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Characterizing preoperative expectations for patients undergoing reverse total shoulder arthroplasty

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Background: There remains a paucity of information analyzing which factors most influence preoperative expectations for patients undergoing reverse total shoulder arthroplasty (RTSA). The purposes of our study were to characterize preoperative patient expectations for those scheduled to undergo RTSA and to determine the impact of demographic factors, shoulder function, and shoulder pain on these preoperative expectations.
Methods: Patients were prospectively recruited into the study if they were scheduled to undergo an elective unilateral primary RTSA for a diagnosis of glenohumeral arthritis. Preoperative patient expectations were evaluated using the Hospital for Special Surgery's Shoulder Surgery Expectation Survey. Patients also completed the American Shoulder and Elbow Surgeons shoulder score, the Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Function–Upper Extremity computer adaptive test (version 2.0), the PROMIS Pain Interference (PI) computer adaptive test (version 1.1), the PROMIS Depression computer adaptive test (version 1.0), visual analog scores, and an itemized satisfaction questionnaire, which paralleled the Hospital for Special Surgery's Shoulder Surgery Expectation Survey. Demographic data and preoperative shoulder range of motion (ROM) were also recorded.
Results: A total of 107 patients scheduled to undergo RTSA were included in the study. Relief of daytime pain (n = 91, 85%), improvement in self-care (n = 86, 80%), and improvement in shoulder ROM (n = 85, 79%) were most commonly cited as "very important" expectations. In the item-specific analysis, lower PROMIS Upper Extremity scores were correlated with greater expectations for the ability to reach sideways ($P = .015$) and the ability to perform daily activities ($P = .018$). Patients with lower shoulder ROM had greater expectations for improved shoulder ROM (internal rotation with arm at 90°, $P = .004$) and an improved ability to perform daily activities (forward elevation, $P = .038$; abduction, $P = .009$). In the cumulative analysis, a greater number of very important expectations was associated with African American race ($P = .013$), higher PROMIS PI score ($r = 0.351$, $P = .004$), and lower overall preoperative satisfaction ($r = 0.334$, $P < .001$).
Conclusion: Patients scheduled to undergo RTSA have the greatest expectations for relief of daytime pain, improvement in self-care, and improvement in shoulder ROM. Patients with limited preoperative ROM have greater expectations for improvement in self-care and the ability to perform daily activities in addition to expectations for improvement in shoulder ROM. Greater overall expectations for surgery were not associated with preoperative physical function but were instead associated with lower preoperative satisfaction and higher PROMIS PI scores.
Level of evidence: Basic Science Study; Validation of Outcome Instrument
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Keywords: Patient-reported outcomes; PROMIS; ASES; expectations; reverse total shoulder arthroplasty; rotator cuff arthropathy; satisfaction

The ability to understand which factors most influence patients' preoperative expectations and to provide appropriate counseling is essential to providing quality orthopedic care. Greater preoperative expectations are inconsistently associated with improved outcomes postoperatively[25]; however, unfulfilled preoperative expectations are associated with decreased patient satisfaction.[22] In an effort to provide a framework to guide preoperative counseling and maximize postoperative satisfaction, several studies have attempted to characterize preoperative expectations for a variety of orthopedic procedures relating to the shoulder,[5,6,18,23] hip,[3,7,10,16] knee,[13,15,17] and spine.[8,12,22,24]

Reverse total shoulder arthroplasty (RTSA) is a relatively new procedure traditionally performed for glenohumeral arthritis, although it has also been increasingly used in the acute traumatic setting. The number of patients undergoing RTSA has been rapidly increasing, accounting for one-third of all shoulder arthroplasties in 2011.[21] Given the relative recency of this procedure, little is known about preoperative expectations for patients undergoing RTSA. A recent study characterized preoperative expectations for patients scheduled to undergo RTSA and found that patients with better physical function and no history of joint replacement surgery had greater preoperative expectations.[20] Another study found that greater expectations for relief of nighttime pain and the ability to play non-overhead sports was associated with improved outcomes following RTSA.[19]

Despite these studies, there remains a paucity of information analyzing which factors most influence preoperative expectations for patients undergoing RTSA. With the evolution of patient-reported outcomes (PROs) toward computer adaptive testing, as well as the increase in routine collection of electronic PROs during orthopedic clinic visits, these analyses would greatly benefit from the inclusion of Patient-Reported Outcomes Measurement Information System (PROMIS) testing.[1] Furthermore, the impact of routinely collected objective physical function measurements (eg, range of motion [ROM]) on preoperative expectations may provide insight into patients' goals for surgery.

