Shoulder Arthroplasty in Patients with a Prior Anterior Shoulder Dislocation

RESULTS OF A MULTICENTER STUDY

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Background: Prior reports of shoulder arthroplasty performed for dislocation-induced arthropathy have included only patients who had had a prior stabilizing procedure. The purpose of this study was to report the results of shoulder arthroplasty in all patients with a prior anterior shoulder dislocation, including both those previously treated operatively and those previously treated nonoperatively.

Methods: Fifty-five shoulders undergoing arthroplasty for arthritis following a prior anterior shoulder dislocation were evaluated. Twenty-seven of the shoulders had undergone a prior anterior stabilization procedure. The measures used to evaluate the shoulders included the Constant score, adjusted Constant score, active mobility, subjective satisfaction, radiographic result, and complications.

Results: The shoulders were evaluated at a mean of 45.0 months. The Constant score improved from a mean of 30.8 points preoperatively to a mean of 65.8 points at the time of follow-up. The adjusted Constant score improved from a mean of 38.2% to a mean of 79.8%. Active forward flexion improved from a mean of 82.1° to a mean of 138.9°. Active external rotation improved from a mean of 4.0° to a mean of 38.6°. Fifty patients rated the result as good or excellent. Negative prognosticators included an older age at the time of the initial dislocation and a rotator cuff tear. No significant differences in demographic factors, pre-arthroplasty function, post-arthroplasty function, pre-arthroplasty radiographic findings, post-arthroplasty radiographic findings, complication rate, or reoperation rate were noted between the patients treated with a prior operation for the anterior instability and those treated nonoperatively.

Conclusions: This investigation documented the good results obtainable with shoulder arthroplasty for the treatment of arthritis following anterior shoulder instability. In addition, our findings suggest that capsulorrhaphy-induced arthropathy may be indistinguishable from arthritis following nonoperatively treated anterior shoulder instability.

Level of Evidence: Therapeutic study, Level IV (case series [no, or historical, control group]). See Instructions to Authors for a complete description of levels of evidence.

Narce et al. first characterized arthritis following glenohumeral dislocation in 1982. Samilson and Prieto further analyzed the condition and coined the term “dislocation arthropathy.” Dislocation arthropathy has been described in shoulders that had previously undergone a surgical procedure to treat the instability as well as in those in which the instability had been treated nonoperatively. Factors contributing to the development of arthritis in shoulders with a prior anterior dislocation include the age of the patient at the time of the initial dislocation, the delay between the initial dislocation and surgical stabilization, the age of the patient at the time of the surgical stabilization, and the presence of a glenoid fracture. In addition, factors specific to certain glenohumeral stabilizing surgical procedures have been mentioned as contributing to the development of dislocation arthropathy. These factors include encroachment on the articular cartilage by hardware or a laterally placed bone block and excessive anterior soft-tissue tension imparted by a Putti-Platt procedure or similar type of intervention (“capsulorrhaphy arthropathy”).

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A commentary is available with the electronic versions of this article, on our web site (www.jbjs.org) and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM).
There is surprisingly little published information on the results of shoulder arthroplasty following operative treatment of anterior shoulder instability, and we are not aware of any study of the results of shoulder arthroplasty for the treatment of dislocation arthropathy resulting from nonoperatively treated anterior shoulder instability. The purpose of the present study was to evaluate the results of shoulder arthroplasty for the treatment of dislocation arthropathy resulting from either operatively or nonoperatively treated anterior shoulder instability.

Materials and Methods

The present series was drawn from a multicenter study of 1542 primary shoulder arthroplasties performed between September 1991 and September 1998 and reported in September 2001. Fifty-seven surgeons from nine countries contributed patients to that multicenter study. Of the 1542 shoulders, fifty-five were identified as having had a prior anterior dislocation that had been reduced and those shoulders are the subject of the present investigation. (Twelve shoulders that had presented with a fixed anterior dislocation were excluded from the present series.) None of the fifty-five shoulders had a history of dislocation in any direction other than anterior, as determined by a review of the available medical records and radiographs. (Three patients with a dislocation in a direction other than anterior were excluded.) Twenty-seven of the shoulders had undergone prior surgery to stabilize the glenohumeral joint, and the remaining twenty-eight shoulders had not had surgery prior to the time of the arthroplasty.

