

Reverse Total Shoulder Arthroplasty: A Review of Results According to Etiology

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Background: Reverse total shoulder arthroplasty provides a surgical alternative to standard total shoulder arthroplasty for the treatment of selected complex shoulder problems. The purpose of the present study was to evaluate the effects of etiology on the results of reverse total shoulder arthroplasty.

Methods: Between May 1995 and June 2003, 240 consecutive reverse total shoulder arthroplasties were performed in 232 patients with an average age of 72.7 years. Patients were grouped according to etiology, and the clinical and radiographic outcomes for each group were measured and compared.

Results: One hundred and eighty-six patients with 191 retained reverse total shoulder arthroplasty prostheses were followed for an average of 39.9 months. Overall, the average Constant score improved from 23 points before surgery to 60 points at the time of follow-up and 173 of the 186 patients were satisfied or very satisfied with the result. Although substantial clinical and functional improvement was observed in all etiology groups, patients with primary rotator cuff tear arthropathy, primary osteoarthritis with a rotator cuff tear, and a massive rotator cuff tear had better outcomes, on average, than patients who had posttraumatic arthritis and those managed with revision arthroplasty. Dislocation (fifteen cases) and infection (eight cases) were the most common complications among the 199 shoulders that were followed for two years or were revised prior to the minimum two-year follow-up. Patients who received the reverse prosthesis at the time of a revision arthroplasty had a higher complication rate than did those who received the reverse prosthesis at the time of a primary arthroplasty.

Conclusions: The reverse total shoulder arthroplasty prosthesis can produce good results when used for the treatment of a number of other complex shoulder problems in addition to cuff tear arthropathy. Patients with posttraumatic arthritis and those undergoing revision arthroplasty may have less improvement and higher complication rates in comparison with patients with other etiologies. The advanced age of the patients in the present series and the relatively short duration of follow-up suggest that the prosthesis should continue to be used judiciously.

Level of Evidence: Prognostic Level II. See Instructions to Authors for a complete description of levels of evidence.

In 1983, Neer et al. described cuff tear arthropathy as glenohumeral joint changes and humeral head collapse thought to be secondary to attrition of the rotator cuff¹. Neer recommended that these patients should be managed with total shoulder arthroplasty and “limited-goals rehabilitation,” noting that the results were inferior to those for patients with typical glenohumeral arthritis. To address cuff tear arthropathy, fixed-fulcrum prostheses that allowed the deltoid to raise the arm while the prosthesis remained located were

developed. These designs created excessive shear forces that led to rapid glenoid component loosening^{2,9}. Consequently, many surgeons adopted hemiarthroplasty and limited-goals rehabilitation for the management of these patients.

Grammont et al. were the first to report on a reverse shoulder prosthesis consisting of a cemented polyethylene humeral cup and a metallic glenoid component¹⁰. The original glenoid component was two-thirds of a sphere and was medialized to position the center of rotation near the native glen-

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TABLE I Number of Cases According to Etiology for Reverse Total Shoulder Arthroplasty

Indication	Total Number of Shoulders (N = 240)	Number of Shoulders with Two-Year Follow-Up (N = 196)
Rotator cuff tear arthropathy	74 (30.8%)	59 (30.1%)
Revision arthroplasty	54 (22.5%)	45 (23.0%)
Massive rotator cuff tear	41 (17.1%)	34 (17.3%)
Primary osteoarthritis	33 (13.8%)	25 (12.8%)
Posttraumatic arthritis	33 (13.8%)	28 (14.3%)
Tumor	2 (0.8%)	2 (1.0%)
Acute fracture	2 (0.8%)	2 (1.0%)
Rheumatoid arthritis	1 (0.4%)	1 (0.5%)

oid. In 1991, the humeral component was changed to a stemmed metallic implant and the glenoid component was changed to a hemispherical design that positioned the glenohumeral center of rotation at the interface of the glenoid component and the scapula¹¹.

The largest reported series of reverse shoulder arthroplasties to date comprised eighty patients with cuff tear arthropathy¹². The Constant score increased by an average of 43 points, and the average active elevation improved from 65° to 138° at an average of forty-four months postoperatively. Although there was a 15% complication rate with a 5% revision rate, 96% of the patients complained of little or no residual pain. A separate investigation of patients with cuff tear arthropathy demonstrated good results after more than five years of follow-up, with no evidence of progressive glenoid loosening or deterioration of the results over time¹³. Reverse shoulder arthroplasty also has been used for a number of other complex shoulder reconstruction problems, such as revision arthroplasty, tumor resection, and rheumatoid arthritis¹⁴⁻¹⁶. The purpose of the present study was to determine whether the short-term results of reverse total shoulder arthroplasty are affected by etiology.