For these reasons, the purposes of our study were to characterize preoperative patient expectations for patients scheduled to undergo RTSA and to determine the impact of demographic factors, shoulder function, and shoulder pain on these preoperative expectations. We hypothesized that patients with greater preoperative physical function would have greater expectations for RTSA.

Materials and methods

This prospective cohort study was performed from February 2017 through December 2020. Patients were recruited into the study if they were scheduled to undergo an elective unilateral primary RTSA for a diagnosis of glenohumeral arthritis performed by a single operating surgeon (S.J.M.). Patients were excluded if they were scheduled to undergo a revision procedure or RTSA for acute fracture care.

Patients' preoperative expectations were evaluated using the Hospital for Special Surgery's Shoulder Surgery Expectation Survey (HSS-ES).[14] This 17-item questionnaire asks respondents to rate the importance of common expectations prior to shoulder surgery as "very important," "somewhat important," "a little important," "I do not expect this," or "this does not apply to me." Patients were also assigned a series of other preoperative questionnaires, including the American Shoulder and Elbow Surgeons (ASES) shoulder score, the PROMIS Physical Function–Upper Extremity (UE) computer adaptive test (version 2.0), the PROMIS Pain Interference (PI) computer adaptive test (version 1.1), the PROMIS Depression (DE) computer adaptive test (version 1.0), visual analog scale (VAS) scores, and an itemized satisfaction questionnaire. The VAS scores assessed the amount of current pain, pain at rest, pain during activity, and nighttime pain; all VAS scores were measured from 0 to 100. In addition, an overall rating of general health was obtained, and the Single Assessment Numeric Evaluation score was determined for the affected shoulder. The satisfaction survey included itemized questions that paralleled those of the HSS-ES, but instead of asking "How important are these expectations in the treatment for your shoulder?," the satisfaction survey instead asked "How satisfied are you with the following aspects of your shoulder?" All surveys were administered on electronic tablets (iPad tablet; Apple, Cupertino, CA, USA) using a secure Web-based application (REDCap; Vanderbilt University, Nashville, TN, USA) that was designed to support data capture for research studies at our institution.[4]

Demographic information including age, sex, race, hand dominance, history of shoulder surgery, and shoulder diagnosis (rotator cuff arthropathy, post-traumatic osteoarthritis, or inflammatory arthritis) was also recorded. ROM measurements were obtained during a physical examination and included shoulder forward elevation, abduction, and external and internal rotation with the shoulder at 90° of abduction. All ROM measurements were recorded in degrees.

Statistical analysis

Patients were excluded from analyses if they consented to study participation but did not complete the assigned preoperative questionnaires. For purposes of analysis, responses to the HSS-ES were categorized as follows: greatest level of expectations (very important), moderate level of expectations (somewhat important or a little important), and lowest level of expectations (I do not expect this or this does not apply to me); this method of categorization is consistent with methods in prior studies using the HSS-ES.[5,20] Similarly, responses to the itemized satisfaction survey were categorized as greater satisfaction ("very satisfied" or "somewhat satisfied"), less satisfaction ("a little satisfied" or "not satisfied at all"), and not applicable ("this does not apply to me" or the patient did not answer the question).

Demographic and baseline PRO data were calculated and presented using means, standard deviations, and percentages. For the item-specific analysis, the association between each preoperative expectation and continuous variables was analyzed using the nonparametric Wilcoxon rank sum test for 2-group comparisons

Table I Patient demographic data

Variable	Mean ± SD or n (%)
Age, yr	71 ± 7
Sex	
Male	50 (46.7)
Female	57 (53.3)
Race	
White	83 (77.6)
African American	22 (20.6)
Other or prefer not to answer	2 (1.8)
BMI, kg/m^2	30.0 ± 7.1
Previous surgery	
Yes	19 (17.8)
No	88 (82.2)
Indication for surgery	
Rotator cuff arthropathy	97 (90.7)
Post-traumatic osteoarthritis	7 (6.5)
Inflammatory arthritis	3 (2.8)
Surgery on dominant shoulder	
Yes	71 (66.4)
No	36 (33.6)

BMI, body mass index; *SD*, standard deviation.

and the Kruskal-Wallis test for comparisons of ≥3 groups. The association of each preoperative expectation and categorical variables was analyzed using the χ^2 test or the Fisher exact test when there were <5 expected responses for a category. For the cumulative analysis, the total number of very important expectations was calculated for each patient. The relationship between the total number of very important expectations and each categorical variable was calculated using the Wilcoxon rank sum test and Kruskal-Wallis test, whereas the relationship with each continuous variable was calculated using the Spearman rank correlation test. Statistical significance was defined as $P < .05$. All analyses were performed using SAS software (version 9.4; SAS Institute, Cary, NC, USA).

