Surface Replacement Arthroplasty of the Humeral Head in Young, Active Patients

Midterm Results

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Background: The treatment of glenohumeral arthritis in young, active patients remains controversial. Standard total shoulder arthroplasty in this patient group has not obtained the same satisfaction rate as in older patients. One surgical option that has emerged is humeral resurfacing.

Hypothesis: Humeral head surface replacement arthroplasty (SRA) would provide satisfactory clinical outcomes in active patients, allowing them to maintain their normal lifestyle without activity restrictions.

Study Design: Case series; Level of evidence, 4.

Methods: From 2004 to 2007, all consecutive surface replacement arthroplasties of the humerus performed at the authors' institution were identified and retrospectively reviewed, and 118 patients who underwent SRA during this time were identified. This study included patients younger than 60 years who wished to maintain an active lifestyle; 52 of the 118 patients met the inclusion criteria. University of California at Los Angeles (UCLA) shoulder scores and subjective shoulder value (SSV) scores were used to measure clinical outcomes at an average follow-up of 6 years (range, 4-8 years). Of the 52 patients meeting the inclusion criteria, 48 were contacted and examined for the study, with 4 patients lost to follow-up.

Results: The mean postoperative UCLA score was 28.03, with 1 patient requiring revision because of pain and glenoid wear. The mean SSV was 92% (range, 0%-100%), with 3 patients restricting their activity because of the shoulder. Forty-seven of the 48 contacted patients stated that, given the option, they would have the same surgery again. One patient required revision surgery because of pain.

Conclusion: Surface replacement arthroplasty provided reasonable results in patients younger than 60 years with high activity demands with a low rate of revision at midterm follow-up.

Keywords: surface replacement arthroplasty; glenohumeral arthritis; shoulder arthritis; young patients; humeral head surface replacement

Osteoarthritis of the shoulder is a cause of significant pain and functional impairment. Originally introduced by Neer[29,32] in the 1950s for fracture management, shoulder arthroplasty has evolved to allow surgeons to restore active function with decreased pain in patients with arthritis of the shoulder. Comparative studies since that time have consistently shown superior results with total shoulder arthroplasty (TSA) as compared with humeral hemiarthroplasty for primary osteoarthritis of the shoulder.[10,13,14,18,32] The cumulative evidence on shoulder replacement has been evaluated by the American Academy of Orthopaedic Surgeons Clinical Practice Guidelines Committee, with resultant recommendation of TSA over hemiarthroplasty in patients with primary glenohumeral osteoarthritis.[1] However, loosening of the glenoid component, especially in young, active patients, remains a major concern regarding the long-term survivorship of TSA.[4,6,8,20,26,33]

These concerns have led to debate over the advantage of glenoid implant resurfacing in active individuals and, as a result, the optimal treatment choice for glenohumeral arthritis in young, active patients remains controversial.[13,35] Sperling et al[37] have shown lower patient satisfaction with TSA in patients younger than 50 years. Possible