Materials and Methods

Study Group

Between May 1995 and June 2003, 240 consecutive reverse total shoulder arthroplasties were performed at the Clinique Sainte Anne Lumière. All procedures were performed by one of two surgeons (G.W. or L.N.-J.). The prosthesis that was implanted was either the Delta III (DePuy France, Saint Priest, France) or the Aequalis system (Tornier, Montbonnot, France), both of which are based on the Grammont design with a medialized center of rotation. The Delta III implant was used in 209 shoulders, and the Aequalis was used in thirty-one shoulders.

The indications for reverse total shoulder arthroplasty were classic rotator cuff tear arthropathy as described by Neer et al.¹; a massive irreparable rotator cuff tear with chronic loss of elevation (of more than six months' duration) that had failed to respond to treatment with physiotherapy; posttrau-

matic glenohumeral arthritis with rotator cuff compromise; primary osteoarthritis with rotator cuff compromise; primary osteoarthritis with severe glenoid bone loss and static posterior instability that prevented insertion of an unconstrained glenoid component; rheumatoid arthritis with rotator cuff compromise; an acute comminuted displaced proximal humeral fracture in an elderly patient; a shoulder girdle tumor requiring resection of all or a portion of the rotator cuff, creating rotator cuff compromise; and revision arthroplasty with rotator cuff compromise. In the present series, rotator cuff compromise was defined as an irreparable tear of at least two tendons or grade-3 or 4 fatty infiltration of the infraspinatus or subscapularis on preoperative computed tomography images according to the classification system described by Goutallier et al.¹⁷. Although no specific age limits were imposed, the prosthesis generally was reserved for older patients or for younger patients in whom it would have been impossible to reconstruct the rotator cuff. Severe posterior or superior glenoid bone loss was used as a relative indication for reverse total shoulder arthroplasty. The reverse total shoulder arthroplasty was used in cases in which the glenoid defect jeopardized glenoid keel fixation or prevented the implantation of the

TABLE II Classification According to Hamada Stage

Hamada Stage	Number of Shoulders* (N = 115)
1	5 (4.3%)
2	22 (19.1%)
3	14 (12.2%)
4a	17 (14.8%)
4b	27 (23.5%)
5	30 (26.1%)

*Hamada staging was only performed for patients in whom it was necessary to differentiate between rotator cuff tear arthropathy (n = 74) and massive rotator cuff tear without arthritis (n = 41), as described in the text.

