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ORIGINAL STUDY

Arthroscopic treatment of the young degenerative shoulder joint ; is there a role for interpositioning arthroplasty ?

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We evaluate our experience with arthroscopic interpositioning arthroplasty as a treatment of the young degenerative shoulder joint.
Between 2007 and 2009 ten patients were treated with either a dermal allograft or a meniscal allograft.
In seven patients the graft failed and within 13 months these were revised to a total shoulder arthroplasty. Three patients are still satisfied after 7 to 8 years follow-up.
Biologic resurfacing of the glenoid may have a role in the management of glenohumeral arthritis in the young and active patient, but the optimal graft and pathology still need to be defined.

Keywords : shoulder ; osteoarthritis ; arthroscopy ; arthroplasty ; interpostion.

INTRODUCTION

A painful arthritic shoulder in a young and active patient can have a diverse etiology. Most frequent causes are post-traumatic (fracture or instability) or postsurgical (persistent instability, capsulorrhaphy arthropathy, hardware problems), but causes as avascular necrosis, glenoid dysplasia or a localized degeneration do occur. Chondrolysis has also been associated with the use of intraarticular local anesthetic pain pumps and with the use of thermal energy probes (*13*). The treatment of this pathology is challenging and once conservative treatment fails there are two surgical options, either arthroscopic debridement of the glenohumeral joint or prosthetic surgery. The latter needs to be postponed as long as possible because of the expected need for a revision of the shoulder prosthesis during his or her lifetime. Bartelt and Sperling studied outcomes of hemi arthroplasty and total shoulder arthroplasty (TSA) in patients less than 50 to 55 years old and within a follow-up of 5 years they found an unacceptable rate of symptomatic glenoid erosion and glenoid loosening (*3,20*). A study by Dillon showed that patients younger than 59 have a two times higher risk of revision at early follow-up than older patients (*9*). Clinical studies show successful short to mid-term results of arthroscopic debridement of the cartilage with microfracture and capsular release (*17,21,24*). If this fails biological resurfacing of the glenoid can be an alternative to prosthetic surgery in a young and active patient (*1,5,6*). This procedure preserves

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the glenoid bone stock and it can be performed as a minimal invasive arthroscopic procedure thereby sparing the subscapularis tendon. In this article we evaluate our experience with a prospective randomized controlled trial investigating clinical and radiographic outcomes of arthroscopic soft tissue interpositioning arthroplasty with either a meniscal allograft or a dermal allograft as a treatment for severe osteoarthritis of the glenohumeral joint after failed conservative treatment.

MATERIAL AND METHODS

This is a prospective randomized controlled clinical trial investigating clinical and radiographic outcomes of interpositioning arthroplasty.

Material

Young and active patients with painful non-inflammatory osteoarthritis of the shoulder, a spherical humeral head and not responding to conservative treatment for at least 3 months were included in the study. Only patients motivated to sustain a long rehabilitation were selected. Exclusion criteria were inflammatory arthropathy, avascular necrosis, rotator cuff lesions, previous arthroplasty, persistent glenohumeral instability and infection.

Patients were randomized for treatment with either a meniscal allograft or a dermal allograft.

The grafts we used were lateral meniscal allografts from the tissue bank from the University hospital of Ghent, Belgium, or processed human dermal allografts (Graftjacket, Regenerative Tissue Matrix, Wright Medical Technology, Inc., Arlington, TN).

Methods

Preoperatively clinical evaluation included a Constant Murley score and a VAS score (*7*). The grade of osteoarthritis was classified on anteroposterior and lateral X-rays according to the Kellgren and Lawrence grading system (Grade 0 : no radiographic features of osteoarthritis are present ; Grade 1 : doubtful joint space narrowing and possible osteophytic lipping ; Grade 2 : definite osteophytes, unimpaired joint space ; Grade 3 : multiple osteophytes, moderate diminution of joint space ; Grade 4 : large osteophytes, marked joint space narrowing, severe sclerosis and definitely bony deformity) (*11*). Preoperative CT images were used to define glenoid morphology according to Walch (*23*). The retroversion