Of the patients who had undergone a prior operation to...
treat the instability, sixteen were male and eleven were female and their average age was 31.6 years (range, seventeen to sixty-nine years) at the time of the first dislocation. The dominant shoulder was affected in eighteen patients, the non-dominant shoulder was affected in eight, and one patient was ambidextrous. The right shoulder was affected in twenty patients. The average number of prior dislocations, as estimated by the patients, was 18.2 (range, one to 100). Only two patients reported only one prior dislocation. Seventeen shoulders had been treated with a prior coracoid transfer procedure; nine, with a soft-tissue reconstruction, which was a Putti-Platt procedure in two of them; and one, with a combination coracoid transfer and Putti-Platt procedure. Twenty-four of the shoulders had undergone a single operation, whereas two had undergone two operations and one had undergone three operations. The mean delay from the first instability episode to the shoulder arthroplasty was 24.2 years. The average age at the time of the arthroplasty was 55.9 years (range, twenty-seven to seventy-four years). The mean delay from the first operation for treatment of the instability to the shoulder arthroplasty was 20.1 years.

Of the patients who had not had prior surgery, fifteen were men and thirteen were women and their average age was 43.1 years (range, eighteen to eighty-one years) at the time of the first dislocation. The dominant shoulder was affected in twenty patients, the nondominant shoulder was affected in seven, and one patient was ambidextrous. The right shoulder was affected in twenty-one patients. The average number of prior dislocations, as estimated by the patients, was 7.0 (range, one to fifty). Fifteen patients reported only one prior dislocation. The mean delay from the first instability episode to the shoulder arthroplasty was 18.6 years. The average age at the time of the arthroplasty was 62.2 years (range, thirty-three to eighty-three years).

All patients were evaluated preoperatively with anteroposterior radiographs of the shoulder, with the humerus in internal, external, and neutral rotation, and with an axillary lateral radiograph. All patients in whom the first dislocation had occurred before they were sixty years of age had radiographic findings corresponding with type-3 changes (excessive osteophytes; Fig. 1), as described by Samilson and Prieto2. The nine patients (three treated operatively and six treated nonoperatively) who had had the initial dislocation after the age of sixty years demonstrated a loss of articular cartilage with very few, if any, osteophytes (Fig. 2). Four of these nine patients had persistent anterior subluxation of the humeral head, and three of the four had an anterior fracture of the glenoid rim. Six shoulders (one in the operatively treated group and five in the nonoperatively treated group) had evidence of osteonecrosis of the humeral head, with a sclerotic-appearing osseous segment (four shoulders), a subchondral fracture (one), or a segment of osseous collapse (one). Factors possibly contributing to the development of arthritis in the operatively treated group included a coracoid graft that had been positioned too laterally in one shoulder and intra-articular hardware in four. No shoulder in this series had evidence of superior migration of the humeral head on the anteroposterior radiograph.

Prior to the arthroplasty, all but one patient had secondary imaging: forty-two had a computed tomographic arthrogram; six, magnetic resonance imaging; five, an arthrogram; and one, a computed tomographic scan. These studies demonstrated a full-thickness tear of the rotator cuff in twelve patients; the tear was limited to the supraspinatus tendon in eleven and extended into the infraspinatus tendon in one. These tears were subsequently confirmed at the time of the arthroplasty. Four tears (including the one with infraspinatus involvement) occurred in the operatively treated group, and the remainder occurred in the nonoperatively treated group. No shoulder had a complete disruption of the subscapularis tendon.

