Why patients fail to achieve a Patient Acceptable Symptom State (PASS) after total shoulder arthroplasty?

Elliott W. Cole, MD, MPH[a], Samuel G. Moulton, MD[a], Brian C. Werner, MD[b], Patrick J. Denard, MD[a,c,*]

[a]Department of Orthopaedic & Rehabilitation, Oregon Health & Science University, Portland, OR, USA
[b]University of Virginia, Charlottesville, VA, USA
[c]Oregon Shoulder Institute, Medford, OR, USA

Background: The purpose of this study was to compare patient-reported outcomes (PROs) and range of motion (ROM) measurements between patients achieving and failing to achieve a Patient Acceptable Symptom State (PASS) after anatomic total shoulder arthroplasty (TSA) to determine which PRO questions and ROM measurements were the primary drivers of poor outcomes.
Methods: A retrospective review of a multicenter database identified 301 patients who had undergone primary TSA between 2015 and 2018 with ROM and PRO data recorded preoperatively and at a minimum of two years postoperatively. The primary outcome was the difference in active ROM between patients achieving and failing to achieve the PASS threshold for the American Shoulder and Elbow Surgeons (ASES) and Single Assessment Numeric Evaluation (SANE) scores. The secondary outcome was the difference in self-reported pain levels between those achieving and failing to achieve a PASS.
Results: Based on the ASES PASS threshold, 87% (261/301) of patients achieved a PASS after TSA, whereas 13% did not. Based on the SANE PASS threshold, 69% (208/301) of patients achieved a PASS after TSA, whereas 31% did not. Patients who failed to achieve a PASS after TSA were younger and had lower short form-12 mental health scores than those who did. There was a significant difference in pain between those who achieved and failed to achieve a PASS after TSA (ASES PASS current shoulder pain 16.5% vs. 95%, $P < .001$, SANE PASS current shoulder pain 13% vs. 58.1%, $P < .001$). Those failing to reach a PASS had significantly higher pain levels (ASES PASS Visual Analog Scale pain scores [4.2 vs. 0.4, $P < .001$] and SANE PASS Visual Analog Scale pain scores [2.0 vs. 0.4, $P < .001$]) and worse function in nearly all domains of the ASES and Western Ontario Osteoarthritis of the Shoulder index after surgery. There was little difference in ROM between those reaching and failing to reach a PASS (no difference in active external rotation with the arm adducted, active internal rotation at the nearest spinal level, or active internal rotation with the shoulder abducted to 90 degrees for ASES and SANE PASS).
Conclusion: There is variability in the percentage of patients who achieve a PASS after TSA, ranging from 69% to 87% depending on the PRO used to define the threshold. Patients who did not achieve a PASS after TSA were significantly more likely to have pain, whereas there were very few differences in ROM, indicating pain as the primary driver of failing to achieve a PASS. Setting realistic postoperative expectations for pain relief may be important for improving patient-reported results after TSA.
© 2021 The Author(s). Published by Elsevier Inc. on behalf of American Shoulder and Elbow Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

The Patient Acceptable Symptom State (PASS) score has improved the understanding of patients' quality of life after total shoulder arthroplasty (TSA).[1] Historically, patient-reported outcomes (PROs) such as the American Shoulder and Elbow Surgeons

(ASES)[6,9] score and the Single Assessment Numeric Evaluation (SANE) score[4] have been used to quantify clinical outcomes after TSA. The minimal clinically important difference was developed to determine the minimum improvement in PROs a patient needed to achieve to report feeling "better" after surgery. The substantial clinical benefit was further developed to determine the amount of improvement needed for a patient to report feeling substantially better after surgery.[2,5,12] Yet although the minimal clinically important difference and substantial clinical benefit tell us how much improvement is needed for patients to feel "better", they do

not tell us at what level of improvement patients reach a symptom state they deem acceptable.

The PASS score was developed to determine the threshold a patient needed to reach to feel "well" after surgery rather than just "better", which may be a better indicator of individual patient quality of life.[16] Prior studies have determined PASS scores for the ASES and SANE scores as well as risk factors for not achieving a PASS.[1,4] Although the PASS for each PRO provides a threshold to determine when a patient feels their well-being has returned to an acceptable level after surgery, it is composed of responses in multiple domains including pain, range of motion (ROM), activities of daily living (ADLs), work, and recreational activity. It remains unclear which of these components is most responsible for patients failing to achieve an acceptable symptom state after TSA.