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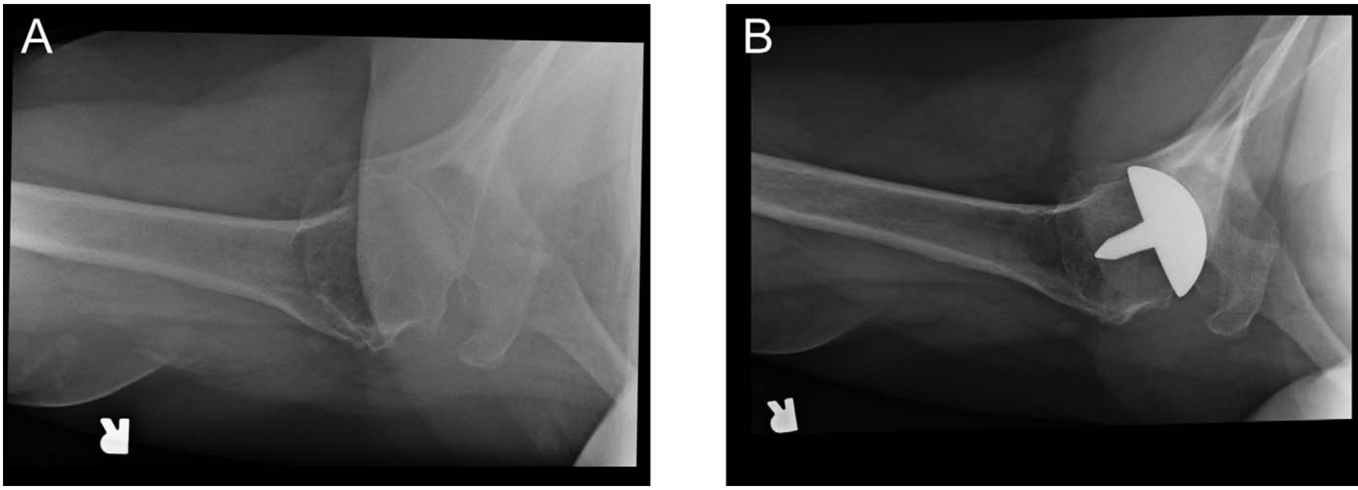

Figure 1. Radiographs of a heavyweight power lifter (A) before and (B) after surgery.

patient dissatisfaction with activity restrictions and the potential for increased glenoid failure due to high activity levels lead us to postulate that surface replacement arthroplasty (SRA) with an anatomic, noncemented humeral surface replacement would provide pain relief and improved function and satisfaction and would continue to "buy time and an active lifestyle" in this younger patient group without significant early glenoid wear.[9,17,35]

Surface replacement of the humerus was initially met with good results but then fell out of favor.[2] Since its reintroduction by Copeland,[11] SRA of the humerus has gained popularity as an alternative to conventional stemmed hemiarthroplasty for the treatment of glenohumeral osteoarthritis. Advantages of humeral resurfacing include shorter operative time, minimal bone resection, restoration of normal anatomy, and low prevalence of periprosthetic fractures. The humeral head is retained, theoretically facilitating a patient-specific, unique version, offset, and inclination of the prosthesis during surgery (Figure 1).[34] In addition, since minimal bone is resected, revision to a conventional total shoulder replacement is a feasible option with less need for bony augmentation.[8]

The purpose of our study was to evaluate clinical outcomes of a young, active patient group with osteoarthritis of the shoulder managed by humeral SRA alone in an attempt to preserve or resume a highly active lifestyle. Our hypothesis is that SRA of the humerus provides satisfactory clinical outcomes in patients with high activity demands without an increased incidence of revision or glenoid wear.

MATERIALS AND METHODS

All consecutive SRAs of the humerus performed by a single surgeon from January 1, 2004, to December 31, 2007, were identified by a computer database search. A retrospective chart review was performed. Inclusion criteria included all patients with significant glenohumeral arthritis who underwent humeral head SRA, who were younger than 60 years, and who wished to maintain an active lifestyle. It should be noted that patients with significant glenoid asymmetry were not included in this study; specifically, patients with a Walch type 2B glenoid and fixed posterior subluxation were managed by an alternate technique.[38] We defined "active lifestyle" as participating in sports or heavy duty manual labor. All patients had at least a 2-year routine follow-up examination and radiographs, and all were contacted for a repeat physical examination and radiographs to provide a current level of function, University of California at Los Angeles (UCLA) score, and satisfaction level. Institutional review board approval was obtained.

Patients

A total of 118 patients underwent SRA of the humerus during the study period. Fifty-two of the original 118 patients met the activity criteria for inclusion in this study. Twenty-two of these patients were managed with a Biomet Copeland prosthesis (Warsaw, Indiana, USA) and 26 with a DePuy Global cap (Raynham, Massachusetts, USA). Four of these were lost to follow-up, leaving 48 patients. The mean age of these 48 patients was 48 years (range, 21-59 years). The mean follow-up was 6 years (range, 4-8 years).