**Fig. 3**
Illustrations of the different types of glenoid morphology:
- type A1 (A),
- type A2 (B),
- type B1 (C),
- type B2 (D),
- and type C (E).
The glenoid morphology in each of the forty-three shoulders that had preoperative computed tomography was classified with use of the previously validated system of Walch et al. (Fig. 3, A through E). According to this system, thirty-three shoulders (sixteen in the operatively treated group and seventeen in the nonoperatively treated group) had a centered humeral head with minor erosion of the glenoid (type A1, concentric) or a centered humeral head with major central erosion of the glenoid (type A2, concentric). Nine shoulders (five in the operatively treated group and four in the nonoperatively treated group) had posterior subluxation of the humeral head, narrowing of the posterior joint space, subchondral sclerosis, and osteophytes (type B1, nonconcentric) or posterior subluxation of the humeral head and a biconcave glenoid (type B2, nonconcentric). Finally, one shoulder in the nonoperatively treated group had glenoid retroversion in excess of 25° and a centered head (type C, dysplasia). None of the type-B glenoids in the operatively treated group had posterior glenoid erosion (B2); these shoulders included four that had undergone a coracoid transfer and one that had had a Bankart repair.

All patients in this series underwent primary shoulder arthroplasty with the Aequalis prosthesis (Tornier, Montbonnot, France). All humeral prostheses were inserted with cement. Thirty-nine shoulders underwent glenoid resurfacing, and the remainder underwent hemiarthroplasty. The decision regarding whether to resurface the glenoid was made by each surgeon. The humeral stem was positioned anatomically in fifty-three shoulders and was intentionally positioned in excess of 25° and a centered head (type C, dysplasia). None of the type-B glenoids in the operatively treated group had posterior glenoid erosion (B2); these shoulders included four that had undergone a coracoid transfer and one that had had a Bankart repair.

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TABLE I Results of Preoperative and Postoperative Evaluations*

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>Pain (points)</th>
<th>Activity (points)</th>
<th>Mobility (points)</th>
<th>Strength (points)</th>
<th>Total (points)</th>
<th>Adjusted (%)</th>
</tr>
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<tbody>
<tr>
<td>Prior op. (n = 27†)</td>
<td>5.3</td>
<td>8.2</td>
<td>15.8</td>
<td>5.7</td>
<td>35.0</td>
<td>42.2</td>
</tr>
<tr>
<td>No prior op. (n = 28†)</td>
<td>4.0</td>
<td>7.3</td>
<td>12.3</td>
<td>3.7</td>
<td>27.3</td>
<td>34.3</td>
</tr>
<tr>
<td>Entire series (n = 55†)</td>
<td>4.6</td>
<td>7.7</td>
<td>14.0</td>
<td>4.7</td>
<td>31.0</td>
<td>38.2</td>
</tr>
</tbody>
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*p < 0.0005 for all comparisons between preoperative and postoperative parameters. †Since, at the time of final follow-up, outcome data were collected only for patients with the original prosthesis in place, the n values for the postoperative data were 26 for the group with a prior operation, 27 for the group without a prior operation, and 53 for the entire series.

The influence on the results of the patient’s age at the time of the initial glenohumeral dislocation, the status of the rotator cuff, whether a glenoid component was utilized, and the type of previous surgery (in the operatively treated group only) was evaluated. In addition, preoperative factors and re-
results were compared between the nonoperatively and operatively treated groups.

Statistical analysis was performed with use of a chi-square test and a Fisher test for qualitative variables. The Student t-test and the test of Levene (based on equality of variance) were employed for quantitative variables. Significance was set at p < 0.05.