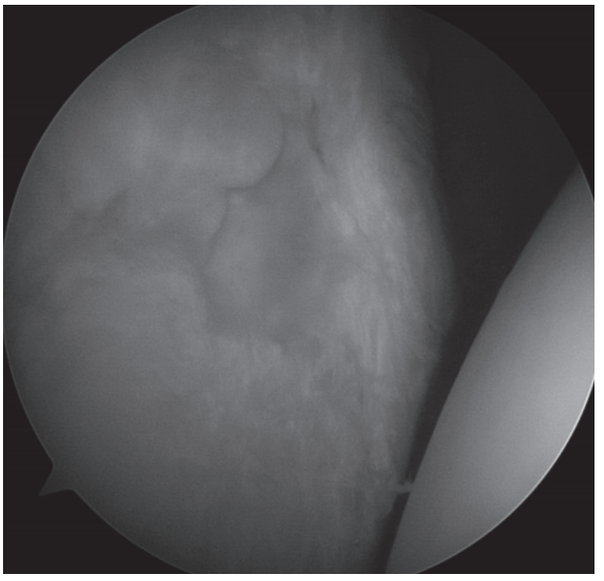

Fig. 1. — Unipolar lesion on the glenoid. Outerbridge Grade 4

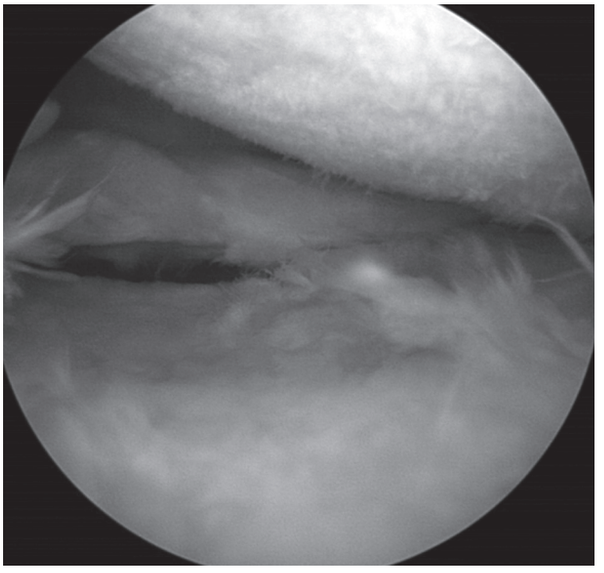

Fig. 2. — Bipolar lesion of glenoid and humeral head. Outerbridge Grade 3 to 4.

was measured as described by Friedman (*10*). An examination under anesthesia was performed to measure the passive range of motion of the shoulder. Peroperatively the cartilage lesions were graded 1 to 4 according to Outerbridge (*15*) (Fig. 1 and 2). Postoperatively clinical evaluation including scores was done after 1, 6, and