The purpose of this study was to compare PROs and ROM between patients achieving and failing to achieve a PASS after TSA to determine which PRO questions and ROM measurements were the primary drivers of poor outcomes. We hypothesized that patients who failed to achieve a PASS after TSA had similar pain levels but worse postoperative active ROM compared with patients who achieved a PASS.

Materials and methods

A retrospective study was performed by querying a prospectively collected multicenter database of TSAs performed between 2015 and 2018. Inclusion criteria were as follows: (1) primary TSA, (2) preoperative ROM and PROs, and (3) postoperative ROMs and PROs at a minimum of two years after surgery. Exclusion criteria were as follows: (1) workers compensation and (2) revision TSA.

Subjects were stratified into two groups based on whether they achieved or failed to achieve a PASS at two years after surgery. Separate analyses were performed for PASS scores based on the ASES and SANE scores. PASS thresholds of 76[1] for the ASES score and 75.5[4] for the SANE score were utilized based on prior studies of shoulder arthroplasty. The primary outcome was the difference in active ROM between those achieving and failing to achieve a PASS score. The secondary outcome was the difference in self-reported pain levels between those achieving and failing to achieve a PASS score.

PASS defined by ASES

First, PRO and ROM variables were compared between patients reaching and failing to reach a PASS for the ASES score. PROs included Visual Analog Scale (VAS) pain scores, Veterans RAND-12 (VR-12) mental scores, Constant-Murley (CM) scores, and the converse PRO (SANE for the ASES subgroup). ROM variables included active forward flexion (FF), active external rotation with the arm adducted (ER0), active external rotation with the shoulder abducted to 90 (ER90), active internal rotation at the nearest spinal level (IR spine), and active internal rotation with the shoulder abducted to 90 degrees (IR90). All measurements other than IR spine were measured with a goniometer. Subject demographics, Walch classification of glenoid morphology, and subscapularis management (peel vs. osteotomy) were compared in a similar fashion.

Next, the responses to individual questions on the ASES and Western Ontario Osteoarthritis of the Shoulder (WOOS) PROs were compared between patients reaching and failing to reach a PASS based on ASES. ASES questions were categorized under the domains of pain, ADLs, and work or sports. The percentage of patients reporting current pain or "very difficult" or "unable to do" for each ASES question was compared between those reaching and failing to reach an ASES PASS. WOOS questions were categorized under the

domains of physical symptoms in the last week, recreation and work, and lifestyle. The mean level of pain or difficulty reported for each WOOS question was compared between those reaching and failing to reach an ASES PASS.

Finally, a multivariate regression analysis was performed to determine which questions on the ASES and WOOS had the strongest association with reaching or failing to reach a PASS based on the ASES score.

PASS defined by SANE

First, PRO and ROM variables were compared between patients reaching and failing to reach a PASS for the SANE score. PROs included VAS pain scores, VR-12 mental scores, CM scores, and the converse PRO (ASES for the SANE subgroup). ROM variables included FF, ER0, ER90, IR spine, and IR90. All measurements other than IR spine were measured with a goniometer. Subject demographics, Walch classification of glenoid morphology, and subscapularis management (peel vs. osteotomy) were compared in a similar fashion.

Next, responses to individual ASES and WOOS questions were compared between patients reaching and failing to reach a PASS based on SANE. The percentage of patients reporting current pain or "very difficult" or "unable to do" for each ASES question and the mean level of pain or difficulty reported for each WOOS question were compared between those reaching and failing to reach a SANE PASS.

Finally, a multivariate regression analysis was performed to determine which questions on the ASES and WOOS had the strongest association with reaching or failing to reach a PASS based on the SANE score.

Surgical technique

Surgeries were performed by 16 surgeons. All surgeons used the same press-fit short or standard-length humeral stem with an all-polyethylene glenoid (Univers II; Arthrex, Naples, FL, USA).

The technique included a standard deltopectoral approach with a biceps tenodesis and a subscapularis peel or tenotomy. Postoperative rehabilitation was not standardized.

