.[3,5,7,15] Numerous etiologies account for these lesions, including anterior and posterior instability, osteonecrosis, osteochondritis dissecans, osteoarthritis, inflammatory

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arthritides, idiopathic chondrolysis, and iatrogenic injury, which may include the effects of intra-articular pain pumps, radiofrequency devices, and prominent suture anchors. All patients should undergo initial nonsurgical management, depending on the etiology and presence of a continued aggravating factor, such as retained hardware. However, when nonsurgical measures fail, a broad array of surgical treatment options exists for chondral lesions of the glenohumeral joint.

Surgical treatment options are generally categorized as reparative, restorative, or reconstructive. Reconstructive options, such as arthroplasty and humeral head resurfacing techniques, provide excellent improvement in pain and function but are best reserved for older, low-demand patients because of poor outcomes in young patients and complexity of revision.[16,19] Surgical treatment options for symptomatic chondral lesions in young patients are generally restricted to reparative (marrow stimulation techniques) or restorative techniques, such as autologous chondrocyte implantation, osteochondral autograft, and osteochondral allograft (OCA).

A few moderately sized cases series have suggested that microfracture may render favorable outcomes for small discrete lesions in the glenohumeral joint.[4,13,17,18] However, literature on restorative techniques used for larger defects is limited primarily to a few case reports and small case series of OCA transplantation.[2,6,8-10,12] These reports are most commonly in setting of reverse Hill-Sachs lesions involving the anteromedial humeral head after a posterior dislocation, and only 1 series contained more than 6 patients.[2]

Fresh OCA transplantation is characterized by the replacement of a chondral or osteochondral lesion with a graft composed of mature hyaline cartilage and supportive subchondral bone. This study investigated the functional outcomes and survivability of fresh OCA transplantation performed in patients with osteochondral defects of the humeral head resulting from any cause. We hypothesized that patients with isolated humeral head disease would experience favorable outcomes and that outcomes would be less favorable in patients with more widespread bipolar disease.

Materials and methods

The study was performed by retrospectively evaluating prospectively collected data for all patients who underwent fresh humeral head OCA transplantation between July 2004 and November 2011 in the practices of 2 fellowship-trained senior orthopedic surgeons (B.J.C., A.A.R.). We included all patients who were aged 18 years or older at the time of follow-up and at least 2 years after OCA transplantation.

Surgical treatment and rehabilitation

Humeral head OCA transplantation was performed open in 19 patients and arthroscopically in 1 patient. The open procedure was performed with the patient in the beach chair position, and the glenohumeral joint was approached through the deltopectoral interval.

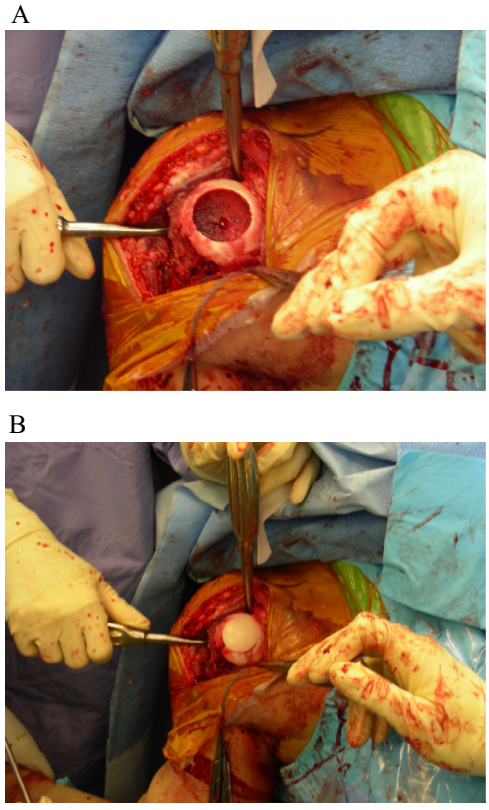

Figure 1 Intraoperative photographs demonstrate **(A)** the recipient socket after reaming of the osteochondral lesion and **(B)** a 30-mm osteochondral allograft after it has been press-fit into place.

The subscapularis was incised 1 cm to 1.5 cm medial to the biceps tendon.

When the humeral head lesion was relatively discrete, the choice was made to use an osteochondral plug. In such cases, the osteochondral defect was exposed by externally rotating the shoulder and débrided sharply using a curette. A guide pin was placed into the center of the lesion, and a cannulated reamer of the appropriate diameter (15-30 mm) was advanced to a depth of 6 to 9 mm to extricate the entire lesion (Fig. 1, *A*). A graft of the same diameter was prepared on the back table and press-fit into place (Fig. 1, *B*).

Contained defects measuring up to 30 mm in diameter were treated with allograft plugs; however, lesions that were larger or uncontained, or both, were generally treated with mushroom cap grafts to reconstruct the entire humeral head articular surface (Fig. 2). In such cases, upon entering the shoulder joint, the humeral head was osteotomized at the head-neck junction. A 15-mm reamer was used to establish a socket for the graft stem (Fig. 3, *A*). The graft was press-fit into place (Fig. 3, *B*). When the stability of the graft was a concern, supplemental fixation was achieved using bioabsorbable compression screws (Bio-Compression; Arthrex, Naples, FL, USA) or metallic headless compression screws (Acutrak 2 Standard; Acumed, Hillsboro, OR, USA; Fig. 4).

When the operation was performed arthroscopically, the patient was positioned in lateral decubitus, and the lesion was visualized through a posterior viewing portal (Fig. 5, *A*). A shaver was introduced through a standard anterior portal and used to débride the defect to a stable base. When sufficiently débrided, the graft recipient site