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Anatomic and reverse shoulder arthroplasty in patients 70 years of age and older: a comparison cohort at early to midterm follow-up

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Background: Reverse shoulder arthroplasty (RSA) has gained popularity in elderly patients because of its limited reliance on rotator cuff function and high survivorship rates. However, although there are theoretical advantages of RSA over anatomic total shoulder arthroplasty (TSA) in elderly patients, there is little data to guide surgeons on implant selection in this population.

Methods: Patients were identified from our prospectively collected shoulder arthroplasty registry. We included patients between the age of 50 and 89 years who underwent primary TSA for osteoarthritis with intact rotator cuff or primary RSA for cuff tear arthropathy. The minimum and mean clinical follow-up was 2 and 3.1±1.3 years, respectively. Four patient groups were formed for analysis: (1) TSA age 50-69 years (n=274), (2) TSA age 70-89 years (n=208), (3) RSA age 50-69 years (n=81), and (4) RSA age 70-89 years (n=104). We evaluated age group differences in pain, Constant score, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) score, patient satisfaction, complications, and revisions.

Results: All groups showed significant improvements from preoperative to final follow-up for all outcome measures ($P < .001$). Visual analog scale for pain average score decreased from 5.8 preoperatively to 1.1, with no significant differences between groups (TSA $P = .180$; RSA $P = .103$). Final ASES scores and improvement from preoperative ASES score between the age groups were not significantly different (TSA $P = .520$; RSA $P = .065$). There were no significant differences in outcomes between TSA in patients older than 70 years vs. patients younger than 70 years (all $P > .05$); however, older RSA patients reported better function during activities of daily living ($P = .020$) than their younger counterparts. Patients undergoing TSA had a lower revision rate of 3.9% compared with 8.1% in the RSA group ($P = .043$).

Conclusions: TSA and RSA are reliable procedures for patients older than 70 years, and have comparable results to their respective patient cohorts younger than 70 years. Although some surgeons anecdotally advocate for RSA in patients older than 70 years with primary osteoarthritis and an intact rotator cuff, we found no difference in outcomes for TSA based on our age cutoff. Given satisfactory results following TSA in patients 70 years of age and older, we do not routinely perform RSA for primary osteoarthritis with an intact rotator cuff solely based on age. Further studies and longer follow-up are needed to determine the optimal implant selection for elderly patients with primary osteoarthritis.

The Texas Orthopedic Hospital's Institutional Review Board committee approved this study (TOH216e).

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The aging population and projected increase in the incidence of total shoulder arthroplasty (TSA) suggest an impending burden of elderly patients presenting with end-stage primary osteoarthritis (OA) of the shoulder.[13] Like many other procedures, shoulder arthroplasty in the elderly population is associated with longer inpatient care and higher major complication rates.[5,12] Thus, there is an emphasis on optimizing outcomes while limiting the potential for reoperation.

There are numerous factors that complicate clinical decision making for implant selection in an elderly patient presenting with end-stage OA of the shoulder. Although anatomic total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA) have historically treated distinct shoulder pathologies, recently some authors have proposed the use for RSA in primary OA with Walch B2 glenoids[11] and Walch type C dysplastic glenoids.[15] Additionally, a significant number of elderly patients with OA present with or are likely to develop rotator cuff pathology.[24] It has also been proposed that chronic stiffness from OA may contribute to rotator cuff dysfunction despite intact rotator cuff tendons.[22] Prior studies on outcomes of TSA have shown secondary rotator cuff dysfunction in 17% of patients of any age at a mean of about 9 years from TSA,[25] and that rotator cuff failure has been found as the most common early reason for TSA failure.[23] Thus, surgeons may reasonably feel that any amount of concurrent rotator cuff pathology in an elderly patient presenting with end-stage primary OA makes RSA attractive as an option to avoid the need for a revision procedure. This reasoning is further supported by recent reports of RSA survivorship from high-volume institutions as high as 95% at midterm follow-up[8] and unreliable outcomes of revision procedures following TSA.