Statistical analysis

Categorical variables were compared using chi-squared tests. Continuous variables were compared using Student's t-tests. A binomial logistic regression analysis was utilized to evaluate the independent influence of each of the individual ASES and WOOS questions on the outcome variable of achieving a PASS for both the ASES and SANE PASS cohorts separately. For each of the two regression analyses, the individual ASES responses were considered categorical variables and the individual WOOS responses were considered continuous variables. A backward conditional method was utilized to arrive at the most significant questions that influence achieving a PASS. Statistical significance was defined as $P < .05$. SPSS, version 27, (IBM, Armonk, NY, USA) was used for all statistical analyses.

Results

Three hundred and one patients met the study criteria. Baseline patient characteristics are summarized in Table I. In the ASES group, 87% (261/301) of patients achieved a PASS and 13% (40/301) failed to achieve a PASS. In the SANE group, 69% (208/301) of patients achieved a PASS and 31% (93/301) failed to achieve a PASS. Patients who failed to achieve a PASS were significantly younger than those

Table I
Comparison of patients who achieved or failed to achieve ASES and SANE PASS after TSA.

ASES PASS					
Patient characteristics	Achieved PASS (n = 261)		Failed to meet PASS (n = 40)		*P* value
Demographics					
Age: years (mean, s.d.)	65.9	7.7	61.8	8.8	.002
Sex: female (n, %)	155	59.4%	23	57.5%	.821
BMI: kg/m^2 (mean, s.d.)	30.5	6.0	32.0	5.3	.136
Dominant arm: yes (n, %)	136	52.1%	21	52.5%	.963
Tobacco use: yes (n, %)	12	4.6%	4	10.0%	.156
Diabetes mellitus: yes (n, %)	27	10.3%	5	12.5%	.681
Walch classification					
A1 (n, %)	90	34.5%	16	40.0%	.496
A2 (n, %)	35	13.4%	4	10.0%	.550
B1 (n, %)	61	23.4%	11	27.5%	.569
B2 (n, %)	75	28.7%	9	22.5%	.413
Subscapularis management					
Peel (n, %)	177	67.8%	24	60.0%	.328
Osteotomy (n, %)	84	32.2%	16	40.0%	
SANE PASS					
Patient characteristics	Achieved PASS (n = 208)		Failed to meet PASS (n = 93)		*P* value
Demographics					
Age: years (mean, s.d.)	66.1	7.7	63.6	8.3	.012
Sex: female (n, %)	121	58.2%	57	61.3%	.611
BMI: kg/m^2 (mean, s.d.)	30.5	5.7	31.1	6.3	.415
Dominant arm: yes (n, %)	112	53.8%	45	48.4%	.381
Tobacco use: yes (n, %)	9	4.3%	7	7.5%	.253
Diabetes mellitus: yes (n, %)	24	11.5%	8	8.6%	.445
Walch classification					
A1 (n, %)	75	36.1%	31	33.3%	.647
A2 (n, %)	26	12.5%	13	14.0%	.724
B1 (n, %)	49	23.6%	23	24.7%	.825
B2 (n, %)	58	27.9%	26	28.0%	.990
Subscapularis management					
Peel (n, %)	137	65.9%	64	68.8%	.615
Osteotomy (n, %)	71	34.1%	29	31.2%	

TSA, total shoulder arthroplasty; *SANE*, Single Assessment Numeric Evaluation score; *ASES*, American Shoulder and Elbow Surgeons; *PASS*, Patient Acceptable Symptom State; *BMI*, body mass index.

who achieved it in both the ASES (65.9 vs. 61.8, *P* = .002) and SANE (66.1 vs. 63.6, *P* = .012) groups. There were no other differences in baseline characteristics between patients who achieved or failed to achieve a PASS.

PASS defined by ASES

Patients who failed to achieve an ASES PASS had significantly higher VAS pain scores (4.2 vs. 0.4, *P* < .001) than patients who achieved an ASES PASS. Patients in the ASES group who failed to achieve a PASS also had lower CM scores (*P* < .001), VR-12 mental scores (*P* < .001), and SANE scores (*P* < .001). Assessing ROM, patients who failed to achieve an ASES PASS had lower FF (135° vs. 149°, *P* < .001) and ER90 (61° vs. 70°, *P* = .011), but no difference in ER0, IR spine, or IR90 (Table II).

Patients who did not achieve an ASES PASS reported worse outcomes on all aspects of the ASES, with those failing to achieve an ASES PASS significantly more likely to report current pain or "very difficult"/"unable to do" on every question in the pain, ADL, and work/sports categories of the ASES (Table III).

