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Results of revision from hemiarthroplasty to total shoulder arthroplasty utilizing modular component systems

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Background: Hemiarthroplasty continues to be a common surgical treatment for glenohumeral arthritis. Unfortunately, some patients will develop painful glenoid arthrosis necessitating revision to total shoulder arthroplasty. Previously reported results of revision have demonstrated variability in results and difficulty. The purpose of this study was to determine the difficulty and results of revision from hemiarthroplasty to total shoulder arthroplasty utilizing modular component systems.

Materials and methods: Between 1995 and 2007, the authors identified 15 patients who underwent revision from hemiarthroplasty (HA) to total shoulder arthroplasty (TSA). Patients were assessed with the use of a UCLA score and a visual analogue scale at the time of the latest follow-up (mean, 40 months; range, 24-70 months). Radiographs were assessed for the presence of glenoid loosening, subluxation, and shift in component position.

Results: Revision HA to TSA was significantly associated with pain relief ($P < .01$) as well as improvement in forward elevation from a mean of 91° to 141°. According to the UCLA scoring, the result was excellent in 9 shoulders, good in 5, and fair in 1. No instances of humeral or glenoid loosening were identified at the most recent examination. Only 2 stem revisions were necessary in this series of modular shoulder arthroplasties.

Conclusion: The data from this study suggest that revision of painful HA for glenoid arthrosis to TSA is a reliable procedure with good improvements in pain, range of motion, and function. With modular components, the complexity of the procedure is minimized. Poor results and the need for stem revision are infrequent occurrences.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Shoulder arthroplasty; revision shoulder arthroplasty; shoulder hemiarthroplasty; total shoulder arthroplasty; glenoid; glenoid component; radiolucency

Total shoulder arthroplasty (TSA) has been shown to provide superior pain relief, motion and outcomes in several studies.[7,10] However, hemiarthroplasty (HA) continues to be a high volume procedure for the treatment of glenohumeral arthritis, as the total number of shoulder arthroplasties continues to rise dramatically.[6] Unfortunately, some patients

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treated with hemiarthroplasty will continue to complain of glenoid arthrosis or may develop the condition over time. For these patients, revision to total shoulder arthroplasty represents the treatment of choice. This study reports the results of revision by 2 surgeons utilizing modular component systems.

Materials and methods

After Mission Hospital Institutional Review Board; and University of Texas Health Science Center at San Antonio Institutional Review Board approval (150584-1; HSC20010109H), all patients undergoing revision shoulder arthroplasty between 1995 and 2007 were reviewed. Patients undergoing revision to reverse shoulder arthroplasty were excluded as well as patients with infection. The authors identified 15 patients that underwent a revision HA-TSA for painful glenoid erosion. These patients' records were then analyzed as the data for inclusion in this retrospective study.

The average age was 69 years (range, 59-86). There were 8 women and 7 men treated. The average duration between HA and revision to TSA was 33 months (range, 6-72). The dominant limb was involved in 9 patients. Analysis of records was utilized to determine a University of California Los Angeles (UCLA) score for each patient prior and after conversion to TSA.

The previous medical and operative records were reviewed prior to revision to TSA. Type of implant utilized as well as the initial diagnosis were recorded. In 11 of the patients treated, the original diagnosis was osteoarthritis. There were 2 cases of avascular necrosis and 2 cases of post-traumatic arthritis. The initial HA had been performed at the author's institution in 2 cases.

The revision operative record was analyzed. Only 2 cases of stem revision were performed in this series. No stem revision was undertaken to improve access and glenoid exposure. Stems were revised only when an excessively superior placement of the initial prosthesis would result in overstuffing the joint. In most cases, anatomical sizing and component positioning could be optimized by changing modular head size.

There were 5 cemented and 10 noncemented stems in this series. Neither of the 2 stems removed were cemented. In 1 implant, a porous coating had been utilized. One stem utilized a male Morse taper and the other a female. Removal was accomplished utilizing flexible osteotomes around the prosthesis and utilization of the stem extractor for the specific implant. Osteotomy of the humerus was not required in either instance. In both instances, an implant 1 size larger was inserted as a press fit without the need of bone grafting or additional humeral bone removal. The stem inserted utilized a female Morse taper.