Results

The shoulders were assessed at an average of 45.0 months (range, twenty-four to eighty-seven months) postoperatively. The findings at t.676 pce preoperative and postoperative evaluations are shown in Table I. We observed ten complications, including three cases of glenoid loosening, in nine shoulders. One case of glenoid loosening occurred in a shoulder with a normal rotator cuff, one occurred in a shoulder with a rotator cuff tear at the time of the arthroplasty, and one occurred in a shoulder in which a late tear of the rotator cuff developed and resulted in superior migration of the humeral component and loosening of the glenoid component. There were four cases of postoperative anterior glenohumeral instability, three of which occurred in shoulders that had undergone prior surgery for the instability; in one of the three, the prosthesis was intentionally placed in excessive humeral retroversion. The fourth case of postoperative anterior glenohumeral instability occurred in a patient in the nonoperatively treated group who had a rotator cuff tear at the time of the arthroplasty. All cases of postoperative anterior instability were diagnosed by clinical and radiographic examination within six months after the arthroplasty, and all presented as dynamically occurring anterior subluxation as the shoulder was positioned in abduction and external rotation. One patient fell approximately one month after the shoulder arthroplasty and sustained a periprosthetic fracture that necessitated open reduction and internal fixation. This case was further complicated by an infection necessitating plate removal. (The prosthesis was preserved.) In addition, one patient had a postoperative axillary nerve palsy, which spontaneously resolved.

Six secondary operative procedures were performed in this series. Of the shoulders with loosening of the glenoid component, one underwent revision of that component. Revision was planned for another shoulder, and the third patient re-

<table>
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<th>TABLE I (continued)</th>
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<tbody>
<tr>
<td>Pain (points)</td>
</tr>
<tr>
<td>13.4</td>
</tr>
<tr>
<td>12.1</td>
</tr>
<tr>
<td>12.7</td>
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</table>

One patient with post-arthroplasty anterior instability underwent revision of the humeral stem to increase humeral retroversion, and the persistent anterior subluxation resolved. The patient with the periprosthetic fracture and subsequent infection underwent two operative procedures, as previously mentioned. Finally, two shoulders underwent arthroscopy because of persistent pain postoperatively: one underwent an arthroscopic biceps tenotomy and the other, an arthroscopic acromioplasty.

Radiographically, we observed five humeral periprosthetic radiolucencies (four partial and one complete). These radiolucencies were not seen to progress on serial radiographs made during the follow-up period. No humeral stem migrated within the humerus during the follow-up period. Twenty-one glenoid components had periprosthetic radiolucent lines, and five of these lines were determined to be progressive. The scores for the radiolucent lines averaged 4.0 points (range, 0 to 18 points). There was superior migration of the humerus in four shoulders, three with a total shoulder replacement and one with a hemiarthroplasty; two of the four shoulders had had a rotator cuff tear preoperatively.

Patients who were younger than forty years old at the time of the initial dislocation had a better mean preoperative mobility score (17.4 points compared with 9.0 points for the older patients; p = 0.009), overall Constant score (37.3 compared with 20.6 points; p = 0.005), adjusted Constant score (45.0% compared with 29.0%; p = 0.041), and active range of forward flexion (92° compared with 48°; p = 0.001). Patients who were younger than forty years old at the time of the initial dislocation also had a better mean postoperative mobility score (32.8 compared with 20.7 points; p = 0.006), activity score (17.9 compared with 13.3 points; p < 0.0005), strength score (11.1 compared with 2.9 points; p = 0.002), overall Constant score (74.9 compared with 49.0 points; p < 0.0005), adjusted Constant score (87.3% compared with 67.4%; p < 0.0005), and active range of external rotation (45° compared with 28°; p = 0.006). With the numbers available, the younger and older groups did not differ significantly with regard to postoperative gains for any parameter. With the numbers available, there was also no significant difference between the groups with regard to the duration of follow-up, radiographic findings, complication rate, or reoperation rate. Patients who...
were younger than forty years old at the time of the initial dislocation were also younger at the time of the shoulder arthroplasty (54.1 compared with 68.2 years; p = 0.009).