Results

A total of 258 RTSAs were performed by 1 shoulder and elbow fellowship-trained surgeon at our institution during the study period. Of these, 112 consented to participate in the study and 107 completed the preoperative expectations survey and were included in the study. The average patient age was 71 years. There were 57 women (53.3%) and 50 men (46.7%). Surgery was performed on the dominant shoulder in 71 patients (66.4%) and was most commonly performed for rotator cuff arthropathy (90.7%). There were no significant differences in age ($P = .897$), sex ($P = .382$), race ($P = .371$), or body mass index ($P = .084$) for patients who chose not to participate or were not enrolled during the study period. Further demographic information is presented in Table I.

Preoperative PROMIS scores, VAS scores, ASES shoulder scores, and ROM measurements are shown in Table II. The low PROMIS UE score, low ASES shoulder score, and limited ROM reflect the diminished physical function of this patient population, whereas the elevated PROMIS PI score and VAS scores reflect increased pain.

There were no metrics for which a majority of patients reported high preoperative satisfaction (Table III). The metrics with the greatest satisfaction were psychological well-being (n = 49, 46%), the ability to drive or put on a seat belt (n = 39, 36%), the ability to interact with others (n = 31, 29%), and the ability to perform self-care (n = 29, 27%). The metrics with the lowest satisfaction were the amount of daytime pain (n = 98, 92%), ROM of the shoulder (n = 95, 89%), the ability to reach above shoulder level (n = 95, 89%), the ability to reach sideways (n = 91, 85%), and the amount of nighttime pain (n = 89, 83%).

The frequencies of responses for each preoperative expectation are shown in Table IV. Relief of daytime pain (n = 91, 85%), improvement in self-care (n = 86, 80%), and improvement in shoulder ROM (n = 85, 79%) were most commonly cited as very important expectations. Conversely, employment for monetary reimbursement (n = 16, 15%), stopping the shoulder from dislocating (n = 34, 32%), and stopping the shoulder from clicking (n = 37, 35%) were least commonly cited as very important expectations.

In the item-specific analysis, patients with higher PROMIS PI scores had greater expectations for daytime pain relief ($P < .001$), nighttime pain relief ($P < .001$), the ability to be employed for monetary reimbursement ($P = .036$), improved psychological well-being ($P = .039$), and an improved ability to drive or put on a seat belt ($P = .041$). Lower PROMIS UE scores were correlated with greater expectations for the ability to reach sideways ($P = .015$) and the ability to perform daily activities ($P = .018$). Higher PROMIS DE scores were correlated with greater expectations for improved psychological well-being ($P < .001$) and an improved ability to drive or put on a seat belt ($P = .026$). Lower ASES scores were correlated with higher expectations for daytime pain relief ($P < .001$), nighttime pain relief ($P < .001$), and improved self-care ($P = .008$).

Higher VAS scores for current pain were correlated with greater expectations for daytime pain relief ($P = .007$) and improved self-care ($P = .018$). Higher VAS scores for pain at rest were associated with greater expectations for nighttime pain relief ($P = .018$), stopping the shoulder from dislocating ($P = .004$), and an improved ability to interact with others ($P = .020$). There were also correlations of higher VAS scores for pain with activity and higher VAS scores for pain at night with greater expectations for daytime pain relief ($P < .001$ and $P = .024$, respectively) and nighttime pain relief ($P = .046$ and $P < .001$, respectively).