Clinical Assessment

Range of motion, strength, visual analog pain score (VAS), and UCLA shoulder scores[12] were collected preoperatively and at latest follow-up in all patients to assess patient outcomes. The results were graded on the UCLA Shoulder Rating Scale and divided into excellent (34-35 points), good (28-33 points), fair (21-27 points), and poor (0-20 points). Scores $\geq$28 were classified as satisfactory, whereas scores <28 were considered unsatisfactory.[28] Patients were asked to compare the current level of function of the operative shoulder to the contralateral shoulder as a percentage of function, described by Gilbert and Gerber[15] as the subjective shoulder value

(SSV) score. Patients were also asked to estimate the level of function of the shoulder prior to the surgery in general percentage terms. Finally, patients were asked if they would have the same surgery again or if they would have preferred TSA.

Radiographic Assessment of Glenoid Wear

Radiographs were available for all 48 patients at 2 years, and for most at 5 years.

Operative Technique

All operative procedures were carried out by 1 surgeon over a 4-year period. Patients were given general anesthesia in combination with an interscalene nerve block. In most patients, a diagnostic arthroscopy, with tenotomy of the biceps and posterior and inferior capsular release, was performed at the beginning of the procedure. The replacement surgeries were performed through a minimally invasive incision, utilizing a limited deltopectoral approach, with only a partial tenotomy of the inferior one half to two thirds of the subscapularis to decrease the risk of postoperative subscapularis failure or atrophy. The inferior aspect of the capsule was released along the humeral neck to aid in exposure. All osteophytes were removed from the humeral head, and the anatomic neck was identified. The humeral head was then sized in situ. The anatomic center of the "normal" articular surface was determined, and a central pin was inserted into this area while maintaining the patient's unique version and varus/valgus inclination. The humeral head was then reamed to remove enough bone to accommodate the thickness of the prosthesis. A trial prosthesis was placed on the reamed humeral head, the shoulder was reduced, and motion, stability, and soft tissue balance were assessed. The trial prosthesis was removed along with any bone shelf created by the reamer. A small amount of bone graft was applied to the central peg hole and the permanent prosthesis implanted. The lower subscapularis was repaired with a double row technique. The incision was closed and dressed, and the patient was placed in a sling with an abduction pillow prior to leaving the operating room.

Postoperative Rehabilitation

Immediate painless passive range of motion was allowed postoperatively followed by sequential initiation of resistance exercise at 2, 4, and 6 weeks after surgery. The sling was maintained for the first month postoperatively in these patients. Formal physical therapy was initiated at 4 to 6 weeks and continued until the patient was able to return to the desired functional level.

Statistical Analysis

Parametric paired *t* tests were utilized to compare preoperative and postoperative outcome measures. A *P* value <.05 was considered statistically significant. QuickCalcs (2005; GraphPad Software Inc, La Jolla, California, USA) was used to calculate the mean, standard deviation, and level of significance for all outcome measures evaluated.

RESULTS

Table 1 contains a breakdown of all results by patient.

Motion

Preoperatively, the mean frontal flexion was 102° (range, 30°-170°). The mean abduction was 70° (range, 20°-160°), and mean external rotation was 7° (range, 0°-70°). These values improved postoperatively to flexion, 158° (range, 90°-180°); abduction, 147° (range, 80°-180°); and external rotation, 70° (range, 0°-90°).

Strength was graded on a 0 to 5 scale, with mean preoperative strength graded as 3 and postoperative as 5.

The average VAS pain score preoperatively was 7 (range, 4-10). Postoperatively, this improved to 1 (range, 0-9).