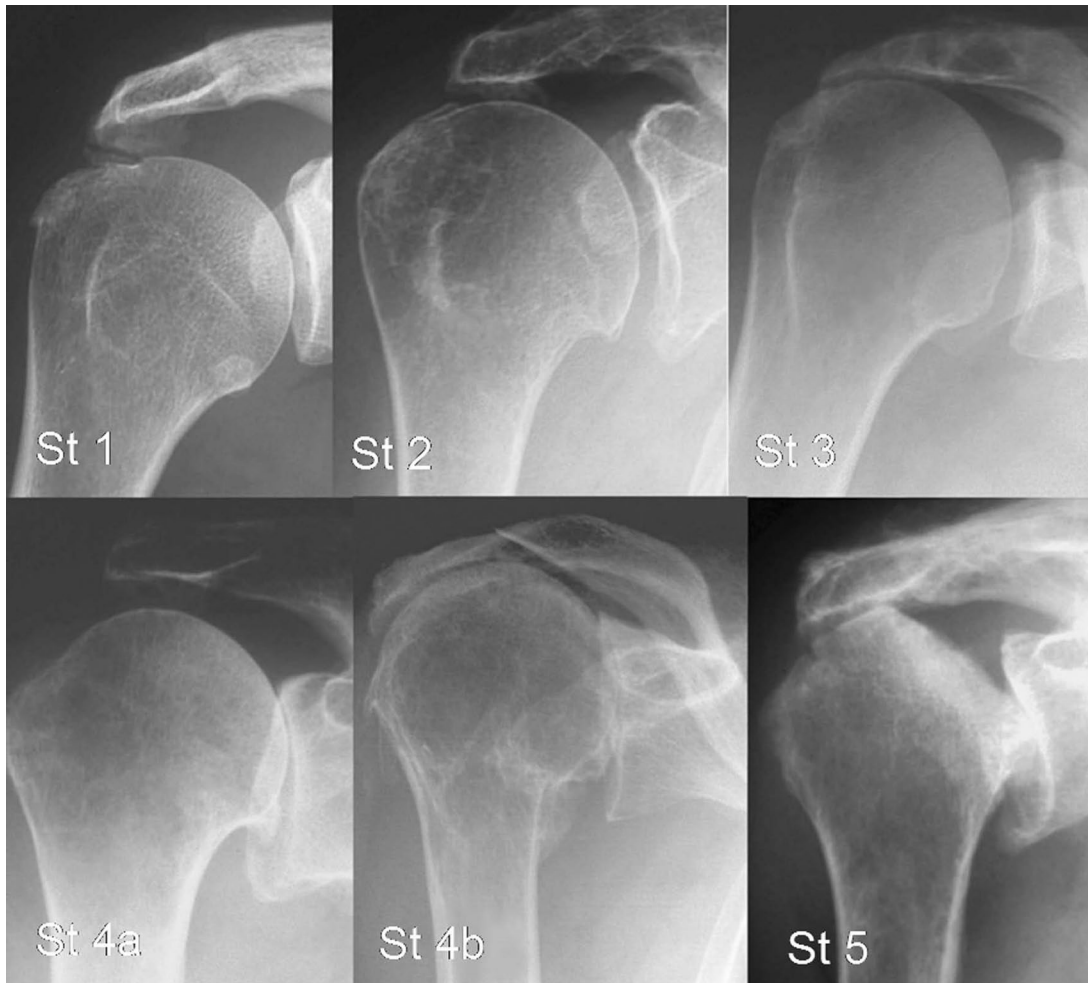


Fig. 1
Radiographs demonstrating the classification of massive rotator cuff tears according to the system of Hamada et al.¹⁸, as described in the text. St = stage.

glenoid component at an acceptable angle to prevent posterior subluxation. The use of the press-fit component allowed for easier structural grafting of the glenoid, and the constrained nature of the reverse total shoulder arthroplasty prevented recurrent posterior subluxation.

Two hundred and forty prostheses were implanted into 232 patients, with eight patients having a bilateral procedure. The average age of the patients was 72.7 years (range, twenty-three to eighty-six years). One hundred and eighty-four procedures were performed in female patients, and fifty-six were performed in male patients. One hundred seventy-three prostheses were placed in the right shoulder, and sixty-seven were placed in the left shoulder. The dominant shoulder was involved in 169 cases, and the nondominant shoulder was involved in sixty-seven cases; in the remaining four cases, the patient was ambidextrous.

The patients were grouped according to the primary etiology of the shoulder disorder (Table I). The radiographic classification system described by Hamada et al. was used to

grade the preoperative radiographs as needed to differentiate rotator cuff tear arthropathy from a massive rotator cuff tear without arthritis (Fig. 1)¹⁸. According to this system, stage 1 is associated with minimal radiographic changes, stage 2 is characterized by narrowing of the subacromial space to ≤ 5 mm, stage 3 is defined as erosion and so-called acetabulization of the acromion secondary to superior migration of the humeral head, stage 4 is associated with glenohumeral arthritis and is subdivided into stage 4a (without acetabulization) and stage 4b (with acetabulization), and stage 5 is characterized by the presence of humeral head osteonecrosis. Patients who met the criteria for Hamada stage-4a, 4b, or 5 radiographic changes, which provided evidence of the glenohumeral changes according to the definition described by Neer et al.¹, were considered to have cuff tear arthropathy (Figs. 2-A and 2-B). Patients with Hamada stage-1, 2, or 3 changes were considered to have a massive rotator cuff tear without arthritis. The distribution of patients according to Hamada classification is shown in Table II.



Fig. 2-A

Figs. 2-A and 2-B Radiographs of the right shoulder of a seventy-four-year old woman who underwent reverse shoulder arthroplasty for the treatment of cuff tear arthropathy. **Fig. 2-A** Preoperative radiograph demonstrating Hamada stage-4B cuff tear arthropathy.