Patients without a rotator cuff tear had a better mean preoperative pain score (5.3 points compared with 3.3 points for patients with a rotator cuff tear; p = 0.006), mobility score (16.5 compared with 9.2 points; p = 0.002), activity score (8.5 compared with 5.8 points; p = 0.005), strength score (6.2 compared with 1.5 points; p = 0.001), overall Constant score (36.4 compared with 19.7 points; p < 0.0005), adjusted Constant score (43.8% compared with 27.0%; p = 0.001), and active range of forward flexion (96° compared with 49°; p < 0.0005). Patients without a rotator cuff tear also had a better mean postoperative mobility score (31.0 compared with 22.6 points; p = 0.009), activity score (16.7 compared with 13.6 points; p = 0.010), strength score (11.9 compared with 3.6 points; p < 0.0005), overall Constant score (72.6 compared with 52.0 points; p < 0.0005), adjusted Constant score (84.3% compared with 69.0%; p = 0.006), and active range of forward flexion (145° compared with 124°; p = 0.034). Shoulders with a rotator cuff tear demonstrated a significantly larger gain in active forward flexion following the arthroplasty (82° compared with 47°; p = 0.010). With the numbers available, no significant difference was found between the two groups (with and without a rotator cuff tear) with regard to duration of follow-up, radiographic findings, complication rate, or reoperation rate.

With the numbers available, no significant differences in any of the preoperative factors were found between the patients undergoing total shoulder arthroplasty and those to be treated with hemiarthroplasty. Postoperatively, patients treated with total shoulder arthroplasty demonstrated a better mean activity score (16.4 compared with 13.8 points; p = 0.036), overall Constant score (69.5 compared with 58.2 points; p = 0.048), and adjusted Constant score (83.6% compared with 71.4%; p = 0.028). Shoulders that had undergone total shoulder arthroplasty also demonstrated a significantly larger gain in active external rotation (39° compared with 23°; p = 0.006). With the numbers available, there was no significant difference between the groups with regard to the duration of follow-up, radiographic findings, complication rate, or reoperation rate.

Comparison of the patients who had previously undergone a bone-block procedure to treat the instability with those who had undergone a soft-tissue procedure revealed that the first group had a better mean pre-arthroplasty mobility score (18.4 compared with 11.0 points; p = 0.037), activity score (9.8 compared with 5.3 points; p = 0.004), adjusted Constant score (49.3% compared with 29.7%; p = 0.008), and active range of external rotation (16° compared with –7°; p = 0.007). After the arthroplasty, patients who had undergone a prior soft-tissue procedure demonstrated a larger mean gain in the mobility score (16.9 compared with 9.5 points; p = 0.013) and a larger mean gain in the activity score (10.1 compared with 6.2 points; p = 0.046). With the numbers available, there was no significant difference between the groups with regard to the duration of follow-up, radiographic findings, complication rate, or reoperation rate.

When the shoulders with prior operative treatment of the anterior shoulder instability were compared with those with previous nonoperative treatment of the anterior shoulder instability, no significant differences were discovered with regard to the duration of follow-up, demographic factors, pre-arthroplasty function, post-arthroplasty function, pre-arthroplasty radiographic findings (glenoid morphology), post-arthroplasty radiographic findings, complication rate, or reoperation rate.

Discussion

This study demonstrated that good results are obtainable with shoulder arthroplasty performed to treat dislocation arthropathy following either operatively treated or nonoperatively treated anterior shoulder instability. We discovered no significant differences in pre-arthroplasty factors or the results of the arthroplasty between the patients with previous operative treatment of the anterior shoulder instability and those with previous nonoperative treatment. In addition, this investigation revealed that complications and reoperations are not infrequent in patients undergoing shoulder arthroplasty for the treatment of dislocation arthropathy.

As far as we know, reports of shoulder arthroplasty in patients with a history of anterior shoulder instability have been limited to patients in whom the instability had been treated surgically. The results in our series are consistent with those of Bigliani et al. in that, although the outcomes were good, they were not as good as the results of arthroplasty performed for primary osteoarthritis. The shoulders treated for dislocation arthropathy had a mean postoperative adjusted Constant score of 79.8% compared with 96.2% for shoulders treated for primary osteoarthritis in the same multicenter patient population.