Patients with lower shoulder ROM had greater expectations for improved shoulder ROM (internal rotation, $P = .004$), improved self-care (internal rotation, $P = .045$;

Table II Preoperative measures

Measure	Mean	SD	Minimum	Maximum
PROMIS UE score	29.2	5.9	17	44.7
PROMIS PI score	62.2	6.74	38.7	72.7
PROMIS DE score	50.2	9.8	34	76.9
ASES shoulder score	39.2	17.3	2.2	80
VAS pain score				
Current	59	26	0	100
At rest	42	29	0	100
With activity	67	21	0	100
At night	63	27	0	100
SANE score	38	23	0	100
Overall health as % of normal	70	20	0	100
Range of motion, °				
Forward elevation	97	46	10	180
Abduction	90	46	0	180
External rotation	70	20	0	90
Internal rotation	39	20	0	80

PROMIS, Patient-Reported Outcomes Measurement Information System; *UE*, Upper Extremity; *PI*, Pain Interference; *DE*, Depression; *ASES*, American Shoulder and Elbow Surgeons; *VAS*, visual analog scale; *SANE*, Single Assessment Numeric Evaluation; *SD*, standard deviation.

Table III Satisfaction survey responses

Variable	Level of satisfaction in response to "How satisfied are you with the following aspects of your shoulder?"		
	Greater satisfaction, %	Less satisfaction, %	Not applicable, %
Amount of daytime pain	7	92	1
Amount of nighttime pain	14	83	3
Range of motion of shoulder	9	89	2
Amount of shoulder dislocating	0	25	75
Amount of shoulder clicking	6	50	44
Ability to carry objects >10 lb (>4.5 kg)	16	79	5
Ability to reach above shoulder level	8	89	3
Ability to reach sideways	14	85	1
Ability to perform self-care	27	71	2
Employment status	20	15	65
Psychological well-being	46	47	7
Ability to interact with others	29	60	11
Ability to perform daily activities	21	79	0
Ability to drive or put on seat belt	36	59	5
Ability to exercise or participate in sports	8	72	20
Ability to participate in recreational activities	16	74	10

The level of satisfaction was categorized as follows: Greater satisfaction represents the percentage of patients who responded "very satisfied" or "somewhat satisfied." Less satisfaction represents the percentage of patients who responded "a little satisfied" or "not satisfied at all." Not applicable represents the percentage of patients who responded "this does not apply to me" or who did not respond to the question.

external rotation, $P = .013$), and an improved ability to perform daily activities (forward elevation, $P = .038$; abduction, $P = .009$). Lower satisfaction was associated with greater expectations for improvement in nighttime pain ($P = .015$), shoulder ROM ($P = .026$), shoulder clicking ($P = .001$), the ability to reach sideways ($P = .048$), the ability to be employed for monetary reimbursement ($P = .003$), psychological well-being ($P < .001$), and the ability to drive or put on a seat belt ($P = .002$).

Women had greater expectations for improved shoulder ROM ($P = .024$) and improved self-care ($P < .001$) but had lower expectations for stopping the shoulder from dislocating ($P = .027$) and clicking ($P = .004$) and the ability

Table IV   Hospital for Special Surgery's Shoulder Surgery Expectations Survey responses

Expectation	No. of responses to "How important are these expectations in the treatment for your shoulder?"					Greatest level of expectations,[*] %
	Very important	Somewhat important	A little important	I do not expect this	This does not apply to me	
Relieve daytime pain	91	13	1	0	1	85
Relieve nighttime pain	81	21	2	3	0	75.7
Range of motion of shoulder	85	21	1	0	0	79.4
Stop shoulder from dislocating	34	4	1	3	65	31.8
Stop shoulder from clicking	37	14	9	3	41	34.6
Improve ability to carry objects >10 lb (>4.5 kg)	62	31	7	3	4	57.9
Improve ability to reach above shoulder level	70	34	2	0	1	65.4
Improve ability to reach sideways	70	32	3	1	1	65.4
Improve self-care	86	15	3	0	2	80.4
Be employed for monetary reimbursement	16	7	5	10	69	15
Improve psychological well-being	59	22	5	9	12	55.1
Improve ability to interact with others	68	22	4	1	11	63.6
Improve ability to perform daily activities	78	25	3	0	1	72.9
Improve ability to drive or put on seat belt	78	13	9	1	6	72.9
Improve ability to exercise or participate in sports	47	29	7	7	17	43.9
Improve ability to participate in recreational activities	51	28	15	3	10	47.7
For the shoulder to be the way it was before this problem started	71	28	2	6	0	66.4

[*] Percentage of patients who responded "very important."

to be employed for monetary reimbursement ($P = .021$). Younger patients had greater expectations for the ability to be employed for monetary reimbursement ($P = .003$). Patients with a previous shoulder operation had greater expectations for an improved ability to drive or put on a seat belt ($P = .015$). Greater Single Assessment Numeric Evaluation scores were associated with greater expectations for an improved ability to exercise or participate in sports ($P = .009$) but lower expectations for daytime pain relief ($P = .02$).