The patients who were classified as having glenohumeral osteoarthritis with a rotator cuff tear had no proximal migration of the humeral head. The patients who were classified as having posttraumatic arthritis included those who had glenohumeral arthritis and a history of a fracture involving the proximal part of the humerus. The patients who were managed with revision arthroplasty included those who had had a previous hemiarthroplasty (thirty shoulders) and those who had had a previous total shoulder arthroplasty (twenty-four shoulders).

Data Collection

The present study was approved by our center's bioethics committee, and all subjects provided informed consent to allow their information to be used in the study. All patients were evaluated preoperatively and postoperatively by an examiner (B.W.) other than the operating surgeon. Preoperative and postoperative ranges of motion were documented, and Constant scores were collected¹⁹. Subjective results were graded by asking the patients to rate their overall experience with the procedure as very satisfied, satisfied, uncertain, or disappointed.

Preoperatively, computed tomography and computed tomography-arthrography were used to evaluate the quality of the rotator cuff and glenoid bone stock. Postoperative standardized radiographs, including anteroposterior views of the glenohumeral joint in neutral rotation, internal rotation, and external rotation as well as outlet and axillary views, were made under fluoroscopic control.

For seventeen patients who were unable to return to the clinic for follow-up, a telephone interview was conducted and radiographs were made at an outlying facility and were sent in for review. For an additional five patients, a physical examination (including measurement of range of motion, computation of the Constant score, and assessment of the subjective result) was conducted by a local physician.

Operative Technique

All but three of the prostheses in this series were placed with use of a deltopectoral approach. From 1995 to 2002, the Delta III implant was used (209 shoulders). In 2002 and 2003, the Aequalis Reversed implant was used (thirty-one shoulders). Both of these implants are based on the Grammont design with a medialized center of rotation. The humeral stem was cemented in all cases but one. The number of screws that were used to fix the glenoid baseplate was dictated by the available glenoid bone stock and surgeon preference. All four screws were used in 203 shoulders, and three screws were used in



Fig. 2-B

Fig. 2-B Postoperative radiograph showing the reverse shoulder prosthesis.



Fig. 3-A



Fig. 3-B

Figs. 3-A through 3-D A female patient was managed with reverse total shoulder arthroplasty for the treatment of primary osteoarthritis at the age of seventy-six years. **Figs. 3-A and 3-B** Radiograph and computed tomography scan demonstrating primary osteoarthritis with severe static posterior instability of the humeral head and posterior erosion of the glenoid.

thirty-one shoulders; the remaining six shoulders required a custom glenoid implant because of glenoid bone loss. In cases in which the subscapularis was still intact, it was divided through the tendinous portion, approximately 1.5 cm medial to the insertion, in line with the anatomic neck of the humerus. Subscapularis tendon repair with use of transosseous nonresorbable sutures was possible in 137 cases. No attempt was made to reattach the tendon in the remaining 103 cases.

Postoperative Rehabilitation

Postoperatively, the shoulder was immobilized with use of a simple sling that held the arm in internal rotation for one month. The sling was removed for patient hygiene, and the patient was allowed to use the hand on the involved side for simple activities of daily living but was instructed to avoid lifting activities. Passive range of motion was begun immediately. After one month, use of the sling was discontinued and

TABLE III Changes in Constant Scores According to Diagnosis*

Etiology	Duration of Follow-Up† (mo)	Constant Score‡									
		Total		Pain		Activity		Mobility		Strength	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Rotator cuff tear arthropathy	40 (24 to 86)	21.7	65.1	3.1	13.0	5.8	16.7	11.7	27.4	1.2	8.1
Revision arthroplasty	40 (24 to 93)	19.7	52.2	4.3	11.3	4.9	14.3	8.9	20.5	1.4	5.3
Massive rotator cuff tear	34 (24 to 118)	27.8	63.4	3.8	12.2	5.6	15.0	16.9	28.4	1.5	7.8
Posttraumatic arthritis	42 (24 to 97)	19.7	53.0	3.2	12.2	5.2	13.1	10.0	20.6	2.1	6.6
Primary osteoarthritis	38 (24 to 81)	24.7	65.1	3.0	12.7	5.5	16.4	14.0	28.0	2.2	8.0
Other	43 (29 to 68)	37.3	61.3	6.3	12.6	11.7	16.8	17.3	26.5	2.0	5.6
All patients	40 (24 to 118)	22.8	59.7	3.5	12.3	5.6	15.3	12.2	24.9	1.5	7.0

*The changes between the initial and final scores were significant for all subscales and all groups ($p < 0.001$). †The values are given as the average, with the range in parentheses. ‡The values are given as the average.

