Single Assessment Numeric Evaluation (SANE) is a reliable metric to measure clinically significant improvements following shoulder arthroplasty

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Background: Single Assessment Numeric Evaluation (SANE) offers a simple method of evaluating patients' sense of functional improvement after shoulder arthroplasty.
Methods: Patients receiving total shoulder arthroplasties were retrospectively queried between 2014 and 2017. Patients completed questionnaires involving SANE, American Shoulder and Elbow Surgeons (ASES) score, and Constant scores at the 1-year interval. Minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptomatic state (PASS) were calculated using the anchor-based methodology.
Results: A total of 207 patients with an average age of 66.7 ± 10.3 years and a body mass index of 31.5 ± 7.3 were available for analysis. The SANE score was the only score to have acceptable area under curve (AUC) (70.5%) for achieving MCID with a cutoff of 28.8. In terms of SCB, ASES (88%) and SANE (70.5%) had acceptable AUC with cutoffs of 20.7 and 50.2, respectively. All 3 scores had excellent AUC (>80%) for PASS with cutoffs of 81.9, 75.5, and 24.5 for ASES, SANE, and Constant scores, respectively. Normalized SANE scores were weakly correlated with ASES and Subjective Constant after normalizing for scale ($R2 < 0.4$). Achieving MCID by SANE was correlated with achieving MCID by Constant ($P < .001$). Achieving SCB and PASS by SANE was correlated with achieving SCB and PASS by ASES and Constant (ASES: $P = .007$, $P < .001$; Constant: $P < .001$, $P < .001$).
Conclusion: The present study establishes clinically significant outcomes for SANE. Achievement of clinically significant outcomes in SANE was correlated with achieving meaningful outcomes with legacy measures of ASES and Constant scores. SANE may be used as a simple and efficient measure of patient outcome after total shoulder arthroplasty.

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Shoulder pain can be debilitating and although it often can be treated nonsurgically, patients with advanced glenohumeral arthritis are prime candidates for total shoulder arthroplasty (TSA) or reverse TSA (RTSA).[10] In fact, the rate of TSA has almost tripled over the past decade,[14] creating an ever-increasing burden on medical resources. To improve the value of orthopedic care, health care providers need to focus on improving quality outcomes while controlling costs.[1] Although traditional outcomes after TSA include complication rate, component loosening, and need for revision surgery, patient-reported outcome measures (PROMs) add interim value and can influence clinical decision making, patient-centered care, and reimbursement.[7,8,25] Assessment of functional outcomes through the use of PROMs plays a critical role in detecting and tracking outcomes as patients progress through treatment.

With the increased use of PROMs in orthopedic clinical research, a shift from statistically significant outcomes to more clinically significant outcomes has occurred.[17] This change sparked the use of quality measures such as minimal clinically important difference (MCID) and substantial clinical benefit (SCB) to report clinically significant improvements in outcomes.[6,13,32] Both the MCID, which is the smallest change in outcomes that a patient perceives as clinically important, and SCB, the value that defines a threshold of outcome improvement that a patient perceives as considerable, have been well documented in the recent literature across many fields of orthopedics.[2,9,16,17] Studies regarding shoulder arthroplasty have established these clinical benchmarks for various outcome scores including American Shoulder and Elbow Surgeons (ASES), Constant, Simple Shoulder Test, and Visual Analog Scale questionnaires.[15,22,29,31,36,32] Even though these questionnaires are necessary for quality-based modeling, according to the literature, longer questionnaires used to assess PROMs have been shown to be burdensome and time inefficient, leading to task-induced fatigue, inaccurate reflections of patients' conditions, and poor patient compliance.[4,20] The Single Assessment Numeric Evaluation (SANE) PROM reduces questionnaire fatigue by simply asking patients to rate the current status of their injured body part from 0% to 100%, with 100% as normal. The SANE score has already demonstrated moderate-to-good correlation with more complicated scoring systems.[24,28,33-35] Thus, although limited, SANE scores may be able to provide a quick alternative to other lengthy questionnaires due to its manageability and increased patient compliance.