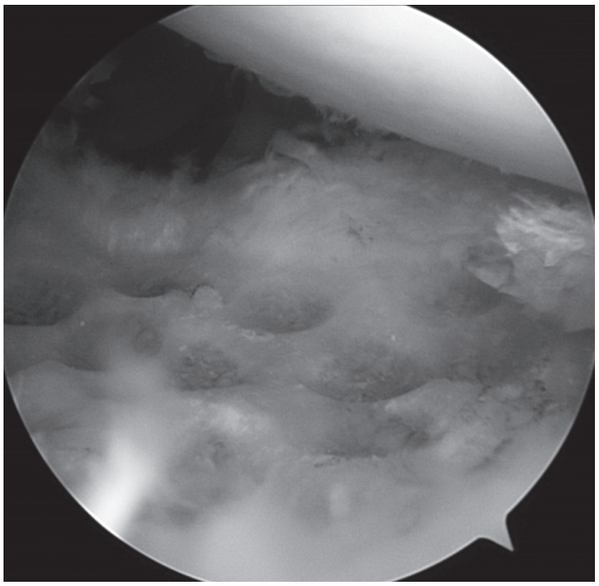

Fig. 3. — Chondroplasty of the glenoid surface

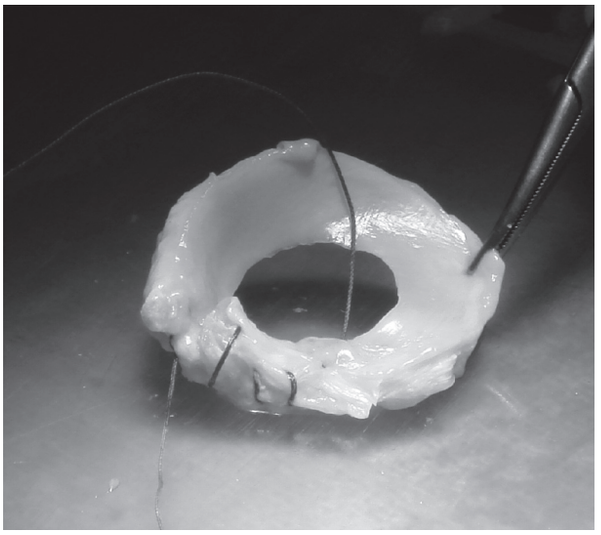

Fig. 4. — Lateral meniscal allograft

12 months, and at final follow up at 2 years. X-rays were taken immediately postoperative, and at clinical follow-up data. At one year a MRI scan with Gadolinium administered intravenously was planned to evaluate positioning and ingrowth of the graft. If a patient had continuous severe pain and no noticeable functional improvement after 4 to 6 months they were withdrawn from the study and treated with a TSA. Patients who had a conversion to a TSA within 2 years after placement of the graft jacket were considered as failures of the arthroscopic treatment. All patients consented prior to being included in the study. Approval of the local ethical committee was received.

Surgical Procedure

Surgery was performed under general anesthesia in a lateral decubitus position with longitudinal and lateral traction. All patients received cefazoline according to protocol pre- and postoperatively for 24 hours. Standard arthroscopic portals were used : posterior, anterosuperior and anteroinferior. A thorough debridement of the cartilage, removal of loose bodies and a release of the rotator cuff interval were performed using a shaver and a VAPR electrode (DePuy Synthes Mitek Sports Medicine). If the passive range of motion was limited due to a capsular contracture then a synovectomy and a circumferential capsular release were performed. The entire glenoid surface was denuded from cartilage and with a burr microfracture of the subchondral bone was done (Fig. 3). In case of a biconcave glenoid we planned to remove the intraarticular rim in an attempt to correct the glenoid version. The labrum, if still present, was kept unattached since it can be used for fixation of the graft. Next the size of the glenoid was estimated with a calibrated probe. Preparation of the graft was done outside the joint. If a graft jacket was used it was cut to the right size and a circumferential running suture was placed to reinforce the edge. If a lateral meniscus was used the horns were sutured together and overlapped depending on the size (Fig. 4). Either graft was armed with six sutures, three anteriorly and three posteriorly. The three posterior sutures were also used as traction sutures to introduce the graft through the anterior portal into the joint, as described by Bhatia *(4)*. Graft alignment was done under arthroscopic control until the entire surface was covered. Next the graft was sutured to the labrum or to the capsule. Loosening the traction on the arm stabilizes the graft by the pressure of the humeral head into the glenoid (Fig. 5 and 6). The postoperative protocol existed of 3 weeks of immobilization in a sling after which gentle auto active movement can start.

RESULTS

Between 2007 and 2009 ten patients were included in the study, 6 males and 4 females, with an average age of 44 (19 to 57). Four lateral meniscal