Patients who failed to achieve an ASES PASS were also more likely to report increased symptoms on the WOOS, with those failing to achieve a PASS reporting significantly increased symptoms on every question in the physical symptoms, recreation/work, and lifestyle categories of the WOOS (Table III).

In the regression analysis, the most significant question that determined achieving an ASES PASS was the ASES question "do you have pain in your shoulder now?". A positive response to this question was the most significantly associated response with failing

to achieve an ASES PASS (odds ratio [OR] 12.6, 95% confidence interval [CI] 2.2-74.1, *P* = .005).

PASS defined by SANE

Patients who failed to achieve a SANE PASS had significantly higher VAS pain scores (2.0 vs. 0.4, *P* < .001) than those who achieved a SANE PASS. Those failing to achieve a SANE PASS also had lower CM scores (*P* < .001), lower VR-12 mental scores (*P* < .032), and lower ASES scores (*P* < .001). ROM was similar in those who did and did not achieve a SANE PASS. Aside from decreased FF (142° vs. 150° *P* = .002) in the group who failed to achieve a SANE PASS, there was no difference in ER0, ER90, IR spine, or IR90 when comparing those who did and did not achieve a SANE PASS (Table II).

With the exception of narcotic pain medicine use (10.8% vs. 5.3%, *P* = .086), those failing to achieve a SANE PASS were significantly more likely to report current pain or "difficult" or "unable to do" for every question in the pain, ADL, and activity categories of the ASES (Table IV).

Those who failed to achieve a SANE PASS also reported significantly higher symptom levels on every question in the physical symptoms, recreation and work, and lifestyle categories of the WOOS (Table IV).

In the regression analysis, the most significant question that determined achieving a SANE PASS was the ASES question "do you have pain in your shoulder now?". A positive response to this question was the most significantly associated response with failing to achieve a SANE PASS (OR 4.7, 95% CI 1.7-12.7, *P* = .002).

Table II
Comparison of clinical outcomes for patients who achieved or failed to achieve PASS after TSA.

ASES PASS					
Outcomes	Achieved PASS (n = 261)		Failed to meet PASS (n = 40)		*P* value
	Mean	Std. Dev.	Mean	Std. Dev.	
VAS pain	0.4	0.7	4.2	1.8	<.001
SANE	83.2	23.4	55.4	21.4	<.001
Constant-Murley	73.7	9.2	54.2	14.3	<.001
VR-12 mental	55.7	8.2	48.5	13.5	<.001
Active FF (degrees)	149	18	135	30	<.001
Active ER at side (degrees)	54	16	50	17	.145
Active ER at 90 (degrees)	70	19	61	30	.011
Active IR (spinal level)	L2	3	L3	3	.051
Active IR at 90 (degrees)	43	19	37	21	.068
SANE PASS					
Outcomes	Achieved PASS (n = 208)		Failed to meet PASS (n = 93)		*P* value
	Mean	Std. Dev.	Mean	Std. Dev.	
VAS pain	0.4	0.9	2.0	2.2	<.001
ASES	93.7	7.5	76.9	18.5	<.001
Constant-Murley	74.8	9.0	63.6	13.6	<.001
VR-12 mental	55.5	8.4	53.0	11.1	.032
Active FF (degrees)	150	18	142	24	.002
Active ER at side (degrees)	54	16	52	17	.327
Active ER at 90 (degrees)	70	18	66	25	.117
Active IR (spinal level)	L2	3	L2	3	1.000
Active IR at 90 (degrees)	43	19	42	20	.678

TSA, total shoulder arthroplasty; *SANE*, Single Assessment Numeric Evaluation score; *ASES*, American Shoulder and Elbow Surgeons; *PASS*, Patient Acceptable Symptom State; *VAS*, Visual Analog Scale; *VR*, Veterans RAND; *FF*, forward flexion; *ER*, external rotation; *IR*, internal rotation (listed as average level obtained).

Discussion

The major findings of the present study are that nearly one third of patients failed to achieve a SANE PASS after TSA and that persistent pain appears to be the major driver of failing to achieve a PASS after TSA. Contrary to our hypothesis that decreased postoperative ROM would be the main predictor of failing to achieve PASS, we found little difference in ROM between those who did and did not achieve a PASS. Instead, we found increased postoperative pain was the main variable associated with failing to reach a PASS two years after shoulder arthroplasty, with those failing to reach an acceptable symptom state reporting nearly universally higher pain levels postoperatively as well as more difficulty with recreational and work-related activities. In addition, a regression analysis determined that the ASES question about current shoulder pain was the most significant predictor of achieving a PASS, with those reporting current shoulder pain being much more likely to fail to achieve a PASS based on SANE (OR 4.7, 95% CI 1.7-12.7, *P* = .002) or ASES (OR 12.6, 95% CI 2.2-74.1, *P* = .005).