A new modular humeral head was utilized in all cases. In the 13 cases that did not require stem revision, the distribution of head sizes was as follows: 1 case required an upsizing of 1 size; 3 cases required no change in head size; 8 cases required downsizing by 1 size (Fig. 1); and 1 case was downsized by 2 sizes.

Postoperatively, all patients were begun on a program for motion and strength for fingers, wrist, and forearm. A sling was utilized full time for the first 2 weeks and in public for the first 12 weeks. Therapy for all patients was physician directed. Pendulum exercises were initiated at 2 weeks postoperatively, with the addition of passive motion at 6 weeks postoperatively. Shoulder strengthening exercises were instituted at 12 weeks postoperative. All patients were instructed to avoid external rotation beyond neutral for the first 12 weeks.

Radiographic analysis was performed preoperatively and for the most recent available films. Radiographs prior to revision were analyzed for glenoid erosion, as described by Levine et al.[14] Most recent radiographs were analyzed for radiolucency and evidence of radiographic loosening by Franklin et al[9] and Lazarus et al.[13]

Each patient was evaluated with a UCLA rating (Table I).[1] All patients in addition were asked to provide a separate visual analogue pain rating, prior to the revision procedure and after the revision arthroplasty procedure. The visual analogue pain scale[11] was measured on a scale of 0-10.

Results

The average length of follow-up was 37 months (range, 24-72; Table). Forward elevation improved prior to revision from 91° (range, 70-150) to 141° (range, 120-175). Pain rating via a visual analogue scale improved from 7.3 preoperatively (range, 6-10) to 2.1 post revision to TSA (range, 0-5). The UCLA scores in our series improved from 15 (range, 11-20) to 31 post revision (range, 21-35) to TSA (Table I).

The subscapularis was managed in 13 cases at the primary procedure with an intratendinous tenotomy. In the 2 cases in which the primary hemiarthroplasty had been performed at the authors' institution, a tendon release from the tuberosity had been performed. At the time of revision, the subscapularis was managed in all cases with an intratendinous tenotomy. Direct repair was possible in all cases. No augmentation of the subscapularis repair was utilized. No additional rotator cuff repairs were performed during the revision procedure.

Fourteen of the 15 patients treated with revision were graded as good or excellent via the UCLA rating system. Only 1 patient was rated as fair. This patient had improvements in range of motion, but still complained of pain. Her preoperative history was significant for myofascial pain syndrome; serology and cultures postoperatively were negative for infection. The patient complaints of pain persisted and her overall result was fair.

No additional procedures were required in this group of patients after revision to TSA. There were no complications noted in this series. Specifically, there were no incidents of infection, fracture, or instability noted after the revision procedure.

Radiographic analysis of preoperative glenoid erosion according to Levine et al[14] revealed type 1 erosion in three shoulders. Type 2 erosion (loss of cartilage with uneven bone loss) was noted in 12 shoulders. Bone erosion was more common posteriorly (7 shoulders) than superiorly (4 shoulders) or medially (1 shoulder).

Radiographic evaluation of the glenoid component after conversion to TSA revealed frequent radiolucent lines, but no gross loosening was observed. Of the 9 keeled glenoid components implanted, radiolucent lines were grade 0 in