There is currently limited contemporary data available to guide surgeons on clinical decision making for implant type in elderly patients. Moreover, there are few prior studies examining differences in outcomes of each implant type based on age, especially using contemporary TSA.

The purpose of this study was to compare early to midterm outcomes of TSA and RSA in elderly patients, whom we defined as 70 years of age and older. In addition, we sought to understand whether there is a difference in outcome of each individual procedure based on age by comparing the results of patients older and younger than 70 years. We hypothesized that TSA and RSA perform equally in patients older than 70 years, and that there would be no differences in outcomes of each individual procedure based on age.

Methods

Patient inclusion criteria/demographics

Our study was a retrospective review of a prospectively collected shoulder arthroplasty registry enrolled from 2004-2018. All arthroplasty procedures were performed by a single, high-volume shoulder arthroplasty surgeon (T.B.E.) at a single institution. Patients were included in the study if they were between the age of 50 and 89 years, underwent a primary TSA with a diagnosis of OA, or underwent a primary RSA with a diagnosis of cuff tear arthropathy (CTA), and had at least 2 years of clinical follow-up. CTA was defined as glenohumeral OA with a massive, irreparable rotator cuff tear involving more than 1 tendon. Preoperative imaging (computed tomography or magnetic resonance imaging) was reviewed along with the Goutallier classification for fatty infiltration of the rotator cuff musculature. TSA patients were rated as stage 0 or 1 for all rotator cuff muscles, whereas the CTA patients receiving RSA typically were rated as stage 3 or 4 on the supraspinatus, infraspinatus, and subscapularis tendons. The teres minor was intact in most RSA cases.

Exclusion criteria included any patient undergoing a hemi- or revision arthroplasty procedure, patients younger than 50 years or older than 89 years, or patients with less than 2 years of clinical follow-up. A total of 667 patients met the inclusion criteria for the study (Fig. 1). Patients were assigned to 4 study groups according to arthroplasty procedure and age.

1. Primary TSA and between the ages of 50 and 69 years (n=274)
2. Primary TSA and between the ages of 70 and 89 years (n=208)
3. Primary RSA and between the ages of 50 and 69 years (n=81)
4. Primary RSA and between the ages of 70 and 89 years (n=104)

The specific demographic and clinical characteristics included in the registry were age, gender, body mass index, shoulder dominance, Walch glenoid type, smoking status, preoperative opioid use, chronic back pain, depression, diabetes, heart disease, and insurance type. Patient and clinician outcome measures were collected preoperatively and at final follow-up and included the Constant score,[3] the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form score,[10] the Single Assessment Numeric Evaluation,[21] and active mobility measurements. In addition, patients were asked to rate their satisfaction as very dissatisfied, dissatisfied, satisfied, or very satisfied to determine satisfaction.

Surgical technique and postoperative rehabilitation

The Aequalis, Aequalis Ascend, and Aequalis Ascend Flex (Wright Medical, Memphis, TN, USA) TSA systems were used for both RSA and TSA. Our surgical techniques have been previously well described.[4] Standard postoperative rehabilitation protocol was prescribed.[9,16]