The percentages of patients failing to achieve a PASS for SANE and ASES after TSA in the current cohort are in line with prior studies evaluating PASS in shoulder arthroplasty. In the 301 TSAs evaluated, 13% of patients failed to achieve a PASS using an ASES score of 75[1] and 31% failed to achieve a PASS using a SANE score of 75.5.[4] A recent systematic review found only three studies that have calculated PASS scores for ASES or SANE in TSA.[14] Chamberlain et al[1] evaluated 326 patients undergoing TSA or reverse shoulder arthroplasty and calculated the ASES PASS to be 76 but did not report the percentage of patients reaching this cutoff. In a study of 207 patients with minimum one-year follow-up after TSA or reverse shoulder arthroplasty, Gowd et al[4] calculated PASS scores to be 81.9 for ASES and 75.5 for SANE and found that 28% of patients did not achieve a SANE PASS and 34% of patients did not achieve an ASES PASS. Sciascia et al[10] evaluated 234 TSAs with minimum 2-year follow-up and calculated the PASS to be 78 for ASES and 58

for SANE and found that only 12% of patients were not satisfied with their shoulder at the final follow-up.

Contrary to our hypothesis that decreased postoperative ROM was the main cause of failing to achieve a PASS after TSA, we found that the main driver of failing to achieve a PASS was increased postoperative pain levels. This was unexpected, as prior studies have found that even small improvements in postoperative ROM, especially external rotation, were associated with clinically significant improvement after TSA.[11] While we found decreased FF (SANE: 142° vs. 150° *P* = .002; ASES: 135° vs. 149°, *P* < .001) and ER90 (ASES: 61° vs. 70°, *P* = .011) were associated with failing to achieve a PASS after TSA, no other postoperative ROM measure was associated with poorer outcomes. However, patients failing to achieve a PASS on the SANE and ASES PROs reported significantly higher levels of pain (ASES PASS current shoulder pain 16.5% vs. 95%, *P* < .001 and SANE PASS current shoulder pain 13% vs. 58.1%, *P* < .001) and more trouble with recreational, work, and daily living activities on nearly every question of the ASES and WOOS PROs. Patients failing to achieve a PASS also had higher VAS pain scores in both the ASES (4.2 vs. 0.4, *P* < .001) and SANE (2.0 vs. 0.4, *P* < .001) groups. This finding is significant because it shows that increased pain, not worse ROM, may be the main driver of worse outcomes after TSA, which may allow surgeons to better tailor their perioperative interventions to maximize patient satisfaction. For example, instead of focusing on physical therapy to regain ROM after surgery, surgeons may instead choose to shift more time and resources into postoperative pain management and helping patients set more realistic expectations about postoperative pain and function to improve postoperative perception of improvement.

In addition, we found younger age (ASES: 61.8 vs. 65.9, *P* = .002; SANE 63.6 vs. 66.1, *P* = .012) and lower VR-12 mental health scores (ASES: 48.5 vs. 55.7, *P* < .001; SANE: 53.0 vs. 55.5, *P* < .001) were associated with failing to reach a PASS after shoulder arthroplasty. This is similar to prior studies that have demonstrated higher preoperative expectation of postoperative pain relief and better preoperative scores on the short form-12 mental health domain

Table III
Comparison of ASES and WOOS question responses between patients who achieved and failed to achieve ASES PASS.