UCLA Score

Preoperatively, our active patient cohort had a mean UCLA score of 12.24 ± 2.45 (range, 6-17). Postoperatively, the group achieved a mean UCLA score of 28.18 ± 6.90 (range, 6-35) ($P < .05$). Seventeen patients had excellent results, 18 had good results, 8 had fair results, and 5 had poor results. Based on the UCLA scores, 36 of 48 patients (75%) attained satisfactory results, and 12 patients (25%) had unsatisfactory results. Additionally, 8 of the 12 patients (17% of total group) with unsatisfactory UCLA scores stated that they were satisfied and would have the surgery again, while 3 patients (6%) responded that they would not, resulting in 94% overall satisfaction. There were multiple causes of the unsatisfactory results on the UCLA score. Pain requiring medication (3 nonnarcotics and 3 narcotics) was a source of dissatisfaction in 6 patients. Active forward flexion of ≤ 120° was a factor in 4 patients. Strength, rated as a 3 out of 5 or less, was a factor in 2 patients. Limitation of activity level to activities of daily living or less was a factor in 3 patients. Rotator cuff tearing postoperatively was present in 1 patient.

Patient Activity Level

Forty-five of the 48 patients resumed high-level activities following surgery, including manual labor (15 patients), golf/tennis/weight training (12 patients), very heavy weight lifting (8 patients), hunting (3 patients), and softball (5 patients). In addition, 2 patients resumed extremely high level activity: 1 to collegiate competitive cheerleading/gymnastics and 1 to professional water skiing. Two patients resumed normal activities of daily living but were unable to resume normal sporting activities. One patient initially improved and returned to normal activities but developed pain and functional limitations within 1 year postoperatively and required further surgeries. When the patients were asked if they

TABLE 1
Pre- and Postoperative Data From the Patient Cohort[a]