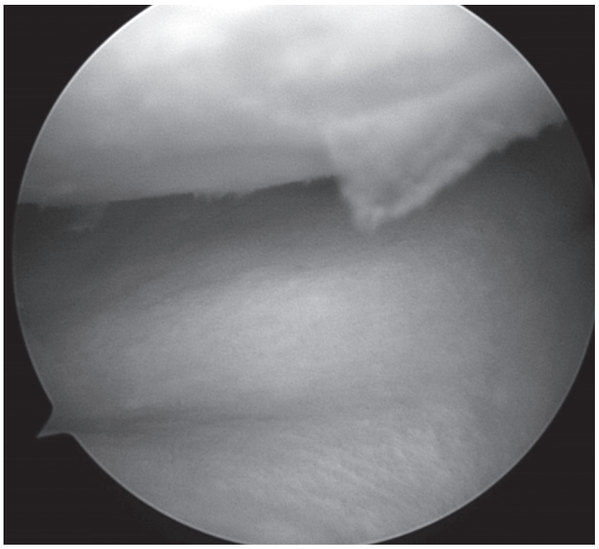

Fig. 5. — Graft jacket in place

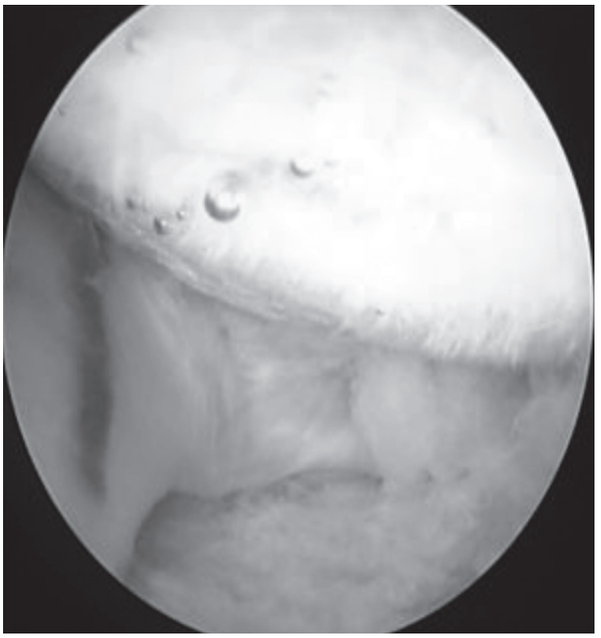

Fig. 6. — Meniscal graft in place

allografts and 6 graft jackets were implanted, but due to a lack of meniscal allografts the study was aborted early. Seven patients had previous instability surgery (4 patients had open capsular shifts, 1 patient had an arthroscopic stabilization, and 1 patient had an arthroscopic stabilization and a Latarjet procedure), 3 patients had no surgery on the shoulder before. Preoperatively all shoulders had limited passive range of motion due to a capsular contracture and the average Constant score was 34 (15 to 46), the VAS 29 (28 to 33). Seven patients were classified with osteoarthritis grade 3, 2 patients with grade 2, and 1 patient with grade 4. The CT images showed 5 type A1 glenoids, 4 type B1 glenoids and 1 type C glenoid. The retroversion averaged 14 degrees (2 to 55).

Peroperatively all patients had severe glenoid cartilage damage graded 3 to 4 according to Outerbridge. The humeral head was in 3 patients graded as 1 to 2, and in 7 patients 3 to 4. Within 13 months after the interpositioning procedure 7 patients underwent a revision to a TSA. All of them had severe damage to the humeral head. One patient (with previous stabilisation and Latarjet) had an infection after the arthroscopic procedure and was treated with arthroscopic debridement and a TSA at a second stage. Three patients are still satisfied at the latest follow-up, although on X-ray OA is deteriorating with diminishing of joint space and enlarging of osteophytes. Of these 1 patient has a dysplastic glenoid and was 19 years old at the time of surgery. He is now a social worker and able to do his job. The Constant score at 8 years follow up is 52. The second patient had severe postraumatic cartilage lesions after a skiing accident and he was 44 at the time of surgery. He is in an administrative job and still reasonably satisfied at 8 years follow up with a Constant score of 67. The third patient was 34 at the time of surgery, and treated with a lateral meniscal graft (Fig. 7 and 8). He was able to return to his job in a factory doing light manual work. The constant score at 2 years of follow-up was 56, and deteriorating, to 44 at 4 years of follow-up. At 1 year of follow-up an MRI scan with Gadolinium of 2 of the shoulders with graft was performed (1 patient refused). This showed small vascular channels in de edge of the meniscal graft. In the shoulder with the graft jacket a fibrocartilaginous layer was identified over the glenoid. Post-arthroplasty the mean Constant Score was 64 (from 61 to 68) at an average follow-up of 3.4 years.

Fig. 7. — Meniscal allograft ; Preoperative X-ray

Fig. 8. — Meniscal allograft ; Postoperative X-ray

DISCUSSION

Clinical studies show successful short to mid-term results of arthroscopic debridement of the cartilage with microfracture and capsular release in patients with a residual joint space of more than 2 mm and an absence of large osteophytes. On average these patients have decreased pain and increased function from 9 months to nearly 3 years in approximately 80 to 90% of cases (*17,21,24*). The results are less satisfying if the joint space is less than 2 mm and osteophytes are large (*12,21,24*). Millett combines debridement of the joint, capsular release, subacromial decompression and biceps tenodesis with removal of the inferior osteophyte in order to decompress the axillary nerve (*14*). The results are good in 85% after 2 years. Despite the limited period of success and the high frequency of failures at the medium and long term of arthroscopic debridement, it seems that this type of treatment can be indicated in a younger active patient with concentric wear of the glenohumeral joint, a residual joint space of more than 2 mm, mild loss of range of motion, and after a failed conservative treatment for at least 3 to 6 months. The procedure is performed arthroscopically and consists of lavage of the glenohumeral joint, debridement of the cartilage and labral tears, removal of loose bodies, and a capsular release of 360 degrees. In case of cartilage lesions grade 3 or 4 stable margins should be created with a curette and microfracture of the defects is performed with a curved awl. It is not clear if it helps to remove the inferior osteophyte or to correct the biconcavity of the glenoid surface. Immediate exercises postoperatively are critical to avoid stiffness however strengthening exercises are avoided for 6 weeks.