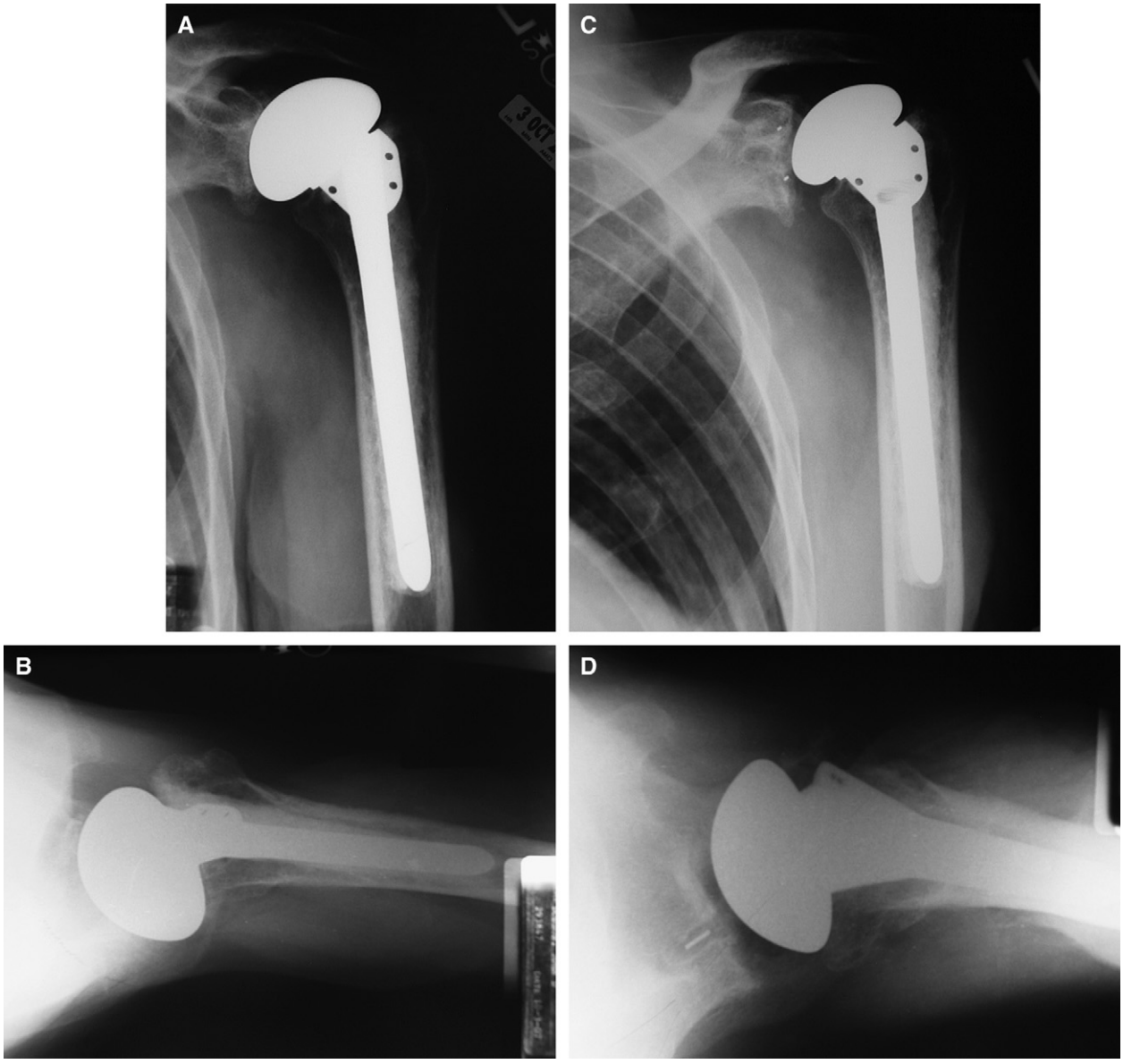

Figure 1 (**A), (B)** Preoperative radiographs of a hemiarthroplasty with painful glenohumeral arthrosis. The implant utilizes a standard male Morse taper. **(C), (D)** Postoperative radiographs after treatment with modular head revision, implantation of pegged glenoid component, and retention of original stem component.

1 shoulder, grade 1 in 3, grade 2 in 1, and grade 3 in 4. The remaining 6 pegged glenoid components showed grade 0 in 4 shoulders, grade 1 in 1, and grade 2 in 1. All glenoid components had been cemented at the time of revision and antibiotic impregnated cement was not utilized in this series.

Discussion

Revision Arthroplasty can be a difficult and technically demanding procedure.[5] The expected numbers of revision shoulder arthroplasty is expected to continue increasing.[5] Although TSA has been documented to improve pain, motion, and outcomes better than HA,[2,3,7,10] HA continues to be a popular surgical procedure for the treatment of shoulder pathology due to concerns regarding glenoid component failure.[8,9,13,17] Wirth et al[19] identified proper selection and techniques that can result in good intermediate outcomes for patients treated with HA for osteoarthritis. Unfortunately, some patients treated with HA will continue to complain of pain from glenoid arthrosis or develop this malady over time.[18]

Initial reports regarding shoulder revision arthroplasty included a variety of causes. Neer and Kirby originally grouped these into preoperative, surgical, and postoperative

Table I Patient demographics and results undergoing revision from hemiarthroplasty to total shoulder arthroplasty