The age at the time of the initial dislocation played a role in pre-arthroplasty and post-arthroplasty function, with the patients who had been younger than forty years old at the time of the initial dislocation having a higher level of shoulder function. This almost certainly was due in part to the discrepancy between the groups with regard to the age at follow-up, although the significant difference between the two groups with regard to the age and gender-adjusted Constant score suggests that the age at the initial dislocation was a contributing factor. Also of interest were the differences in preoperative radiographic findings between the patients younger than sixty years of age and those older than sixty years of age at the time of the initial dislocation. The excessive osteophytes observed in the younger patients suggests a slowly evolving process, whereas the paucity of osteophytes observed in the older patients suggests a rapidly evolving process. This radiographic finding combined with the pre-arthroplasty and post-arthroplasty functional differences may indicate that these two groups of patients are somewhat different.

In accordance with observations in other series of patients treated with arthroplasty, a rotator cuff tear was a negative prognosticator of pre-arthroplasty and post-arthroplasty...
shoulder function. However, patients with a rotator cuff tear had comparable gains in outcome parameters—and even more of a gain in active forward flexion—compared with the patients with an intact rotator cuff. No patient in this series had an attempt at rotator cuff repair. Our rationale for not repairing these small tears was that such repairs may cause stiffness, which may be more detrimental than any weakness caused by a small supraspinatus tear (<1 cm of retraction). We had discovered that small unrepaired tears of the supraspinatus do not appreciably affect the results of shoulder arthroplasty in patients with primary osteoarthritis. However, on the basis of the findings in the present study, it appears that an attempt to repair even small tears may be warranted when arthroplasty is performed in patients with dislocation arthropathy. The sole patient with a tear extending into the infraspinatus did not undergo repair because the tear was thought to be irreparable.

As we have observed in our patients with primary osteoarthritis, total shoulder arthroplasty seems to outperform hemiarthroplasty in the treatment of dislocation arthritis. Since the decision to resurface the glenoid in this multicenter study was based strictly on surgeon preference, we must interpret these results with a degree of caution. Two of the three cases of glenoid loosening in this series occurred in patients with a deficient rotator cuff, prompting us to avoid glenoid resurfacing in patients with dislocation arthritis and a deficient rotator cuff. Alternatively, a total shoulder arthroplasty combined with rotator cuff repair could be attempted, although we are unable to comment on the results of that type of intervention.

Reports of capsulorrhaphy-induced arthropathy have classically described posterior subluxation and posterior glenoid wear created by excessively tight anterior structures. We, however, did not observe a difference in glenoid morphology or posterior subluxation between the shoulders treated previously with stabilizing surgery and those treated nonoperatively. (This observation is based only on the forty-three shoulders with an available computed tomographic scan.) In fact, we did not observe posterior glenoid erosion in any shoulder that had undergone a prior stabilizing operation. In contrast, we have reported that up to 19% of patients with primary osteoarthritis have posterior glenoid erosion. Because it is not possible to determine, from our database, the total number of patients with a prior anterior dislocation, treated either operatively or nonoperatively, in our population, we cannot make conclusions regarding the relative risk of glenohumeral arthritis developing following anterior dislocation or the contribution of prior instability surgery to arthritis. However, because we found no differences between shoulders treated with prior stabilizing surgery and those treated nonoperatively, we have come to question the existence of the condition called “capsulorrhaphy arthropathy.”

We recognize that this study is not free from limitations. This multicenter retrospective review had methodological flaws inherent in this type of study design. Surgical techniques cannot be completely standardized in such a study. In addition, the duration of follow-up averaged only forty-five months, which is relatively short for an arthroplasty study. Statistically, this investigation involved multiple comparisons with multiple factors potentially influencing the results. Thus, comparative differences of marginal significance are of questionable importance. Finally, when this investigation was undertaken, no general health outcome evaluation was used.

In conclusion, despite the aforementioned limitations, this investigation documents the good results obtainable with shoulder arthroplasty for the treatment of arthritis following anterior shoulder instability. However, relatively high complication and reoperation rates can be expected. In addition, the findings in this study suggest that so-called capsulorrhaphy arthropathy may be indistinguishable from arthritis following nonoperatively treated anterior instability of the shoulder.

References