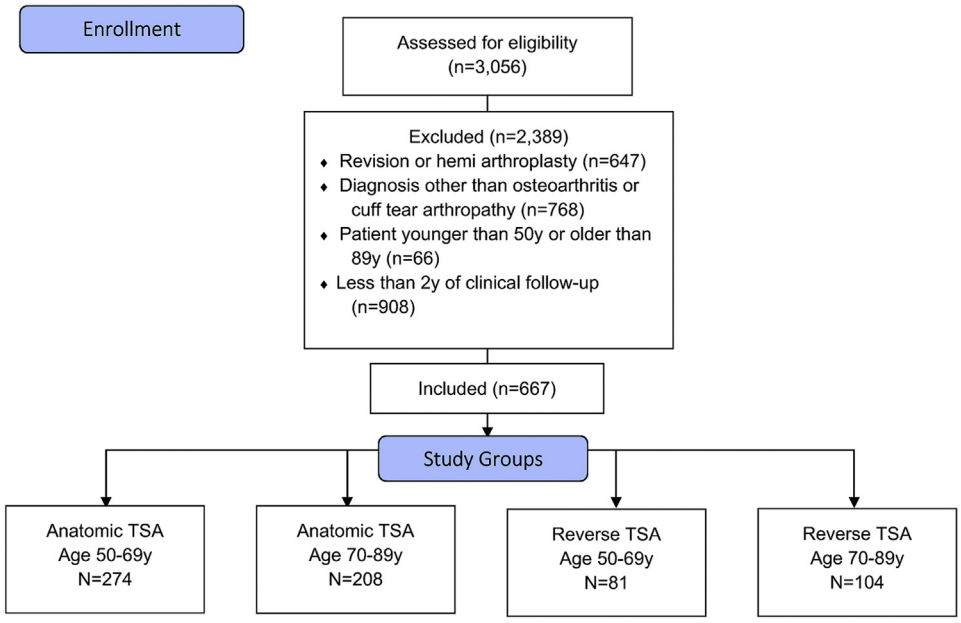

Figure 1 Diagram of patient selection into study groups.

Clinical and radiographic assessment

All patients were enrolled in a prospective shoulder arthroplasty registry. All arthroplasty patients were directed to follow-up at 1 week, 6 weeks, 3 months, 6 months, 12 months, 2 years, and 5-year intervals. Active range of motion measurements were determined using a handheld goniometer at each follow-up by the primary surgeon. Abduction strength was determined with a handheld digital force gauge (Chatillon Digital Force Gauge 200 lbf; AMETEK Inc, Largo, FL, USA). Anterior-posterior, axillary, and scapular Y views were reviewed prospectively by the primary surgeon to determine the presence of radiolucent lines. Glenoid wear pattern was assessed for patients undergoing TSA on the preoperative computed tomograph based on the original classification by Walch et al.[19]

Statistical analysis

Preoperative patient characteristics such as gender, dominant shoulder, body mass index, follow-up duration, and comorbidities were analyzed for the 4 patient groups using independent sample *t* tests or chi-squared tests as appropriate. Patient outcome measures were evaluated with repeated measures analysis of variance to determine differences between age groups and preoperative to final follow-up improvements within each arthroplasty procedure. Post hoc analyses were performed with Bonferroni correction to identify the specific group differences when a significant difference was detected in the group main effect.

Results

Baseline patient characteristics

Analysis of baseline patient characteristics identified several significant differences between patient groups (Table I). The number of women was lower in the TSA age 50-69 years group (34%) as compared to the RSA age 50-69 years (47%, $P = .029$) and RSA age 70-89 years (63%, $P < .001$) study groups. The patients in the RSA age 70-89 years group had a significantly lower body mass index of 27.2 ± 5.3 as compared to all other study groups (average 30.0 ± 6.0; all $P < .05$). Additionally, the RSA age 70-89 years group's clinical follow-up of 2.8 ± 1.2 years was significantly shorter than all other groups (average 3.2 ± 1.3; all $P < .05$), but this difference in follow-up time was less than 5 months. Rates of comorbidities between the 4 study groups were not significantly different (all $P < .05$). In addition, there were no differences in glenoid morphology for the TSA group based on the Walch classification[19] (Table II).

Outcome measures

Patient reported outcome measures were collected preoperatively and at each clinical follow-up. All patient reported outcome measures showed significant improvement from preoperative to final follow-up (all $P < .001$) regardless of implant type or age group (Tables III and IV). Preoperatively, pain was rated as 5.8 ± 2.7 on a visual analog scale for all patient groups and decreased significantly to 1.1 ± 2.1 ($P < .001$) at final follow-up but was not significantly different between age groups (TSA $P = .180$; RSA $P = .103$). Pain and function as measured by the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form score was not significantly different between age groups (TSA $P = .520$; RSA $P = .065$) and the absolute change from preoperative to