In the cumulative analysis, patients cited 10.8 ± 3.8 total expectations as very important, on average (Fig. 1). A greater number of very important expectations was associated with African American race ($P = .013$), higher PROMIS PI score ($r = 0.351$, $P = .004$), and lower overall preoperative satisfaction ($r = 0.334$, $P < .001$) (Table V).

Discussion

One of the most important findings of our study was that patients with limited preoperative ROM have greater

expectations for improvement in self-care and the ability to perform daily activities. To our knowledge, no other study has evaluated the impact of ROM on preoperative expectations for patients undergoing RTSA. Because ROM is routinely assessed as part of the basic orthopedic physical examination, an understanding of these associations between decreased ROM and preoperative expectations makes it more feasible for providers to anticipate these expectations and effectively counsel patients.

Additionally, we believe that this is the first study to evaluate the impact of PROMIS scores on preoperative patient expectations. In lieu of disease- or anatomy-specific PROs, the routine collection of PROMIS computerized adaptive test scores has been shown to be feasible in ambulatory surgery clinics owing to the relatively low number of questions and short time to completion.[11] PROMIS scores also demonstrate lower floor and ceiling effects for a variety of upper-extremity orthopedic conditions when compared with anatomy- or disease-specific PROs.[2] Our study found that greater PROMIS PI scores were associated with greater expectations for a number of items on the HSS-ES, particularly those related to pain
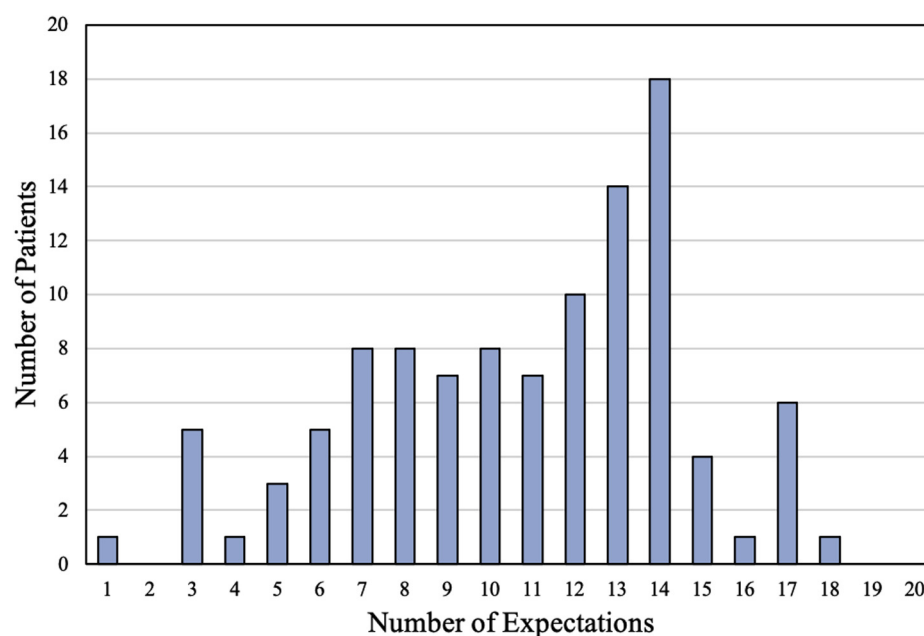
Figure 1   Histogram of total number of expectations cited as ''very important'' by each patient.