ASES

Variable	Achieved PASS (n = 261)		Failed to meet PASS (n = 40)		Difference (%)	P value
ASES: pain questions	n (yes)	% (yes)	n (yes)	% (yes)		
Current shoulder pain	43	16.5	38	95.0	78.5	<.001
Night pain	41	15.7	36	90.0	74.3	<.001
OTC pain meds	77	29.5	31	77.5	48.0	<.001
Narcotic pain meds	13	5.0	8	20.0	15.0	.001
Mean difference					54.0	
ASES: ADL questions	n (very difficult or unable)	%	n (very difficult or unable)	%		
Put on a coat	1	0.4	4	10.0	9.6	<.001
Sleep on the affected side	7	2.7	15	37.5	34.8	<.001
Wash back/fasten bra	23	8.8	21	52.5	43.7	<.001
Toiletting	0	0.0	2	5.0	5.0	<.001
Comb hair	0	0.0	3	7.5	7.5	<.001
Reach a high shelf	5	1.9	15	37.5	35.6	<.001
Mean difference					22.7	
ASES: work/sports						
Lift 10 lbs	20	7.7	22	55.0	47.3	<.001
Throw a ball	29	11.1	25	62.5	51.4	<.001
Perform usual work	3	1.1	6	15.0	13.9	<.001
Do usual sports/leisure activity	11	4.2	17	42.5	38.3	<.001
Mean difference					37.7	

WOOS

Variable	Mean (out of 100)	St. dev.	Mean (out of 100)	St. dev.	Diff. (out of 100)	P value
WOOS: physical symptoms in the last week						
Pain in the shoulder with movement	5.5	11.4	39.4	21.3	33.9	<.001
How much constant/nagging pain	2.9	7.6	32.8	23.9	29.9	<.001
How much weakness in the shoulder	10.8	16.7	47.1	25.0	36.3	<.001
How much stiffness in the shoulder	8.3	15.0	38.6	26.3	30.2	<.001
Mean difference					32.6	
WOOS: recreation/work						
Difficulty reaching above the shoulder level	10.0	17.8	57.3	25.8	47.3	<.001
Difficulty with repetitive motions below the shoulder level	6.8	14.1	43.1	24.7	36.3	<.001
Difficulty pushing or pulling	7.9	14.6	46.3	25.7	38.4	<.001
Mean difference					40.7	
WOOS: lifestyle						
Difficulty sleeping due to the shoulder	4.7	9.3	42.2	22.8	37.5	<.001
Difficulty styling hair due to the shoulder	2.4	7.0	28.4	28.4	26.0	<.001
Difficult reaching behind back	9.7	18.2	41.1	26.9	31.3	<.001
Difficulty dressing/undressing	3.7	10.0	27.9	23.2	24.2	<.001
Mean difference					29.7	

ADL, activity of daily living; *WOOS*, Western Ontario Osteoarthritis of the Shoulder; *ASES*, American Shoulder and Elbow Surgeons; *PASS*, Patient Acceptable Symptom State; *OTC*, over the counter.

were associated with better outcomes after shoulder arthroplasty.[7,8,18] Younger age[4,15] and higher preoperative function[17] have previously been reported as risk factors for worse satisfaction after shoulder arthroplasty. Taken together, this seems to show that younger, more functional patients are at a higher risk of feeling they had an unsatisfactory outcome after TSA.

This study has several limitations. First, we did not calculate a PASS level for ASES and SANE from our own cohort and instead used previously published thresholds.[1,4] Although this could impact the internal validity of our outcome measures, the cutoffs we used are representative of published PASS scores for ASES and SANE.[14] Second, our minimum follow-up time of two years is relatively short. However, multiple studies have shown that a majority of subjective improvement after TSA occurs within the first 6 months postoperatively and nearly all improvement has occurred by 2 years postoperatively.[3,13] Third, the PASS may be an imperfect measure of improvement after TSA. The PASS level can be calculated in multiple ways, resulting in different cutoff values which could significantly affect the interpretation of subjective outcomes after TSA. There is also no agreed on PASS value for SANE and ASES in TSA,[14] and patients with higher preoperative function or lower pain levels may have more difficulty achieving a PASS after surgery. Yet despite its flaws, the PASS remains the most widely validated tool for demonstrating when a patient feels they have returned to an acceptable symptom state after shoulder arthroplasty.

Conclusion

There is variability in the percentage of patients who achieve a PASS after TSA, ranging from 69% to 87% depending on the PRO used to define the threshold. Patients who did not achieve a PASS after TSA were significantly more likely to have pain, whereas there were very few differences in ROM, indicating pain as the primary driver of failing to achieve a PASS. Setting realistic postoperative expectations for pain relief may be important for improving patient-reported results after TSA.

Disclaimers:

Table IV
Comparison of ASES and WOOS question responses between patients who achieved and failed to achieve SANE PASS.