Table I Subject demographic and preoperative clinical characteristics

	Anatomic TSA		Reverse TSA	
	Age 50-69 yr, (n = 274)	Age 70-89 yr, (n = 208)	Age 50-69 yr, (n = 81)	Age 70-89 yr, (n = 104)
Female gender	92 (34)*	100 (48)	38 (47)	65 (63)
Age at surgery, yr, mean ± SD	62.3 ± 5.1	75.3 ± 4.6	62.9 ± 5.6	76.3 ± 4.5
Dominant shoulder	125 (54)	108 (52)	54 (67)	69 (67)
BMI, mean ± SD	30.6 ± 5.7	29.1 ± 5.7	30.7 ± 7.2	27.2 ± 5.3†
Follow-up, yr	3.3 ± 1.3	3.3 ± 1.3	3.1 ± 1.3	2.8 ± 1.2‡
Current smoker	10 (4)	3 (1)	7 (9)	2 (2)
Preoperative opioid use	17 (6)	38 (18)	9 (11)	21 (20)
Chronic back pain	28 (10)	19 (9)	5 (6)	7 (7)
Depression	32 (12)	20 (10)	15 (19)	20 (20)
Diabetes	32 (12)	14 (7)	9 (11)	11 (11)

SD, standard deviation; *BMI*, body mass index; *TSA*, total shoulder arthroplasty; *RSA*, reverse shoulder arthroplasty.
Unless otherwise noted, values are n (%).
* Significantly fewer females as compared to RSA at age 50-69 years ($P = .029$) and RSA at age 70-89 years ($P < .001$).
† Significantly lower body mass index as compared to all other study groups (all $P < .05$).
‡ Significantly shorter clinical follow-up as compared to all other study groups (all $P < .05$).

final follow-up is almost identical regardless of implant type or age.

Total and adjusted Constant scores were not significantly different between age groups for either implant; however, older RSA patients did report greater ability to perform activities of daily living than their younger counterparts ($P = .020$). No significant differences were noted in range of motion measures or strength between older and younger patient groups for either implant (all $P > .05$). Overall, patient satisfaction was high with 86% of patients rating satisfaction with their shoulder as satisfied or very satisfied (Table V). At final follow-up, patient satisfaction was similar between age groups regardless of implant (TSA $P = .269$; RSA $P = .488$).

Revisions

Overall, 34 patients were revised within 5 years of the primary arthroplasty (Table VI). Patients undergoing TSA had a significantly lower revision rate, with 19 of 482 patients (3.9%) being revised as compared to 15 of 185 patients (8.1%) undergoing RSA ($P = .043$). In the TSA study groups, aseptic glenoid loosening was the most frequent indication for revision in the TSA group (6 patients; 1.2% of all TSA), followed by instability (5 patients; 1.0% of all TSA) and rotator cuff tears tied (5 patients; 1.0% of all TSA). In the RSA group, instability accounted was the most common indication for revision (9 patients; 3.2% of all RSA), followed by infection (5 patients; 2% of all RSA) and periprosthetic fracture (1 patient; 0.5% of all RSA).

Eight of the 34 patients who were revised underwent a subsequent revision for a second revision rate of 24%. All 5 patients in the RSA study groups initially revised as a result of infection underwent a second revision. The indications for the second revision were chronic infection in 3 patients, instability in 1 patient, and glenoid fracture in 1 patient. Two patients who were initially revised for aseptic glenoid loosening with bone loss required second revisions for aseptic component loosening (1) and a periprosthetic fracture sustained from a fall (1). A patient in the RSA age 50-69 years group was initially revised with another reverse prosthesis for instability but developed an early infection after the revision. The patient underwent multiple I&Ds and subsequent RSA revision.