If the degeneration is more severe with a joint space of less than 2 mm and if the cartilage defect is situated predominantly on the glenoid side a

biological resurfacing of the glenoid as an interposition arthroplasty has been proposed as an alternative to prosthetic surgery. Savoie used the Restore patch (DePuy) in 20 patients with OA with a mean age of 32. A follow-up of 3 to 6 years resulted in 15 patients satisfied (75%) and 5 patients with a TSA (25%) after failure of the patch (*19*). De Beer used a Graftjacket on 32 patients with osteoarthritis with a mean age of 54. A mean follow-up of 4 years resulted in 23 patients satisfied (72%) and 9 failures (28%) of which 5 patients received a TSA (*8*). Both authors concluded that arthroscopic debridement and resurfacing of the glenoid is a minimally invasive option for treatment of glenohumeral osteoarthritis in the young and active patient with a potential for midterm success. It is considered a time buying procedure to postpone prosthetic surgery. Currently many commercialized processed grafts are available and of these the Restore patch (porcine small intestine submucosa) and the Graft Jacket show superior tissue remodeling (*6*). A Graft Jacket is decellularised human skin with minimal antigenicity, and the extracellular matrix in which the vascular channels are preserved for rapid repopulation and tissue ingrowth. It is a thicker structure than the Restore patch, with a large tensile strength optimising suture retention. Pennington performed arthroscopic resurfacing of the glenoid with a lateral meniscal allograft. He showed that this is technically possible and results are good on the short-term (*16*). Meniscal allografts have proved their beneficial effect in the knee and remodelling of the meniscus by synovial cells has been shown (*2,18,22*). Vascular ingrowth was also found on the MRI of the meniscal allograft in this study. A lateral meniscus is particularly suited to fit the glenohumeral joint because of the profile of a wedge and the circular shape if the horns are sutured together. Our results, 7 failures and 3 satisfied patients for more than five years, are less satisfying than the reports in literature. We had to convert 7 patients to a shoulder replacement within 13 months ; all of them had severe damage of the humeral head, together with chondropathy of the glenoid cartilage preoperatively. Seven of the patients in our study had instability surgery in the past, including 2 patients with a positive outcome after the resurfacing procedure. The patient with type C dysplastic glenoid and retroversion of 55 degrees is one of the 3 satisfied patients, and both other patients had grade 2 cartilage lesions on the humeral head. A difference with the populations of De Beer and Savoie is that these study groups consisted mainly of patients with primary osteoarthritis without previous surgery. The amount of subluxation and width of the joint line seem not to interfere with the outcome, maybe because the most important therapeutical aim for those patients is pain relief and to a lesser degree improvement of motion. All 'successful' patients in our series showed significant shoulder stiffness. We are aware of the shortcomings of this study ; the series of 10 patients is too small to draw explicit conclusions from the results. We aimed to find out which patient and pathology would be best indicated for this type of surgery ; the possible influence of glenoid version and biconcavity ; the influence of humeral head damage ; adherence, ingrowth and remodelling of a graft ; durability ; long term effect on the glenoid and if there is indeed lesser wear of the glenoid with preservation of the bone stock. Surgery was performed by a single surgeon (AK), and failures can be surgeon dependent. Nevertheless we believe our results suggest that biologic resurfacing of the glenoid may have a minimal and as yet undefined role in the management of glenohumeral arthritis in the young active patient over more traditional methods of hemiarthroplasty or TSA. This minimally invasive arthroscopic procedure permits to postpone prosthetic surgery in selected indications. Contraindications are large bipolar lesions and a deformed caput humerus for which other treatments like hemi arthroplasty or TSA have superior results.

To conclude : If conservative treatment fails arthroscopic debridement is a reasonable approach for treating early glenohumeral osteoarthritis in which the humeral head and glenoid remain concentric, and where there is still a visible joint space on an axillary radiograph. If this is not succesfull and the lesions are severe and predominantly on the glenoid side biologic resurfacing can be an option in selected patients. Further investigation is necessary to determine the optimal graft, the durability and the long-term effect on the glenoid bone.

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