ASES

Variable	Achieved PASS (n = 208)		Failed to meet PASS (n = 93)		Difference (%)	P value
ASES: pain questions	n (yes)	% (yes)	n (yes)	% (yes)		
Current shoulder pain	27	13.0	54	58.1	45.1	<.001
Night pain	31	14.9	46	49.5	34.6	<.001
OTC pain meds	57	27.4	51	54.8	27.4	<.001
Narcotic pain meds	11	5.3	10	10.8	5.5	.086
Mean difference					28.1	
ASES: ADL questions	n (very difficult or unable)	%	n (very difficult or unable)	%		
Put on a coat	0	0.0	5	5.4	5.4	.001
Sleep on the affected side	2	1.0	20	21.5	20.5	<.001
Wash back/fasten bra	15	7.2	29	31.2	24.0	<.001
Toiletting	0	0.0	2	2.2	2.2	.034
Comb hair	0	0.0	3	3.2	3.2	.009
Reach a high shelf	4	1.9	16	17.2	15.3	<.001
Mean difference					11.8	
ASES: work/sports						
Lift 10 lbs	12	5.8	30	32.3	26.5	<.001
Throw a ball	21	10.1	33	35.5	25.4	<.001
Perform usual work	0	0.0	9	9.7	9.7	<.001
Do usual sports/leisure activity	10	4.8	18	19.4	14.5	.039
Mean difference					19.0	

WOOS

Variable	Mean (out of 100)	St. dev.	Mean (out of 100)	St. dev.	Diff. (out of 100)	P value
WOOS: physical symptoms in the last week						
Pain in the shoulder with movement	4.3	10.1	22.6	23.1	18.3	<.001
How much constant/nagging pain	2.0	5.7	17.6	22.4	15.6	<.001
How much weakness in the shoulder	7.3	12.4	34.3	26.3	27.0	<.001
How much stiffness in the shoulder	6.0	12.1	26.5	25.5	20.5	<.001
Mean difference					20.4	
WOOS: recreation/work						
Difficulty reaching above the shoulder level	7.7	15.3	35.4	31.0	27.7	<.001
Difficulty with repetitive motions below the shoulder level	5.6	12.8	25.0	26.1	19.4	<.001
Difficulty pushing or pulling	6.2	12.2	28.3	27.6	22.1	<.001
Mean difference					23.0	
WOOS: lifestyle						
Difficulty sleeping due to the shoulder	3.4	6.8	23.7	24.6	20.3	<.001
Difficulty styling hair due to the shoulder	2.1	5.1	14.4	23.9	12.4	<.001
Difficult reaching behind back	7.6	15.7	28.0	27.7	20.4	<.001
Difficulty dressing/undressing	2.5	8.0	17.0	21.1	14.5	<.001
Mean difference					16.9	

ADL, activity of daily living; *WOOS*, Western Ontario Osteoarthritis of the Shoulder; *ASES*, American Shoulder and Elbow Surgeons; *PASS*, Patient Acceptable Symptom State; *OTC*, over the counter.

References

1. Chamberlain AM, Hung M, Chen W, Keener JD, McAllister J, Ebersole GC, et al. Determining the patient acceptable symptomatic state for the ASES, SST, and VAS pain after total shoulder arthroplasty. J Shoulder Elbow Arthroplasty 2017;26:144-8. https://doi.org/10.1177/2471549217720042.

2. Cohn MR, Kunze KN, Polce EM, Nemsick M, Garrigues GE, Forsythe B, et al. Establishing clinically significant outcome thresholds for the Single Assessment Numeric Evaluation 2 years following total shoulder arthroplasty. J Shoulder Elbow Surg 2021;30:e137-46. https://doi.org/10.1016/j.jse.2020.07.011.

3. Drager J, Polce EM, Fu M, Nemsick M, Huddleston HP, Forsythe B, et al. Patients undergoing anatomic total shoulder arthroplasty achieve clinically significant outcomes faster than those undergoing reverse shoulder arthroplasty. J Shoulder Elbow Surg 2021;30:2523-32. https://doi.org/10.1016/j.jse.2021.02.015.

4. Gowd AK, Charles MD, Liu JN, Lalehzarian SP, Cabarcas BC, Manderle BJ, et al. Single Assessment Numeric Evaluation (SANE) is a reliable metric to measure clinically significant improvements following shoulder arthroplasty. J Shoulder Elbow Surg 2019;28:2238-46. https://doi.org/10.1016/j.jse.2019.04.041.