Discussion

Our study compared the clinical outcomes of TSA for primary OA and RSA for rotator CTA in patients 70 years and older compared with patients younger than 70 years. Specifically, in patients older than 70 years who underwent TSA or RSA, there were no or minimal differences in all outcome measures at early to midterm follow-up. When differences did exist, the outcomes favored TSA in patients older than 70 years, although this comparison is made across 2 very different indications for arthroplasty. More important, there were no differences in TSA outcomes between patients older or younger than 70 years. Overall, the results of our study supported our hypothesis that TSA and RSA can perform equally in patients older than 70 years, and that there would be no differences in outcomes of each individual procedure based on age. Importantly, patients older than 70 years who underwent RSA were nearly 4 times more likely to undergo revision at our early to midterm follow-up compared with TSA in patients older than 70 years; again, we highlight that differences comparing each implant are flawed because of the very different indications for arthroplasty.

Table II Walch glenoid classification for anatomic total shoulder arthroplasty patients

Walch glenoid type	Age 50-69 yr, n (%)	Age 70-89 yr, n (%)
A1	112 (41)	88 (42)
A2	25 (9)	25 (12)
B1	29 (11)	18 (9)
B2	74 (27)	50 (24)
C	12 (4)	2 (1)
Missing	22 (8)	25 (12)

Table III Patient and clinician outcome measures for anatomic total shoulder arthroplasty patients

	Age 50-69 yr		Age 70-89 yr		Age group *P* value
	Preoperative	Final follow-up	Preoperative	Final follow-up	
ASES	38.4 ± 18.2	86.0 ± 19.7	37.4 ± 19.6	87.7 ± 17.0	.520
Pain VAS	5.8 ± 2.6	1.1 ± 2.0	5.7 ± 2.8	0.8 ± 1.9	.180
Constant: Pain	3.7 ± 2.8	12.1 ± 3.9	4.0 ± 3.3	13.0 ± 3.5	.515
Constant: ADL	7.6 ± 3.9	16.6 ± 4.5	7.5 ± 4.0	17.5 ± 3.8	.287
Constant: Mobility	11.9 ± 8.3	35.0 ± 6.8	9.9 ± 7.3	35.6 ± 5.9	.207
Constant: Strength	5.0 ± 7.5	11.8 ± 6.9	3.2 ± 5.6	9.3 ± 5.2	.707
Constant: Total	28.2 ± 17.4	75.6 ± 17.1	24.9 ± 1.9	76.2 ± 12.9	.561
Constant: Adjusted	34.6 ± 20.5	96.2 ± 21.2	34.5 ± 20.2	108.2 ± 19.4	.572
SANE	32.3 ± 23.7	76.8 ± 31.1	33.6 ± 24.5	79.1 ± 31.3	.156

ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *VAS*, visual analog scale; *ADL*, activities of daily living; *SANE*, Single Assessment Numeric Evaluation.

Table IV Patient and clinician outcome measures for reverse shoulder arthroplasty patients

	Age 50-69 yr		Age 70-89 yr		Age group *P* value
	Preoperative	Final follow-up	Preoperative	Final follow-up	
ASES	31.6 ± 18.9	71.1 ± 24.2	31.7 ± 18.9	73.0 ± 23.6	.065
Pain VAS	6.1 ± 2.8	1.6 ± 2.5	6.0 ± 3.0	1.5 ± 2.4	.103
Constant: Pain	3.6 ± 3.1	11.0 ± 4.4	4.1 ± 3.4	11.9 ± 4.2	.161
Constant: ADL	5.5 ± 3.4	13.4 ± 5.8	5.7 ± 3.1	15.0 ± 5.2	.020
Constant: Mobility	8.1 ± 8.0	28.2 ± 9.1	5.5 ± 5.8	27.5 ± 9.1	.406
Constant: Strength	1.1 ± 2.8	9.1 ± 6.0	0.2 ± 1.5	6.6 ± 4.4	.664
Constant: Total	18.3 ± 12.2	61.1 ± 19.3	15.5 ± 9.3	61.2 ± 17.5	.748
Constant: Adjusted	23.4 ± 15.6	81.5 ± 27.3	22.0 ± 13.0	88.9 ± 25.6	.193
SANE	24.4 ± 21.9	67.9 ± 32.3	30.3 ± 24.2	66.8 ± 34.0	.332

ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *VAS*, visual analog scale; *ADL*, activities of daily living; *SANE*, Single Assessment Numeric Evaluation.