Patient #	Age yrs	Initial diag-nosis	Interval to (months) revision	VAS pre-op	UCLA score pre-op	Follow-up months	Hemiarthroplasty stem cemented	Morse taper type of hemi	Stem revis-Ion	Morse taper type of total	VAS post-op	UCLA score post-op
1	70	OA	22	7	15	36	Yes	F	N	F	0	35
2	59	AVN	6	6	20	48	No	F	N	F	1	33
3	72	OA	32	7	16	70	No	M	N	M	2	33
4	64	OA	31	8	15	34	No	F	N	F	3	28
5	86	OA	48	6	19	24	Yes	M	N	M	3	28
6	63	PTA	6	10	11	48	Yes	F	N	F	1	35
7	64	OA	30	8	18	26	No	M	Y	F	3	28
8	75	OA	20	7	16	24	No	M	N	M	2	30
9	71	OA	31	9	13	30	Yes	F	N	F	3	29
10	61	AVN	20	8	15	28	No	F	Y	F	1	32
11	63	OA	31	7	18	72	No	F	N	F	0	34
12	60	PTA	12	9	17	36	Yes	M	N	M	4	27
13	71	OA	27	7	15	48	No	M	N	M	1	33
14	72	OA	29	6	14	36	No	F	N	F	2	32
15	69	OA	24	7	15	36	No	M	N	M	2	30

OA, osteoarthritis; *PTA*, post-traumatic arthritis; *AVN*, avascular necrosis; *VAS*, Visual Analogue Score; *F*, female; *M*, male.

categories.[15] Wirth and Rockwood[18] defined 7 causes of failure leading to revision shoulder arthroplasty. This heterogeneity of causes resulted in reports with varying degrees of satisfaction reported among the patients treated.[15,18]

Carroll et al were the first to review the results of conversion from HA to TSA.[4] Carroll et al noted an improvement in pain associated with revision, but continued restricted motion. These findings were echoed by Sperling and Cofield.[16] Both of these series reported low numbers of postoperative infections: 1/16 in Carroll et al and 2/18 in Sperling and Cofield. Dines et al,[5] however, noted that in these series, even small numbers of patients affected by infection may have skewed rates of patient satisfaction.

Dines et al reported as part of a larger series[5] good or excellent results in 11 of 16 patients treated with revision HA-TSA. Hattrup[12] reported excellent results in 7 out of 16 patients treated, 5 satisfactory and 4 unsatisfactory results. Our results more closely align with those reported by Dines et al,[5] with 14 of the 15 patients treated rated as good or excellent.

Sperling and Cofield[16] were the first to speculate that modular components would make stem removal less common in revision from HA to TSA. Although Dines et al[5] do not comment on their need for stem revision, Hattrup[12] in his report notes that stem revision was required in 12 of 17 procedures. We noted only 2 cases requiring stem removal for revision in this series.

Stem removal in revision arthroplasty yields variables that may include bone loss, fracture, and increased operative time.[18] We agree with Hattrup[12] that often the humeral osteotomy in revision cases is higher than optimal. However, in only 2 cases did this require stem extraction. In both cases, the previously implanted humeral head component was the shortest neck length available. It was felt in both instances that adding a prosthetic glenoid would result in ''overstuffing'' the joint. We also agree with Hattrup[12] that standard male Morse taper humeral components make glenoid exposure challenging. Revision surgery is typically easier when the stem utilizes a female Morse taper. However, in our experience, this does not necessitate stem removal. The exception occurs when component positioning cannot be remedied with modular component resizing.

The ability to utilize modular components while avoiding stem revision may be 1 component of our improved outcomes. The other components include soft tissue findings and management. We did not experience any patients that required augmentation of the subscapularis repair. The postoperative course we utilized is conservative and geared to protect the subscapularis which has been violated and repaired on 2 occasions. The slower rehabilitation did not seem to adversely affect the final outcome in this patient group.

There are obvious limitations to this study. The sample size, although comparable to previous reports, is small. The

follow-up, although adequate for initial reporting, must continue to be scrutinized to insure the initial good results do not deteriorate over time. The results reflect the experience of 2 shoulder trained surgeons with considerable experience. These good results may not be applicable to all population groups treated by other surgeons.

Conclusion

Our experience suggests that revision from HA to TSA can be accomplished with good or excellent results in the vast majority of cases. Unsatisfactory results and complications are infrequent. Modular components have allowed us to make stem revisions an unusual event.