Table V   Correlation of demographic variables with number of "very important" expectations

Variable	Median No. of very important expectations	Correlation coefficient (r)	P value
Sex			
Male	11		.212
Female	12		
Race			
White	11		.013*
African American	14		
Employment			
Full or part time	8.5		.087
Unemployed or retired	12		
Workers' compensation	13		
Age		−0.041	.673
BMI		0.165	.127
PROMIS UE score		−0.227	.066
PROMIS PI score		0.351	.004*
PROMIS DE score		0.192	.132
ASES shoulder score		−0.187	.055
SANE score		−0.038	.698
Satisfaction		0.334	<.001*

BMI, body mass index; *PROMIS*, Patient-Reported Outcomes Measurement Information System; *UE*, Upper Extremity; *PI*, Pain Interference; *DE*, Depression; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation.
The relationship between the number of "very important" expectations and each categorical variable was calculated using the Wilcoxon rank sum test and Kruskal-Wallis test, whereas the relationship with each continuous variable was calculated using the Spearman rank correlation test.
* Statistically significant.

relief but also those related to functional tasks such as putting on a seat belt or being employed for monetary reimbursement. Lower functional scores as assessed by PROMIS UE testing were associated with greater expectations for simple tasks, such as reaching sideways or performing daily activities. Worse PROMIS DE scores, in addition to being associated with greater expectations for improvements in psychological well-being, were associated

with greater expectations for the ability to drive or put on a seat belt. This association may be a reflection of the negative psychological impact of having difficulty with transportation. As the routine collection of PROMIS scores becomes increasingly popular for clinical decision making, the information provided in this study provides a framework for providers to guide patients during preoperative discussions.

Similar to our study, the study by Rauck et al[20] characterized preoperative expectations as measured by the HSS-ES for patients scheduled to undergo RTSA and evaluated the impact of demographic characteristics and several PROs on these preoperative expectations. They found that patients had the greatest expectations for pain relief as well as simple functional tasks, including the ability to provide self-care, perform daily activities, and drive or put on a seat belt. Our study supports these findings, with the patients in our study having the greatest expectations for relief of daytime pain, improvement in self-care, and improvement in shoulder ROM. Additionally, in line with the findings of Rauck et al, the expectations least often cited as very important (including employment for monetary reimbursement, stopping the shoulder from dislocating, and stopping the shoulder from clicking) had a substantial number of responses of "this does not apply to me." These responses may reflect a limitation of the HSS-ES for patients undergoing RTSA; that is, although the HSS-ES is used for a variety of shoulder conditions, some items may not be relevant for this specific patient population.

In addition to RTSA, other studies have used the HSS-ES to evaluate preoperative expectations for patients scheduled to undergo total shoulder arthroplasty (TSA). Henn et al[5] used the HSS-ES to evaluate 98 patients scheduled for TSA and found that younger patients had greater expectations for surgery. Furthermore, on average, patients rated 10.1 of the 17 items on the survey as very important to them. In contrast, we found that patients scheduled for RTSA rated 10.8 of the 17 items as very important, on average. The greater number of overall expectations may be a reflection of the increased baseline pain and decreased function of the RTSA population in comparison to patients scheduled to undergo TSA.

Jawa et al[9] identified sex differences in expectations for patients scheduled to undergo TSA. In their study, men were more likely to value returning to exercise and participation in sports whereas women were more likely to value their ability to perform daily routines and chores. However, in our study of patients scheduled to undergo RTSA, men were more likely to have greater expectations to be employed for monetary reimbursement whereas women were more likely to have greater expectations for improved shoulder ROM and improved self-care. The increased value placed on these simpler functional tasks may again reflect the overall greater debilitation of the RTSA population when compared with the TSA population. Ultimately, when comparing these patient populations, patients scheduled to undergo RTSA have high expectations for a greater number of domains compared with those undergoing TSA, generally emphasizing the ability to perform activities of daily living and other practical tasks.

This study has several limitations. First, the study population was exclusively composed of patients who were scheduled to undergo RTSA, which means that their expectations were collected after they underwent preoperative counseling with the operative surgeon. The informed consent process could certainly influence their responses; however, it is important to note that a single operative surgeon was involved in our study, so all patients underwent consistent preoperative discussions. Second, our study did not include eligible patients who declined participation in the study, potentially introducing a selection bias. Third, the VAS scores and the itemized satisfaction questions have not been validated in the orthopedic literature. Fourth, some of the questions on the HSS-ES questionnaire, particularly those relating to shoulder dislocation and clicking, may not be applicable for patients undergoing RTSA.

Conclusion

Patients scheduled to undergo RTSA have the greatest expectations for relief of daytime pain, improvement in self-care, and improvement in shoulder ROM. Patients with limited preoperative ROM have greater expectations for improvement in self-care and the ability to perform daily activities, in addition to expectations for improvement in shoulder ROM. Greater overall expectations for surgery were not associated with preoperative physical function but were instead associated with lower preoperative satisfaction and higher PROMIS PI scores.

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