Elderly patients undergoing shoulder arthroplasty experience a higher risk of complications than younger patients.[6,8] Prior database studies have demonstrated that elderly patients, generally defined as older than 75 years old, have longer length of stay, transfusion rates, 90-day readmissions, and in-hospital mortality.[7,12] These findings likely reflect the increased risk of performing any surgical procedure in the elderly population. The relative morbidity of shoulder arthroplasty for the elderly places an emphasis on selecting the most reliable procedure, which can be defined as the one least likely to require revision while still providing improvements in pain and function, as well as salvage options in the case of failure.

RSA has recently been proposed as the optimal procedure in older patients largely owing to the rates of secondary rotator cuff dysfunction following TSA that can ultimately lead to implant failure.[22,24,25] The results of our study provide some support to this reasoning given that 3 of 5 revisions in the TSA age 70-89 years group were for soft tissue failures; however, the revisions in the TSA group were significantly fewer than in the RSA group in our study. Moreover, recent survivorship studies from high-volume institutions have

Table V Patient satisfaction at final follow-up

	TSA		RSA	
	Age 50-69 yr, n (%)	Age 70-89 yr, n (%)	Age 50-69 yr, n (%)	Age 70-89 yr, n (%)
Very dissatisfied	13 (5)	8 (4)	8 (11)	6 (6)
Dissatisfied	22 (8)	8 (4)	9 (12)	16 (16)
Satisfied	62 (23)	49 (25)	18 (24)	30 (30)
Very satisfied	170 (64)	138 (68)	39 (53)	47 (47)

TSA, total shoulder arthroplasty; *RSA*, reverse shoulder arthroplasty.
Patient satisfaction was not significantly different between age groups (TSA $P = .269$; RSA $P = .488$).

Table VI Revision rates and indication for first revision

	TSA		RSA	
	Age 50-69 yr	Age 70-89 yr	Age 50-69 yr	Age 70-89 yr
Patients revised, n (%)	14 (5.1)	5 (2.4)	7 (8.6)	8 (7.7)
Second revision	4	1	2	1
Indication for first revision				
Infection	1	0	1	3
Instability	3	2	5	4
Periprosthetic fracture	1	1	1	1
Rotator cuff tear	4	1	0	0
Component loosening	5	1	0	0

TSA, total shoulder arthroplasty; *RSA*, reverse shoulder arthroplasty.
Patients undergoing TSA had a significantly lower rate of revisions ($P = .043$).

demonstrated mid- to long-term follow-up for RSA as high as 95%,[8] and that RSA has a lower complication rate in patients older than 65 years.[18] These findings are encouraging given that most revisions following RSA occur within 6 months of surgery.[8] Lastly, the outcomes of revision of a failed anatomic arthroplasty to RSA are known to be inferior to primary RSA,[2,14] providing some support against the argument that a failed anatomic arthroplasty could always be later revised to RSA. Nevertheless, the benefits of RSA are weighed against an incomplete understanding of its longevity and poor salvage options. Patients requiring revision of RSA can require several reoperations, compared with revisions of TSA to RSA that are most commonly a single stage.[1,14] In addition, there is a known learning curve with RSA and the survivorship results of high-volume institutions may not be applicable to all settings.[6,20] In short, although there are theoretical and demonstrated benefits to RSA in the elderly population, there are concerns about its routine use for indications that can be treated by more traditional implants.