Patient Information			UCLA		VAS		Preop Motion, deg			Postop Motion, deg			Strength, 0-5							
No.	R/L	Age, y	Preop	Postop	Preop	Postop	Flex	Abd	ER	Flex	Abd	ER	Preop	Postop	SSV %	Revision Surgery?	Would Do Again?	Satisfied?	Activity Level	F/U
1	R	56	15	12	10	5	160	100	30	140	100	70	4	4	50	N	Y	N	ADL	7
2	R	53	12	35	6	0	90	80	0	180	180	90	2	5	100	N	Y	Y	Manual labor	7
3	L	58	11	26	7	0	90	80	0	160	100	45	3	5	100	N	Y	Y	Heavy work	7
4	R	58	11	20	5	0	90	80	0	160	100	45	3	5	100	N	Y	Y	Heavy work	6
5	L	59	12	27	8	1	100	80	0	170	170	90	3	5	98	N	Y	Y	Pro athlete	6
6	R	54	16	31	4	0	150	80	0	180	180	90	4	5	100	N	Y	Y	Heavy work	6
7	L	54	12	31	5	0	120	80	10	175	160	80	3	5	100	N	Y	Y	Heavy work	6
8	L	59	11	35	7	0	70	40	0	160	160	80	2	5	100	N	Y	Y	Heavy activity	8
9	R	59	14	35	6	0	120	90	10	180	180	90	3	5	100	N	Y	Y	Manual labor	6
10	L	58	16	22	10	4	150	100	30	170	160	80	4	5	80	N	Y	Y	Manual labor	8
11	R	59	11	25	9	3	90	70	0	130	120	20	3	4	85	N	Y	Y	Manual labor	6
12	R	56	6	33	4	0	30	20	0	160	150	80	2	4	100	N	Y	Y	Manual labor	8
13	L	56	12	30	5	0	120	60	0	170	170	90	3	5	100	N	Y	Y	Softball	7
14	L	57	9	6	7	5	70	50	0	90	80	30	2	3	60	N	Y	N	Light activity	6
15	L	48	7	35	6	0	80	70	0	160	150	80	3	5	100	N	Y	Y	Golf/weights	6
16	R	56	15	35	6	0	110	80	0	125	175	80	3	5	100	N	Y	Y	Manual labor	8
17	R	59	11	6	10	3	80	30	0	120	90	30	2	4	75	N	Y	Y	Manual labor	7
18	R	57	11	35	10	0	90	0	0	170	170	90	3	5	100	N	Y	Y	Manual labor	8
19	L	58	12	35	6	0	120	80	0	170	170	90	3	5	100	N	Y	Y	Manual labor/ weights	8
20	R	54	9	29	5	0	50	30	0	160	150	85	2	4	100	N	Y	Y	Manual labor	8
21	R	54	13	35	6	0	120	60	10	180	180	90	3	5	100	N	Y	Y	Heavy work	7
22	L	55	14	35	5	0	80	30	0	180	180	90	2	5	100	N	Y	Y	Weights	7
23	L	57	13	35	7	0	110	70	10	180	180	90	3	5	100	N	Y	Y	All	8
24	R	50	13	33	6	0	90	70	0	150	140	40	4	5	90	N	Y	Y	Manual labor	8
25	R	55	11	31	5	1	70	60	0	120	100	60	3	4	95	N	Y	Y	Carpenter	8
26	L	52	15	24	10	5	160	100	40	170	150	40	4	4	70	N	Y	Y	W/C + modified work	6
27	L	44	8	26	10	2	90	70	0	170	170	60	3	5	98	N	Y	Y	Heavy Work	7
28	L	46	12	28	5	2	100	70	0	175	175	90	3	5	95	N	Y	Y	Heavy Work	7
29	R	50	11	29	5	1	160	120	40	150	100	20	4	5	95	N	Y	Y	Manual labor	7
30	L	49	17	30	6	0	90	70	0	150	150	90	3	5	100	N	Y	Y	Manual labor	6
31	R	44	17	9	7	9	170	160	70	90	50	0	4	3	0	Y	N	N	Pro athlete	2
32	L	54	8	27	6	1	80	70	0	120	100	70	3	4	90	N	Y	Y	Farmer	9
33	R	53	13	35	5	0	90	60	0	170	170	90	4	5	100	N	Y	Y	Tennis	6
34	R	54	16	33	5	1	150	100	30	180	180	90	4	5	100	N	Y	Y	All	7
35	L	55	11	26	5	1	70	30	0	175	160	90	3	5	90	N	Y	Y	All	8
36	L	59	13	35	5	0	120	90	0	180	180	90	3	5	100	N	Y	Y	Manual labor/ weights	8
37	R	35	15	35	5	1	120	80	0	160	150	70	4	5	95	N	Y	Y	Heavy Work	8
38	R	29	13	30	6	1	120	80	0	180	180	90	3.5	5	95	N	Y	Y	Heavy work	8
39	R	30	16	30	10	1	100	0	0	180	180	90	3	5	95	N	Y	Y	Ultimate fighter	8
40	L	33	13	33	10	3	160	80	0	150	120	70	3	4	90	N	Y	Y	Weights	7
41	R	46	11	35	5	0	100	90	0	170	160	80	3	5	100	N	Y	Y	ADL	7
42	R	33	7	33	10	1	80	70	0	180	180	90	2	5	90	N	Y	Y	ICU nurse	7
43	L	23	8	35	10	0	80	70	0	180	180	90	2	5	100	N	Y	Y	Sports	7
44	R	25	11	35	7	0	90	80	0	180	180	90	3	5	100	N	Y	Y	Gymnastics	7
45	L	26	6	30	10	3	90	60	10	180	180	90	3	4	90	N	Y	Y	Manual labor	7
46	R	37	9	30	10	1	90	70	10	170	160	70	3	4	95	N	Y	Y	Manual labor	6
47	R	22	11	35	10	0	60	50	0	180	180	90	2	4	100	N	Y	Y	Manual labor	8
48	R	21	7	30	10	2	90	90	30	170	160	80	4	5	100	N	Y	Y	Softball	8
Med	—	54	12	31	6	0	90	70	0	170	160	80	3	5	100	—	—	—	—	7
Avg	—	48	12	28	7	1	102	70	7	158	147	70	3	5	92	—	—	—	—	7
High	—	59	17	35	10	9	170	160	70	180	180	90	4	5	100	—	—	—	—	—
Low	—	21	6	6	4	0	30	20	0	90	80	0	2	3	0	—	—	—	—	—
R	27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L	21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	47	45	—	—
N	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47	1	3	—	—

[a]Abd, abduction; ADL, activities of daily living; Avg, average; ER, external rotation; F/U, follow-up; Flex, flexion; ICU, intensive care unit; L, left; Med, median; N, no; Postop, postoperative; Preop, preoperative; pro, professional; R, right; SSV, subjective shoulder value; W/C, workers' compensation; UCLA, University of California at Los Angeles; VAS, visual analog scale; Y, yes.

considered the surgery a success, 45 patients (94%) responded "satisfied" and 3 patients (6%) "dissatisfied" with the outcome of the surgery.