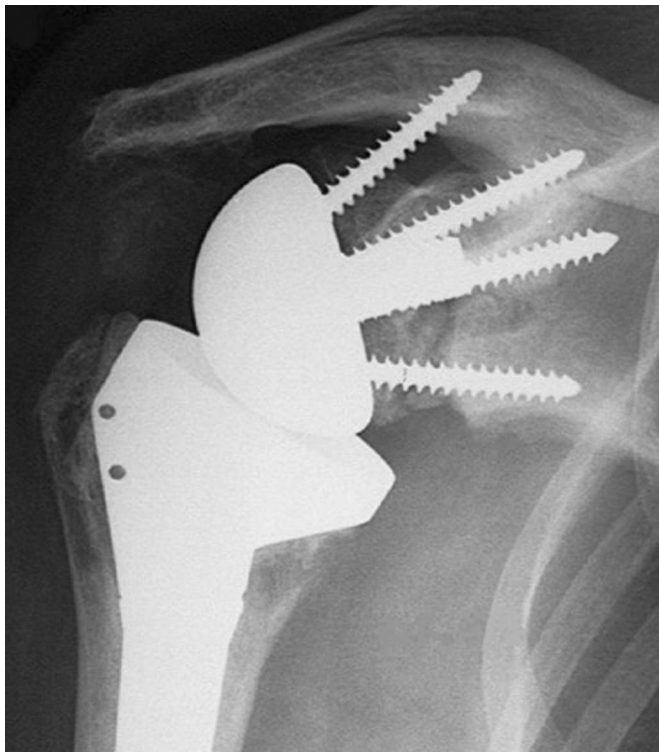


Fig. 3-C

The patient was managed with reverse total shoulder arthroplasty and an associated iliac crest bone graft. Because of a technical error, the central peg of the base plate was not implanted in the native glenoid.

the patient was allowed activity as tolerated.

Data Analysis

Analysis of variance was used to compare the functional scores and ranges of motion in the various etiologic groups. Improvements in functional scores and range of motion from the preoperative period to the time of the most recent follow-up within each etiologic group were analyzed with repeated-measures analyses. Satisfaction and complication rates were compared between groups with use of chi-square analyses. All post hoc tests were adjusted for multiple comparisons with use of the Sidak method. The level of significance was set at $p \leq 0.05$.

Results

Of the original 232 patients, five had a reverse shoulder arthroplasty following tumor resection (two patients) or for the treatment of acute fracture (two patients) or rheumatoid arthritis (one patient). These patients were excluded from the analysis because the small number of subjects with these etiologies would not yield meaningful group comparisons.

Of the remaining 227 patients, twenty-two (9.7%) died before the minimum two-year follow-up, eight (3.5%) had removal or revision of the prosthesis, and eleven (4.8%) were lost to follow-up. This left 191 shoulders in 186 patients (forty-one men and 145 women) who were available for study

after an average duration of follow-up of 39.9 months (range, twenty-four to 118 months).

All 186 patients completed a questionnaire and were evaluated radiographically; five patients were unable to return for a clinical examination. The mean age at the time of follow-up was 75.3 years (range, twenty-six to eighty-nine years). The dominant side was affected in 133 patients (71.5%), and the nondominant side was involved in fifty-two; the remaining patient was ambidextrous. Four patients had undergone bilateral reverse shoulder arthroplasty.

Overall Functional and Clinical Outcomes

The average Constant score improved from 22.8 points before surgery to 59.7 points at the time of follow-up. All components of the Constant score improved significantly after reverse total shoulder arthroplasty (Table III). Across all etiologic groups, the mean active elevation improved from 86° to 137° ($p < 0.001$) and the mean internal rotation improved from L5 to L4 (Table IV). No significant improvement was seen in terms of external rotation with the arm at the side or with the arm at 90° of abduction. Patients with repair of the subscapularis had greater improvement in the amount of internal rotation (from L5 to L4) than did those without repair (from the sacrum to L5).

