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ORIGINAL STUDY

Resection arthroplasty of the infected shoulder : A salvage procedure for the elderly patient

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Infection of the shoulder joint is a challenging problem for the orthopaedic surgeon. Several treatment options have been proposed. Here, we evaluate the results achieved following resection arthroplasty of the shoulder in seven patients.

We performed resection arthroplasty in seven cases to treat a chronic uncontrollable infection of the shoulder. Three patients had an infected shoulder arthroplasty, one had an infected non-united arthrodesis, one was treated for an infected osteosynthesis, one had an infected rotator cuff repair and one patient had a septic arthritis of the shoulder joint. All patients were reviewed after a mean of 252 days. The functional outcome was evaluated using the Constant and DASH score. C-Reactive Protein levels were determined to evaluate the presence of residual infection.

Except for one doubtful result, all our patients remained free of infection and there was excellent pain relief after the resection. Nevertheless, the functional outcome was poor : the mean Constant score was 25.7 and the mean DASH score was 69.3.

Resection arthroplasty of the shoulder is a valuable treatment option for infection of the shoulder, especially in older patients with a poor mental and physical condition who suffer intolerable pain.

Keywords : shoulder ; infection ; resection arthroplasty ; outcome.

INTRODUCTION

Uncontrollable infections around the shoulder joint, with or without implants, remain a challenging problem for the orthopaedic surgeon. When antibiotic treatment, early debridement and/or staged exchange arthroplasties fail, a resection arthroplasty of the shoulder with aggressive synovectomy can be considered. Depending on the extent of humeral head and glenoid osteomyelitis, a variable amount of the proximal humerus is resected, after removal of all the hardware. In some cases even part of the glenoid can be removed. Although resection arthroplasty is a salvage procedure, it is still considered a valuable treatment option for patients with intolerable shoulder pain, loss of function and infection of the shoulder with possible severe systemic repercussions. Unfortunately this operation often leaves the patient with a severely restricted range of motion (ROM) of the shoulder and the pain relief seems to be unpredictable.

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The goal of this study was to evaluate the functional and subjective outcome of seven resection arthroplasties performed in our hospital and to determine whether the infection was eradicated successfully.

MATERIALS AND METHODS

Between January 2003 and June 2005 a resection arthroplasty of the shoulder was performed in seven patients with an uncontrollable infection of the shoulder joint. The preoperative diagnosis of infection was made based on clinical signs of infection, CRP levels, standard radiographs, and pre- and intraoperative cultures.

Surgery was performed as follows : the patient was installed in a beach-chair position. A long delto-pectoral approach was used to expose the glenohumeral joint. A thorough debridement of the glenohumeral joint and the subacromial space was performed with an extensive synovectomy and resection of all necrotic tissues. If necessary an additional lateral deltoid split approach was used to clean the subacromial space. When present, all the hardware (prosthesis, osteosynthesis material) was removed together with all the cement. When the humeral head was still present, it was found to be necrotic in all cases. A resection of the proximal humerus was performed at the level of the surgical neck. In all cases, gentle manual reaming of the glenoid was performed to remove all the necrotic tissues. Multiple cultures and biopsies were taken and the joint was washed with 15 litres of normal saline. After this lavage the wound was closed over two suction drains. The arm was put in a sling and immediately postoperatively pendulum and gentle range of motion exercises were started. Intravenous antibiotic treatment was given according to the antibiogram and was continued till the CRP levels were normal and till there were no clinical signs of infection. Oral antibiotics were given for a period of 6 weeks.

All patients were reviewed in the out-patient clinic. To assess the postoperative function of the shoulder, we used the Constant-score (3). A subjective evaluation was performed using the DASH score (5). This score gives a more general view of the patients' daily capabilities, taking the unaffected side into account. At follow-up CRP levels were determined.