Subjective Shoulder Value

Prior to the surgery, each patient was asked to estimate the level of function of the operative shoulder (compared with the contralateral shoulder) in general percentage terms. Thirty-two patients felt their functional level was less than 25%, 10 patients felt their functional level was less than 50%, and 6 patients felt it was about 50%, resulting in a mean SSV score of 83% (range, 20%-100%). All patients were then asked to rate the current level of function in the operative shoulder in comparison to the contralateral shoulder. Thirty-seven patients rated the shoulder as "normal or within 10% of normal," 7 as "75% to 90% of normal," 2 as "better than 50% of the opposite shoulder," and 2 patients rated the operative shoulder as "<50% of function of the opposite shoulder." The SSV scores correlated with satisfaction: The 3 patients who rated their result as unsatisfactory had the lowest SSV scores.

Radiographic Analysis

Humeral prostheses were assessed based on migration of the prosthesis. One patient seemed to show some change in orientation of the humeral component from the original preoperative radiographs. No patient showed gross evidence of loosening.

The glenoid was assessed by wear pattern as described by Levine et al[22] and by comparing the most recent radiograph with the initial postoperative one based on the anteroposterior (AP) view. All 5 patients in the "poor" group showed glenoid wear on the AP view, with loss of glenoid ranging from 3 to 6 mm. Additionally, 1 of these patients developed posterior erosion and a Walch type B2 pattern with subluxation. None of the patients in the "excellent" group and only 1 in the "good" group showed any glenoid erosion.

Revisions

One patient (2%) required revision surgery because of pain and rotator cuff tearing. This has resulted in multiple surgeries with a continued unsatisfactory rating.

DISCUSSION

The 2 main concerns regarding arthroplasty as the treatment for the young patient with arthritis of the shoulder are activity restriction and the longevity of the prosthesis after the index surgery. In the study by Sperling et al,[37] one of the main causes of patient dissatisfaction was activity restriction. In our study, we allowed patients to resume full activities, performing any activity they desired. Forty-five of 48 patients were able to resume all desired activity without restriction. It is our belief that the activities these patients were participating in, especially those in heavy labor jobs and power lifting, would have jeopardized the glenoid component fixation had a TSA been performed.

Shoulder resurfacing arthroplasty has gained popularity as an alternative to conventional shoulder arthroplasty for the treatment of glenohumeral arthritis.[8,25,27] It is our belief that humeral head resurfacing more closely approximates normal anatomy, preserving the native version and inclination and, therefore, will not result in a significant rate of glenoid erosion. This hypothesis was supported at midterm follow-up in the present study, as only 1 of the patients in the study required revision for glenoid erosion. Although controversy exists regarding the need to resurface the glenoid, we believe that in highly active individuals, especially those involved in manual labor and heavy weight lifting, the stress placed upon an artificial glenoid would result in early loosening of the prosthesis if the glenoid were replaced.[8,35]

There is considerable controversy over the best surgical option in the highly active patient with degenerative arthritis, and there is little information to guide clinical decision making in these patients.[5,19,21,22,25,30,31,36,37,39] Previous authors have advocated that glenoid resurfacing in younger patients should be avoided because of the possibility of early glenoid loosening.[5,22,37] However, the use of regular stemmed implants in these patients has not resulted in a high success rate either, with 1 study reporting 72% of patients with glenoid erosion after humeral hemiarthroplasty.[5,22,39] This erosion was not noted in our study. We believe that humeral surface replacement more closely approximates the patient's normal anatomy, thereby delaying the risk of glenoid erosion for a time in these patients. Longer follow-up is necessary to determine if the lack of glenoid erosion will be maintained.[37]