5. Juniper EF, Guyatt GH, Willan A, Griffith LE. Determining a minimal important change in a disease-specific Quality of Life Questionnaire. J Clin Epidemiol 1994;47:81-7.

6. Orfaly RM, Rockwood CA Jr, Esenyel CZ, Wirth MA. A prospective functional outcome study of shoulder arthroplasty for osteoarthritis with an intact rotator cuff. J Shoulder Elbow Surg 2003;12:214-21. https://doi.org/10.1016/s1058-2746(02)86882-3.

7. Rauck RC, Ruzbarsky JJ, Swarup I, Gruskay J, Dines JS, Warren RF, et al. Predictors of patient satisfaction after reverse shoulder arthroplasty. J Shoulder Elbow Surg 2020;29:e67-74. https://doi.org/10.1016/j.jse.2019.07.043.

8. Rauck RC, Swarup I, Chang B, Dines DM, Warren RF, Gulotta LV, et al. Effect of preoperative patient expectations on outcomes after reverse total shoulder arthroplasty. J Shoulder Elbow Surg 2018;27:e323-9. https://doi.org/10.1016/j.jse.2018.05.026.

9. Richards RR, An KN, Bigliani LU, Friedman RJ, Gartsman GM, Gristina AG, et al. A standardized method for the assessment of shoulder function. J Shoulder Elbow Surg 1994;3:347-52.

10. Sciascia AD, Morris BJ, Jacobs CA, Edwards TB. Responsiveness and internal validity of common patient-reported outcome measures following total shoulder arthroplasty. Orthopedics 2017;40:e513-9. https://doi.org/10.3928/01477447-20170327-02.

11. Simovitch R, Flurin PH, Wright T, Zuckerman JD, Roche CP. Quantifying success after total shoulder arthroplasty: the minimal clinically important difference. J Shoulder Elbow Surg 2018;27:298-305. https://doi.org/10.1016/j.jse.2017.09.013.

12. Simovitch R, Flurin PH, Wright T, Zuckerman JD, Roche CP. Quantifying success after total shoulder arthroplasty: the substantial clinical benefit. J Shoulder Elbow Surg 2018;27:903-11. https://doi.org/10.1016/j.jse.2017.12.014.

13. Simovitch RW, Friedman RJ, Cheung EV, Flurin PH, Wright T, Zuckerman JD, et al. Rate of improvement in clinical outcomes with anatomic and reverse total shoulder arthroplasty. J Bone Joint Surg Am 2017;99:1801-11. https://doi.org/10.2106/JBJS.16.01387.

14. Su F, Allahabadi S, Bongbong DN, Feeley BT, Lansdown DA. Minimal clinically important difference, substantial clinical benefit, and patient acceptable symptom state of outcome measures relating to shoulder pathology and surgery: a systematic review. Curr Rev Musculoskelet Med 2021;14:27-46. https://doi.org/10.1007/s12178-020-09684-2.

15. Tashjian RZ, Hung M, Keener JD, Bowen RC, McAllister J, Chen W, et al. Determining the minimal clinically important difference for the American Shoulder and Elbow Surgeons Score, Simple Shoulder Test, and Visual Analog

Scale (VAS) measuring pain after shoulder arthroplasty. J Shoulder Elbow Surg 2017;26:144-8. https://doi.org/10.1016/j.jse.2016.06.007.

16. Tubach F, Ravaud P, Baron G, Falissard B, Logeart I, Bellamy N, et al. Evaluation of clinically relevant states in patient reported outcomes in knee and hip osteoarthritis: the patient acceptable symptom state. Ann Rheum Dis 2005;64: 34-7. https://doi.org/10.1136/ard.2004.023028.

17. Werner BC, Chang B, Nguyen JT, Dines DM, Gulotta LV. What change in American Shoulder and Elbow Surgeons Score represents a clinically important change after shoulder arthroplasty? [published correction appears in Clin Orthop Relat Res. 2017 Jan;475(1):293]. Clin Orthop Relat Res 2016;474:2672-81. https://doi.org/10.1007/s11999-016-4968-z.

18. Wong SE, Zhang AL, Berliner JL, Ma CB, Feeley BT. Preoperative patient-reported scores can predict postoperative outcomes after shoulder arthroplasty. J Shoulder Elbow Surg 2016;25:913-9. https://doi.org/10.1016/j.jse.2016.01.029.