When asked to grade the subjective result of the procedure, 111 (59.7%) of the 186 patients reported being very satisfied, sixty-two (33.3%) reported being satisfied, eleven

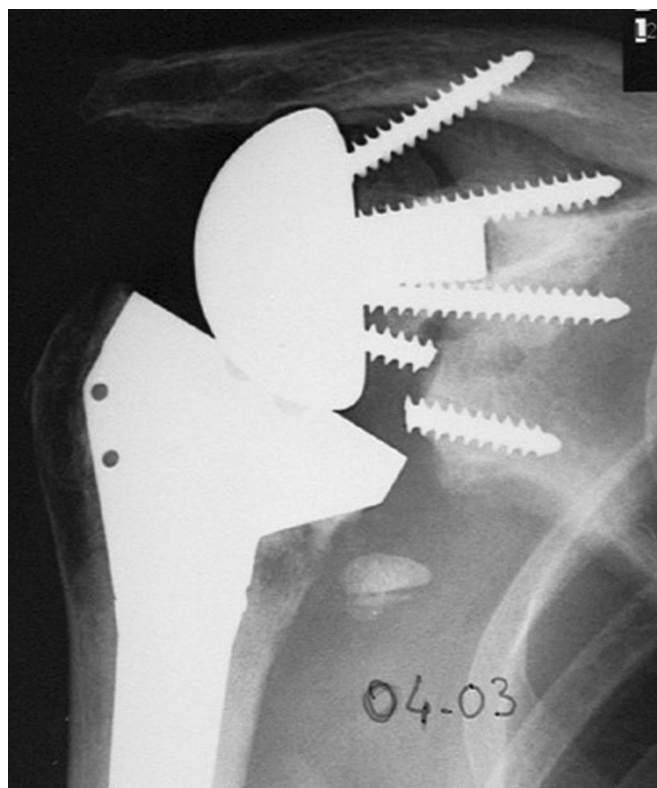


Fig. 3-D

Three months after implantation, the glenoid pulled out.

(5.9%) reported being uncertain, and two (1.1%) reported being disappointed.

Functional and Clinical Outcomes

According to Etiology

Patients with primary rotator cuff tear arthropathy, primary osteoarthritis with a rotator cuff tear, and a massive rotator cuff tear without arthritis had the best final outcomes (Tables III and IV). These three groups did not differ significantly from one another with respect to postoperative Constant scores ($p = 0.540$), range of motion ($p = 0.350$), or the subjective rating of the outcome ($p = 0.127$).

In contrast, the patients in the posttraumatic arthritis and revision arthroplasty groups had significantly worse postoperative Constant scores (53 and 52, respectively) in comparison with the other three groups ($p = 0.006$) (Table III). Patients in the posttraumatic arthritis and revision arthroplasty groups also had significantly worse postoperative ranges of elevation (115° and 118° , respectively) in comparison with the other three groups ($p = 0.001$) (Table IV). In addition, the percentage of patients who stated that they were very satisfied or satisfied with the outcome was lower in the posttraumatic arthritis and revision arthroplasty groups (89%) than in the other three groups (96%), although this difference did not achieve significance ($p = 0.083$).

The postoperative Constant scores were significantly related to the patients' subjective ratings ($p < 0.01$) in all of the etiology groups except the massive rotator cuff tear group ($p = 0.648$). The postoperative Constant scores were significantly related to the postoperative active range of elevation in all of the etiology groups ($p < 0.001$). The postoperative Constant scores were not related to the preoperative Hamada score ($p = 0.503$) in any of the etiology groups.

Patients undergoing reverse total shoulder arthroplasty for revision of a hemiarthroplasty had a significantly worse mean preoperative Constant score (16.4 points) ($p = 0.038$) and worse preoperative strength (0.6 kg) ($p = 0.025$) in com-

parison with those undergoing reverse total shoulder arthroplasty for revision of a total shoulder arthroplasty (25.6 points and 2.5 kg, respectively). However, following reverse total shoulder arthroplasty, both groups had approximately the same degree of improvement from their respective baseline values for the Constant score, strength, and range of motion. Thus, previous surgery had no apparent effect on the relative degree of improvement following reverse total shoulder arthroplasty when performed as a revision procedure, but patients who had had failure of a previous hemiarthroplasty had lower preoperative ratings and thereby had a worse final outcome in comparison with those who had had failure of a previous total shoulder arthroplasty.