The results of this study add to the question of the implant selection by demonstrating that successful results can be achieved with TSA in patients 70 years of age and older. In addition, the functional results and satisfaction for TSA were either the same or slightly better than RSA in our study. Two prior studies comparing outcomes of TSA and RSA in elderly patients also found similar outcomes for the 2 procedures, or slightly favoring TSA. Triplet et al[17] compared 18 TSA for primary OA and 33 RSA for CTA in patients older than 80 years at a minimum 2-year follow-up. They found similar pain, function, and range of motion between the 2 procedures; however, there was a small but statistically significant advantage in the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form score, satisfaction, length of stay, and transfusion rates in the TSA group. Wright et al[22] conducted a perhaps more clinically relevant comparison between 102 TSAs and 33 RSAs for primary OA with an intact rotator cuff in patients older than 70 years. At a minimum 2-year and mean 7-year follow-up, they reported no differences in function, pain, complications, and revisions between the 2 groups. However, unlike prior studies, our results demonstrated a higher rate of revision in the RSA patients older than 70 years (8%) compared with TSA patients older than 70 years (2%).

Based on our findings and prior studies, we do not routinely use RSA in elderly patients with primary OA with an intact rotator cuff based on age alone. Although concerns about secondary rotator cuff failure after TSA are justified, our results demonstrate that TSA can achieve successful results and RSA may have a higher rate of revision at early to midterm follow-up. Moreover, prior

studies have shown that failure of RSA can lead to multiple reoperations in the higher-risk elderly population. As patients are expected to live longer, revision of a failed primary RSA in an octogenarian may theoretically present a significantly more difficult situation than a failed TSA although our study was not designed to answer this question. Further prospective studies are needed before the use of age as an indication to perform RSA in elderly patients for primary OA.

Our study has multiple important limitations. The difference in indications between the TSA (primary OA) and RSA (CTA) cohorts may account for differences in outcome measures and patient satisfaction. However, in our practice and likely many others, RSA for primary OA with an intact rotator cuff is reserved for select patients with severe glenoid morphology (some B2 and B3 glenoids). Our investigation was not able to perform a head-to-head comparison of TSA vs. RSA in patients 70 years of age and older with primary OA and an intact rotator cuff because our institution has not routinely performed RSA in the setting of primary OA and an intact rotator cuff. Age alone has not been historically used as a cut-off at our institution to favor RSA over TSA in patients with primary OA. Given that the primary question in this study was comparing the results of the TSA and RSA based on age, we felt that this imperfect comparison (OA and CTA) could still provide valuable information on whether one implant has demonstrable differences in function, pain, or complications in elderly patients. Furthermore, we wanted to see if patients older than 70 years with primary OA and an intact rotator cuff somehow fare worse after TSA when compared to a younger cohort after TSA. Fortunately, we did not see a significant difference between outcomes following TSA for patients regardless of age.

Another limitation is our early to midterm follow-up, especially in the TSA group. Longer-term follow-up may have identified secondary rotator cuff failure and associated glenoid loosening, and therefore affected the difference in revision rates between TSA and RSA. Further follow-up is needed on this cohort to determine the compare the durability of TSA and RSA. Nevertheless, the higher rate of early to midterm revisions in the RSA group suggests that RSA should continue to be approached with caution. Lastly, all procedures were performed by a single, high-volume shoulder arthroplasty surgeon, and therefore these results may not be generalizable to all surgeons and institutions.

Conclusion

Both anatomic and reverse total shoulder arthroplasty are reliable procedures for patients 70 years of age and older with comparable results to the respective patient cohorts younger than 70 years. Although some surgeons anecdotally advocate for RSA in patients older than 70 years with primary OA and an intact rotator cuff, we did not find a difference in outcomes for TSA in patients 70 years of age and older compared with TSA in patients younger than 70 years. Given satisfactory results following TSA in patients 70 years of age and older, we do not routinely perform RSA for primary OA with an intact rotator cuff solely based on age. Further studies are needed to determine the optimal implant selection for elderly patients with primary OA.

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Brent J. Morris has received intellectual property (IP) royalties/work as a consultant for Wright Medical Technology, Inc. He also works as a paid consultant, presenter, or speaker for DJ Orthopedics and Smith & Nephew and receives royalties from DJ Orthopedics. None of the commercial entities were involved in any aspect of the study.

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