There are additional advantages of resurfacing in active patients. A decreased incidence of periprosthetic fracture, preservation of bone stock,[8] and decreased operative time and blood loss are advantages of surface replacement over humeral hemiarthroplasty or TSA.[20,23,24]

Levy and Copeland[24] reported on 103 shoulders that underwent shoulder resurfacing arthroplasty. Sixty-eight patients underwent total shoulder replacement, and 35 patients underwent hemiarthroplasty. At a mean follow-up of 7 years, 94% of the patients felt that the shoulder was improved. The best results were achieved in the treatment of primary arthritis, with Constant scores of 93.7% for total replacement and 73.5% for hemiarthroplasty. The authors concluded that the results of cementless SRA were comparable to published outcomes of conventional TSA, with decreased rates of complications involving the humeral shaft and periprosthetic fractures.[24] These same authors later reported similar results in 79 shoulders that underwent cementless shoulder resurfacing for osteoarthritis.[23] In this study, 42 were total replacements and 37 were hemiarthroplasties. They noted improvements in mean shoulder elevation and Constant scores, and 90% of the patients subjectively considered the shoulder to be improved.

Buchner et al[7] compared 22 patients treated with shoulder surface replacement with a matched group of 22 patients who had undergone a conventional stemmed total shoulder replacement. They found that mean operative time, estimated blood loss, and length of hospital stay were significantly decreased in the resurfacing group, but the total shoulder replacement group had a higher mean Constant score at the 12-month follow-up. They concluded that the outcomes of surface replacement at 1 year were slightly inferior to those of arthroplasty with a stemmed prosthesis. However, because of the decreased operative time, decreased blood loss, and preservation of bone stock, the authors felt that resurfacing could be a therapeutic option for younger patients with primary arthritis.[7,8]

Bailie et al[3] performed a prospective study on 36 shoulders that underwent cementless humeral SRA in patients younger than 55 years. They showed significant improvement in the clinical findings and ASES (American Shoulder and Elbow Surgeons) scale at mean follow-up of 38 months. In addition, 35 of 36 patients reported that they had been able to return to their desired athletic activities at a satisfactory level. Our results are similar in our active patient population, with more than 80% returning to high-level activities that are normally discouraged after TSA.

In this patient cohort, SRA of the humerus was associated with a satisfactory UCLA score in 75% of our patients, a satisfaction rate of 94%, and a revision rate of only 2%. In addition, the average SSV score was 92%, with 94% of patients able to return to sports or manual labor following surgery. We conclude that these patients are good candidates for surface replacement arthroplasty of the humerus. Young, active patients benefit from the potential advantages of this procedure and are able to enjoy an active lifestyle without fear of disrupting their prosthesis at midterm follow-up.

Our main concern in initiating this treatment protocol and allowing high level activity was that it would lead to early joint failure and revision. All patients were extensively counseled that we were just "buying active time" with this surgery and future surgery would be needed. However, at midterm follow-up, only 1 patient had undergone revision surgery, and none of the other patients wished to be converted to a TSA. Most of the patients were able to participate in very high level activity with this procedure.

It was our thought that the surface replacement more accurately reproduced the patient's unique humeral orientation and would limit the amount of glenoid wear despite a high level of activity. A recent study by Hammond et al[16] supports this concept in vitro, but we did not have the benefit of this excellent paper at the time of the study. Another factor in the lack of glenoid wear is no doubt the elimination of those patients with asymmetrical glenoid wear patterns. During the time of this study, patients younger than 60 years were managed by arthroscopic reaming and resurfacing of asymmetrical glenoid wear without humeral head replacement. Removing these patients no doubt contributed to the success of the present group.

A weakness of the study is its retrospective nature and the failure to preoperatively collect the subjective shoulder value score.

CONCLUSION

Surface replacement arthroplasty of the humerus provides satisfactory results in active patients younger than 60 years, with a low revision rate. Ninety-four percent of the patients in this study were able to resume normal activities at this midterm follow-up. The rate of glenoid erosion was quite low at 2%.

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