RESULTS

We evaluated 7 patients (3 men, 4 women) who underwent a resection arthroplasty of the shoulder to treat a chronic infection (table I). Their mean age was 64.1 years (ranging from 41 to 79 years). All patients had previous surgery on the affected shoulder, including 2 to 6 interventions. Three had an infected shoulder arthroplasty (1 Delta prosthesis, 2 hemi-arthroplasties), one had an infected non-united arthrodesis, one was treated for an infected osteosynthesis, one had an infected rotator cuff repair and one patient had a septic arthritis of the shoulder joint. The mean follow-up period was 252 days after the resection.

Constant and DASH score

We noticed severe functional limitations in all patients. None of the operated shoulders had a good range of motion or a good strength. The mean postoperative Constant score was 25.7 and the mean DASH score 69.3. The mean subscore was 8.5 for function (maximum possible score 20), 3.4 for ROM (maximum possible score 40) and 4.4 for strength (maximum possible score 25). Despite these severe functional limitations, pain relief was considered good by 6 patients. The mean subscore for pain was 8.8 (maximum possible score 15). Mild pain after exercise and demanding use of the shoulder was present in all cases. All but one patient (patient 3) had considerably less pain than before the operation. Patient 3 still complained of severe pain after the resection and she was the only one who desired another procedure which could give her some more function and ease her pain. All the other patients were satisfied with the result and accepted their functional limitations. None of these patients wanted any other interventions to be performed.

Infection

Pre- and intraoperative cultures were positive in all but one patient. This patient (patient 2) had received antibiotics prior to the aspiration of the joint. The most common micro-organisms were methicillin resistant *Staphylococcus aureus* (MRSA ; 4 shoulders), coagulase negative *Staphylococcus aureus* (3 shoulders), *Propionibacterium acnes* (1 shoulder), *Streptococcus viridans* (1 shoulder)

Table I. — Overview of the functional outcome after resection arthroplasty of the shoulder

Patient	Age (yrs)	Diagnosis	Culture	Pain	Function	Strength	ROM	Total Constant score	DASH score	CRP (mg/l)	Infection ?
1	59	Infected Delta prosthesis	CNS, MRSA, P. acnes	10	6	5	4	25	94	< 5	/
2	79	Infected osteo-synthesis	Sterile*	10	6	5	2	23	48	< 5	/
3	50	Infected arthrodesis	CNS	0	12	5	2	19	93	< 5	/
4	77	Infected hemi-arthroplasty	MRSA, CNS	10	16	5	6	37	49	5.4	UTI
5	41	Infected hemi-arthroplasty	CNS, Coryne-bacterium	11	4	9	2	26	85	15.6	Low grade ? ?
6	74	Infected rotator cuff repair	MRSA	11	9	2	6	28	No data	< 5	/
7	69	Septic arthritis	MRSA	10	7	0	2	22	47	< 5	/
Mean	64.1			8.8	8.5	4.4	3.4	25.7	69.3		

* Patient under prolonged antibiotic treatment prior to the resection.

and *Corynebacterium species* (1 shoulder). A preoperative leucocyte count was available for 6 patients and varied from 5.4×10^9/L to 12.5×10^9/L (average 8.3×10^9/L). The erythrocyte sedimentation rate was elevated in all patients in which it was determined (average : 53 mm/h ; range : 16 to 128 mm/h). Preoperative CRP levels were determined in all patients and ranged from < 5 to 96.7 mg/L.

At follow-up, none of the patients had clinical signs of a shoulder infection. We only noticed elevated CRP levels in patients 4 and 5. Patient 4 suffered from a urinary tract infection but in patient 5 no clear focus could be identified. Further investigations to determine the source of the elevated CRP levels were declined by the patient. Clinically, no infection was present in the shoulder joint.

DISCUSSION

Historically, resection arthroplasties were mainly performed as a treatment for non-reducible fractures of the humeral head (overview in Cofield (*2*)). As early as in 1916, Nové-Joserand (in *11*) reported on the functional outcome of 237 resection arthroplasties. His main conclusion was that the function of the shoulder was lost. Garre (in *11*) performed 105 resection arthroplasties and in 76 cases 'a final cure for all conditions was obtained'. Jones (*6, 7*) already stressed that after a resection arthroplasty the best results that could be expected are pain relief, stability and maximum 90° of active abduction. Neer *et al* (*9*) reported satisfactory results in 14 of 19 cases. Knight and Mayne (*8*) on the other hand described 4 failures and 1 unsatisfacory result

out of 8 resection arthroplasties as a treatment for proximal humeral fractures. In 1985, Cofield (*2*) reported good pain relief after a resection arthroplasty in 1/2 to 2/3 of the patients. Abduction was below 90° in all cases, external rotation was limited and strength was reduced.

