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Early clinical and structural results after autologous chondrocyte transplantation at the glenohumeral joint

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Background: The purpose of the study was to report early functional and radiographic results of a small series of patients who underwent autologous chondrocyte transplantation—collagen membrane seeding (ACT-Cs) for focal chondral defects of the shoulder.

Methods: The outcome of 4 consecutive male patients (mean age, 29.3 ± 6.2 years; range, 21-36 years) who underwent ACT-Cs for treatment of large symptomatic glenohumeral cartilage defects was retrospectively evaluated with clinical and radiographic measures at a mean of 41.3 ± 24.9 months (range, 11-71 months) after surgery. The evaluation included a visual analog scale for pain, the Constant score, the American Shoulder and Elbow Surgeons shoulder index, the Rowe score, and a satisfaction scale. Magnetic resonance imaging evaluation was performed according to the Magnetic Resonance Observation of Cartilage Repair Tissue scoring system.

Results: There were 3 humeral full-thickness cartilage defects (each 6.0 cm^2) and 1 glenoid full-thickness cartilage defect (2.0 cm^2). The mean postoperative visual analog scale score (0.3 of 10), the mean unweighted Constant score (83.3 ± 9.9), and the mean American Shoulder and Elbow Surgeons index (95.3 ± 8.1) were representative of satisfactory shoulder function. The Magnetic Resonance Observation of Cartilage Repair Tissue score was indicative of satisfactory defect coverage with signs of fibrocartilaginous repair tissue.

Conclusions: Autologous chondrocyte transplantation at the glenohumeral joint is a remote option for young adults with symptomatic, isolated, large-diameter cartilage lesions. Potential complications as a result of the open approach and 2-step procedure have to be considered carefully. Long-term data, larger patient populations, and randomized studies are required to determine the potential for chondrocyte transplantation techniques to be standard procedure for treatment of symptomatic, large-diameter, full-thickness cartilage defects in the glenohumeral joint.

Level of evidence: Level IV, Case Series, Treatment Study.

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Keywords: Articular cartilage; collagen matrix; autologous chondrocyte transplantation; glenohumeral joint; cartilage defect

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Focal chondral defects of the shoulder are rarely reported in the young and active patient.[6] These defects may occur as the result of a number of mechanisms. Injury to the articular surfaces has been associated with trauma involving high-impact forces and repetitive shear and torsional loads.[10] Chondral defects are also thought to be the result of progressive cartilage damage stemming from repetitive mechanical irritation occurring within the glenohumeral joint. Several etiologic factors for these defects have been proposed, including loose joint bodies, microinstability, and instability of the long head of the biceps.[22] Iatrogenic chondral wear resulting from malpositioned suture anchors or screws has also been reported.

Management of symptomatic focal chondral lesions in the young patient can be challenging because the risk for osteoarthritis (OA) is high and data regarding treatment options are limited.[1,11,15,16,24,28] Conversely, treatment guidelines for the management of chondral defects around the knee have been well established.[18,29] Specifically, management of articular defects of the knee with standardized autologous chondrocyte transplantation has resulted in significant improvements in clinical and radiologic outcome measures.[26,30] Considering the positive results seen with autologous chondrocyte transplantation procedures in the treatment of articular pathology at the knee, autologous chondrocyte transplantation−collagen membrane seeding (ACT-Cs) may be a viable treatment option for patients with chondral defects of the shoulder.

The purpose of the study was to evaluate the early functional and radiographic results of a small series of patients undergoing ACT-Cs for focal chondral defects of the humeral head.[3] Our hypothesis was that treatment of large-diameter, symptomatic chondral defects of the humeral head with ACT-Cs results in a satisfactory clinical outcome and adequate defect coverage on radiographic analysis.

Materials and methods

Four consecutive male patients underwent ACT-Cs for treatment of large symptomatic glenohumeral cartilage defects. Each patient's case is described later.

Criteria for ACT-Cs

Indications for ACT-Cs included young and active patients (aged <40 years) with a symptomatic, large-sized, full-thickness cartilage lesion without relevant subchondral bone edema (groups 1 and 2 according to Niemeyer et al[20]). During diagnostic arthroscopy, the size and shape of the chondral defect were confirmed and comparisons to preoperative magnetic resonance (MR) film measurements were made. Before cartilage biopsy, indications for autologous chondrocyte transplantation were confirmed by palpating the borders of the defect to ensure that adequate stability was present.

Clinical outcome measures

Preoperative data were taken from the patient files (clinical history, visual analog scale [VAS]). Postoperative outcome was assessed by use of a VAS for pain (with 0 representing no pain and 10 representing maximal imaginable pain), the unweighted Constant score,[7] the American Shoulder and Elbow Surgeons (ASES) index,[23] the Rowe score,[25] and an overall 4-part satisfaction scale (1, very satisfied; 2, satisfied; 3, partially satisfied; and 4, not satisfied). For this retrospective study, all patients signed a consent form for enrollment in the study before follow-up testing (clinical examination and magnetic resonance imaging [MRI]).

Diagnostic imaging

Plain radiographs were obtained in 3 planes (true anteroposterior, Y-view, and axillary) preoperatively in all patients to exclude OA and additional osseous pathologies. MRI was performed preoperatively and postoperatively with a 1.5-T MR scanner (Siemens Avanto; Siemens Medical Solutions, Erlangen, Germany). Intra-articular gadolinium was used during the acquisition of the preoperative MRI scan to improve visualization and permit evaluation of defect size and location. A standard shoulder protocol consisting of a fat-suppressed PDw TSE (proton density weighted turbo spin echo) sequence in the transverse and coronal planes, a coronal T1-weighted spin echo (SE) sequence, and a sagittal T2-weighted TSE sequence was acquired in all patients.[6]

A single experienced radiologist (K.W.) specializing in musculoskeletal radiology and blinded to the clinical information evaluated all MRI scans. The progression of OA and soft-tissue changes were assessed and the Magnetic Resonance Observation of Cartilage Repair Tissue score was documented as previously described.[13,14] This score uses 9 different variables to describe morphology and signal intensity of the repair tissue compared with the adjacent native cartilage: degree of defect repair and filling, integration to border zone, surface, structure and signal intensity of the repair tissue, subchondral lamina and bone, adhesions, and effusion.

Patients

Patient 1 was a 31-year-old right-handed semiprofessional ice hockey player who underwent a body check during play. He immediately stopped playing because of pain and loss of motion in his left shoulder. Within a few days after the initial trauma, he presented to our clinic with complaints of persistent pain during sports activity (VAS score, 6-7 of 10), limited external rotation, and a locking phenomenon of his left shoulder. MR arthrography showed a grade 4 chondral lesion according to the Outerbridge classification scheme[21] on the anterosuperior portion of the humeral head with intact subchondral bone.

Patient 2 was a 21-year-old right-handed recreational handball player with a physically demanding overhead profession. Atraumatic right shoulder pain developed in this patient. He reported progressive crepitations and pain during overhead activities that started when he was aged 14 years. He presented to our clinic after an unsuccessful course of nonoperative treatment with complaints of right shoulder pain (VAS scores, 4 of 10 with low activities and 7 of 10 with overhead activities). Clinical examination showed full active and passive range of motion (ROM) with audible and

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