Disclaimer

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References

1. Amsutz HC, Sew Hoy A, Clark ID. UCLA anatomic total shoulder arthroplasty. Clin Orthop Related Res 1981;155:7-20. doi:10.1097/00003086-198103000-00002
2. Boyd A, Thomas W, Scott R, Sledge CB. Total shoulder arthroplasty versus hemiarthroplasty: indications for glenoid resurfacing. J Arthroplasty 1990;5:329-36.
3. Bryant D, Litchfield R, Sandow M, Gartsman GM, Kirkley A. A comparison of pain, strength, range of motion and functional outcomes after hemiarthroplasty and total shoulder arthroplasty. J Bone Joint Surg Am 2005;87:1947-56. doi:10.2106/jbjs.d.02854
4. Carroll RM, Izquierdo R, Vazquez M, Flane T, Levine WN, Bigliani LU. Conversion of painful hemiarthroplasty to total shoulder arthroplasty: long term results. J Shoulder Elbow Surg 2004;13:599-603. doi:10.1016/j.jse.2004.03.016
5. Dines JS, Fealy S, Strauss EJ, Allen A, Craig EV, Warren RF, et al. Outcomes analysis of revision total shoulder arthroplasty. J Bone Joint Surg Am 2006;88:1494-500. doi:10.2106/jbjs.d.02946
6. Engelheart SA. Reverse shoulders…something for everyone in upper extremity repair. Orthopaedic Product News April/May 2009:40-3.
7. Edwards T, Kadakia NR, Boulahia P, Walch G. A comparison of hemiarthroplasty and total shoulder aerthroplasty in the treatment of primary glenohumeral osteoarthritis; results of a multicenter study. J Shoulder Elbow Surg 2003;12:207-13. doi:10.1016/51058-2746(02)86804-5
8. Fox TJ, Akin C, Sperling JW, Sanchez-Sotelo J, Schleck CD, Cofield RH. Survival of the glenoid component in shoulder arthroplasty. J Shoulder Elbow Surg 2009;18:859-63. doi:10.1016/j.jse.2008.11.020
9. Franklin JL, Barrett WP, Jackins SE, Matsen FA III. Glenoid loosening in total shoulder arthroplasty. Association with rotator cuff deficiency. J Arthroplasty 1988;3:39-46.
10. Gartsman GM, Roddey TS, Hammerman SM. Shoulder arthroplasty with or without resurfacing of the glenoid in patients who have osteoarthritis. J Bone Joint Surg Am 2000;82:26-34.
11. Huskisson EC. Measurement of pain. J Rheumatol 1982;9:768-9.
12. Hattrup SJ. Revision total shoulder arthroplasty for painful humeral head replacement with glenoid arthrosis. J Shoulder Elbow Surg 2009;18:220-4. doi:10.1016/j.jse.2008.09.006
13. Lazarus MD, Jensen KL, Southworth C, Matsen FA. The radiographic evaluation of keeled and pegged glenoid component insertion. J Bone Joint Surg Am 2002;84:1174-82.
14. Levine WN, Djurasovic M, Glasson JM, Pollock RG, Flatow EL, Bigliani LU. Hemiarthroplasty for glenohumeral osteoarthritis; results correlated to the degree of glenoid wear. J Shoulder Elbow Surg 1997;6:449-54.
15. Neer CS II, Kirby RM. Revision of failed total shoulder arthroplasty. Orthop Clin North Am 1998;29:519-33.
16. Sperling JW, Cofield RH. Revision total shoulder arthroplasty for the treatment of glenoid arthrosis. J Bone Joint Surg Am 1998;80:860-7.
17. Tammachote N, Sperling JW, Vathana T, Cofield RH, Harmsen WS, Schleck CD. Long term results of cemented metal-backed glenoid components for osteoarthritis of the shoulder. J Bone Joint Surg Am 2009;91:160-6. doi:10.2106.jbjs.f.01613
18. Wirth MA, Rockwood CA Jr. Complications of total shoulder replacement arthroplasty. J Bone Joint Surg Am 1996;78:603-16.
19. Wirth MA, Tapscott RS, Southworth C, Rockwood CA Jr. Treatment of glenohumeral arthritis with a hemiarthroplasty; a minimum five year follow-up study. J Bone Joint Surg Am 2006;88:964-73. doi:10.2106/jbjs.d.03030