Today, resection arthroplasties of the humeral head are mainly restricted as a treatment option for uncontrollable chronic infections. Infections remain an important and potentially devastating complication of arthroplasty and the increasing use of shoulder prostheses in the treatment of glenohumeral arthritis and fractures has resulted in an increase in the number of patients with infection of the glenohumeral joint. The treatment of infections of the shoulder joint continues to be a challenging problem. Several treatment options have been proposed including prolonged antibiotic treatment, debridement of the joint with or without removal of all the implants, direct exchange, delayed reimplantation of the prosthesis, resection arthroplasty, arthrodesis and even amputation.

The purpose of this study was to review the functional outcome of 7 resection arthroplasties as a treatment for chronic uncontrollable infections of the shoulder joint. All patients had multiple surgical interventions prior to the resection and complained of severe pain. Resection of the humeral head resulted in adequate pain relief in 6 patients, but the function remained poor in all cases, with a mean postoperative Constant score of 25.7. Active abduction and elevation were less than 70° in all cases and strength was markedly reduced. The important functional limitations are reflected in the poor postoperative DASH scores (mean 69.3). However, despite these functional limitations the majority of the patients were happy with the result.

In this study, presence of residual infection after the resection arthroplasty was determined by the CRP levels at follow-up and the clinical examination. At follow-up, 5 patients remained free of infection (normal CRP levels and no clinical signs of infections in the shoulder). Two patients had elevated CRP levels at follow-up. One patient had a urinary tract infection and there were no clinical signs of residual infection in the shoulder joint. Patient 5 had a marked elevation of his CRP level. Although there were no clinical signs of infection we suspect that this man has a residual low grade infection.

Few studies have addressed the functional outcome of resection arthroplasties as a treatment option for infections of the glenohumeral joint. Codd *et al* (*1*) compared the results of staged exchange arthroplasties with resection arthroplasties for infected shoulder prostheses. No recurrent infection was observed and improvement in pain was similar in both groups. Functional results, in term of range of motion and use of the shoulder during activities of daily living, were clearly superior if a prosthesis could be reimplanted. Sperling *et al* (*10*) reviewed the results of 32 infected shoulder arthroplasties : 21 shoulders were treated by resection arthroplasty, 6 by a debridement with retention of the prosthesis, 2 by one-stage exchange and 3 by two-stage exchange. Of the 21 patients with a resection arthroplasty, 11 had a follow-up of more than 2 years. Of these, 7 had no pain, or only pain with unusual activity. The mean abduction was 69° and the mean external rotation was 31°. Persistence of the infection was noted in 29% of the resection arthroplasties but none of them required additional surgery to treat the infection. Coste *et al* (*4*) reviewed the results of 49 infected shoulder prostheses ; 10 patients were treated with a resection arthroplasty. The Constant score increased from 16 to 30. This increase was mainly due to an improvement in the pain score, which rose from 3 to 11.5 points. Thirty percent of the patients had persistent infection after the resection. This however did not result in further surgery afterwards.

In conclusion we can say that our results are comparable to those in the literature and this study confirms the findings of other authors. Resection arthroplasty of the shoulder is a valuable treatment option to control infection and intolerable pain in patients with infected prostheses, infected osteosynthesis or osteomyelitis of the shoulder. Acceptable pain relief and satisfactory eradication of infection can be expected, but because of the severe functional repercussions of the operation, it should always be considered a salvage procedure. We believe that this procedure should be reserved

for the older patients with a poor mental and physical condition. In all other cases other treatment options like a one- or two-stage exchange arthroplasty should be considered.

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