Radiographic Outcomes

Two patients had signs of glenoid loosening. In both cases, the loosening was thought to be attributable to surgical error. In the first patient, the superior approach had been used and the glenoid component had been placed with a substantial superior tilt. The end result was superior cutout and loosening of the implant. The second patient had had severe posterior glenoid wear at the time of the reverse arthroplasty, and a structural iliac crest graft had been used to reconstruct the glenoid bone stock. The central peg of the baseplate, however, had not been anchored in the native host bone. This patient had rapid loosening of both the graft and implant (Figs. 3-A through 3-D). In both cases the arthroplasty was converted to hemiarthroplasty, and both patients reported good pain relief but little functional improvement.

Two patients had signs of loosening of the humeral component. One patient had undergone revision arthroplasty with an uncemented stem and had required a longitudinal osteotomy of the humerus. The second patient had been managed with a cemented stem for the treatment of cuff tear arthropathy.

Improper seating of the glenosphere on the metaglene baseplate was seen in five patients. In all cases this appeared to

TABLE IV Changes in Range of Motion According to Diagnosis*

Diagnosis	Elevation		External Rotation at 0° of Abduction		External Rotation at 90° of Abduction		Internal Rotation	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Rotator cuff tear arthropathy	76°	142°	5°	7°	29°	43°	L5	L3
Revision arthroplasty	58°	118°	5°	9°	24°	26°	Sacrum	L5
Massive rotator cuff tear	94°	143°	14°	8°	40°	41°	L2	L3
Posttraumatic arthritis	77°	115°	4°	6°	22°	35°	Sacrum	L4
Primary osteoarthritis	77°	115°	7°	9°	31°	39°	Sacrum	L3
Other	107°	131°	17°	20°	40°	63°	L3	L2
All patients	86°	137°	8°	6°	34°	40°	L5	L4

*The values are given as the average.

be a stable problem, and none of the patients required a revision. There was no deleterious effect on either the functional scores or the range of motion. At the time of review, these five patients had a mean Constant score of 57.2 points and a mean elevation of 141°.

Of the 186 patients with two-year follow-up radiographs, 152 had adequate radiographs to evaluate potential scapular notching. Seventy-seven (50.7%) of the 152 patients had evidence of scapular notching. Notching could be seen on only the anteroposterior view in sixty-two cases, on only the axillary view in twelve cases, and on both views in three cases. The mean postoperative Constant score was 60.6 points for patients with notching and 58.7 points for those without notching. The mean elevation was 132° for patients with notching and 131° for those without notching. There were no cases of glenoid loosening in the group of patients with notching.

Complications

The eight patients who had removal or revision of the reverse prosthesis before completing the two-year follow-up period were included in this portion of the analysis, bringing the total number of cases reviewed to 199. Thirty-six patients had a total of thirty-eight complications (prevalence, 19.1%). The most common complications were dislocation (fifteen cases; prevalence, 7.5%) and infection (eight cases; prevalence, 4.0%). Glenoid fractures, postoperative humeral fractures, symptomatic hardware, musculocutaneous nerve palsy, radial nerve palsy, glenoid sphere loosening, and glenoid base loosening also occurred in five or fewer cases each. The risk of complication associated with revision surgery (36.7%; eighteen of forty-nine) was significantly higher than the risk of complication associated with primary surgery (13.3%; twenty of 150) ($p < 0.001$). With the numbers studied, repair of the subscapularis was not related to the occurrence of postoperative complications ($p = 0.123$) or dislocations ($p = 0.115$).

During thirteen (24.1%) of the fifty-four revision procedures, a humeral fracture occurred during removal of the primary prosthesis or cement mantle. These events were not counted as complications because they were thought to be related to the revision surgery and not to the reverse prosthesis itself.

Discussion

The short-term functional results of reverse total shoulder arthroplasty appear to be excellent, and the level of patient satisfaction also appears to be high^{12,20-22}. Overall, patients in the current series had 37 points of improvement in terms of the Constant score and 51° of improvement in terms of active elevation, which are gains that are comparable with the findings described in previous reports of reverse total shoulder arthroplasty for the treatment of rotator cuff tear arthropathy^{12,20-22}. As has been the case in previous reports^{22,23}, the patients in the current study had no gains in active external rotation with the arm at 0° of abduction; this finding can be attributed to the prosthesis design (which produces limited lateral offset of the glenosphere and medialization of the cen-

ter of rotation) and, possibly, to the status of the teres minor. We believe that the present report describes the first study in which functional and clinical outcomes of reverse total shoulder arthroplasty have been compared according to etiology.

Our results showed that patients who were managed with a reverse total shoulder arthroplasty for the treatment of posttraumatic arthritis or for a revision arthroplasty fared worse than patients with cuff tear arthropathy, primary osteoarthritis associated with a massive rotator cuff tear, or a massive rotator cuff tear alone. The patients in the posttraumatic arthritis and revision arthroplasty groups had worse preoperative Constant scores and worse active elevation as compared with those in the other three groups. Thus, although patients in the posttraumatic arthritis and revision arthroplasty groups had improvements of similar magnitudes in terms of shoulder motion and function, they did not achieve the level of performance observed among patients in the other groups at the time of the most recent follow-up. Previous studies have indicated that the results of reverse total shoulder arthroplasty as a revision procedure are less predictable than those of reverse total shoulder arthroplasty as a primary procedure^{22,23}.

Our results showed that the improvement in function associated with reverse total shoulder arthroplasty appears to be stable for at least three years, although previous investigations have indicated that improvement can be maintained for much longer. For example, Valenti and coauthors reported on a group of sixty patients who underwent reverse shoulder arthroplasty for the treatment of cuff tear arthropathy¹³. After an average duration of follow-up of eighty-four months, they showed no increase in the rate of loosening or deterioration in function, with a survival rate of 93% at five years. Similarly, Guery et al. reported a survival rate of 84% at ten years in a group of seventy-seven patients who had undergone reverse shoulder arthroplasty²⁴.

Several previous studies have indicated that hemiarthroplasty for the treatment of cuff tear arthropathy decreases but does not eliminate pain and that it increases active elevation to between 85° and 120°²⁵⁻²⁹. In comparison, eighty-four of our 186 patients reported having no pain in the involved shoulder at the time of the most recent follow-up; an additional seventy-eight of our 186 patients reported having only mild pain. In addition, our patients with cuff tear arthropathy were able to achieve an average active elevation of 142° (range, 95° to 180°).

Latissimus dorsi transfer is commonly performed for the treatment of massive, irreparable tears of the rotator cuff that have failed to respond to nonoperative treatment. Latissimus dorsi transfer has been shown to increase active elevation to between 135° and 170° and to improve functional ability³⁰⁻³³. Some studies, however, have indicated that a substantial proportion (23%³³ to 42%³⁰) of patients may have development of osteoarthritic changes within three years after the procedure. In the present study, reverse total shoulder arthroplasty was successful for restoring active elevation and function among patients with irreparable rotator cuff tears while addressing

detected or undetected arthritic changes.

The complication rate in the current study (19%; thirty-eight of 199) was lower than has been previously reported in association with reverse total shoulder arthroplasty. For example, one study demonstrated a complication rate of 50%²². That study, however, included relatively minor complications, such as wound hematomas, that did not affect the final outcome. In addition, 70% of the arthroplasties in the previous series were revision procedures. The complication rate associated with revision procedures in the present study (37%; eighteen of forty-nine) was similar to the overall complication rate reported in that study²², but the complication rate associated with our primary procedures (13%; twenty of 150) was considerably lower. Thus, patients undergoing reverse total shoulder arthroplasty as a revision procedure or for the treatment of trauma are at the greatest risk for postoperative complications.

The present study had several limitations. The retrospective design did not allow for a direct comparison between reverse total shoulder arthroplasty and other treatments for the included etiologies. The inclusion of patients who had been managed by two experienced surgeons who were working at the same specialty clinic with a high referral caseload also introduces the possibility of selection bias; less experienced surgeons may not obtain the same results³⁴. In addition, the minimum duration of follow-up of twenty-four months is relatively short when dealing with the results of arthroplasty.

We believe that the present study represents the largest

reported series of patients who have been managed with reverse total shoulder arthroplasty to date. The present study shows that the reverse total shoulder arthroplasty prosthesis may be used not only for patients with cuff tear arthropathy but also for those with a number of other complex shoulder problems in whom the soft tissues or glenoid bone stock may be deficient. The advanced age of the patients in this series and the relatively short duration of follow-up suggest that the prosthesis should continue to be used judiciously, particularly because the use of this prosthesis in difficult cases, for example, for revision arthroplasty or for the treatment of posttraumatic arthritis, results in less improvement and higher complication rates. ■

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