Although prior studies have established the MCID and SCB after shoulder arthroplasty, few studies have calculated the MCID, SCB, and patient acceptable symptomatic state (PASS) for ASES, Constant-Murley, and SANE and determined correlation between SANE and longer legacy scores. The purpose of this study was to define the MCID, SCB, and PASS after shoulder arthroplasty and determine whether a SANE rating correlates with ASES and/or Constant-Murley after shoulder arthroplasty.

Methods

Study design

The present study is a retrospective analysis of prospectively collected clinical outcomes of patients undergoing TSA or RTSA between 2014 and 2017. An institutional registry was accessed to determine all patients who received TSA or RTSA within the included timeframe. An electronic data collection service (Outcome Based Electronic Research Database; Universal Research Solutions, Columbia, MO, USA) was used to send electronic surveys before shoulder replacement and at 1 year after shoulder replacement. Trained research staff were present during the day of surgery to administer in-person questionnaires to all patients undergoing surgery. One-year follow-up questionnaires were timed to expire 1 month after the anniversary of the patients' surgery, to ensure outcomes representative of the follow-up period. Reminder emails to complete questionnaires were sent automatically every 5 days to maximize patient compliance.

Patient selection

Patients who received either an anatomic or RTSA were included within this study. Diagnoses were reviewed to include only patients who received surgery for primary glenohumeral arthritis and rotator cuff arthropathy. Exclusion criteria were those who received a revision procedure, those who received surgery for alternate diagnosis, and those who received a hemiarthroplasty. Patients who were noncompliant with completing postoperative questionnaires were not included within the study. Demographic information and baseline scores were compared between patients compliant with questionnaires and those who were not to ensure that the included patient cohort was representative of the entire population as performed in a previous study.[32] Concomitant biceps tenodesis and tenotomy were frequently performed in patients with tenosynovitis. Tenotomy was chosen over tenodesis based on higher age and lower functional demand.
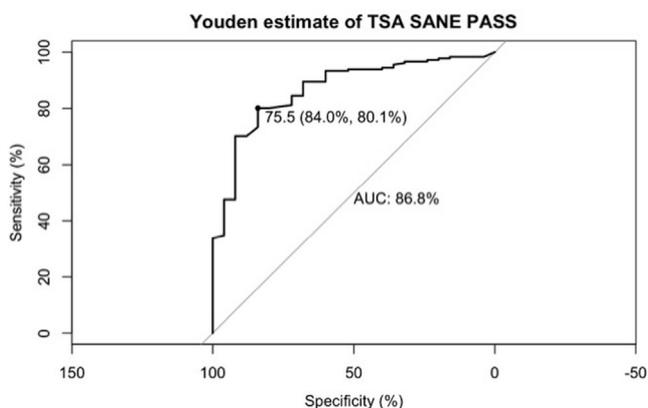
Figure 1 Receiver operating characteristic curve of patient acceptable symptomatic state (PASS) calculation for the Single Assessment Numeric Evaluation (SANE) within the shoulder arthroplasty population. Youden's estimate was used to calculate the optimum threshold score. *TSA*, total shoulder arthroplasty; *AUC*, area under curve.

Outcome and anchor measurements

Questionnaires administered included the ASES,[15] SANE,[33,34] and Subjective Constant-Murley score.[5] Anchor questions were administered along with these questionnaires at the 1-year postoperative time point. This anchor question was structured as follows: "Since your surgery, has there been any change in the pain in your shoulder?" This anchor question was graded on a previously reported 15-point scale.[11,12] The no change group was composed of patients who responded, "Almost the same, hardly any worse" or "No change" or "Almost the same, hardly any better." The minimal improvement group was composed of patients who responded, "A little better" or "Somewhat better" or "Moderately better." The substantial improvement group was composed of patients who responded, "A good deal better" or "A great deal better" or "A very great deal better." Differences
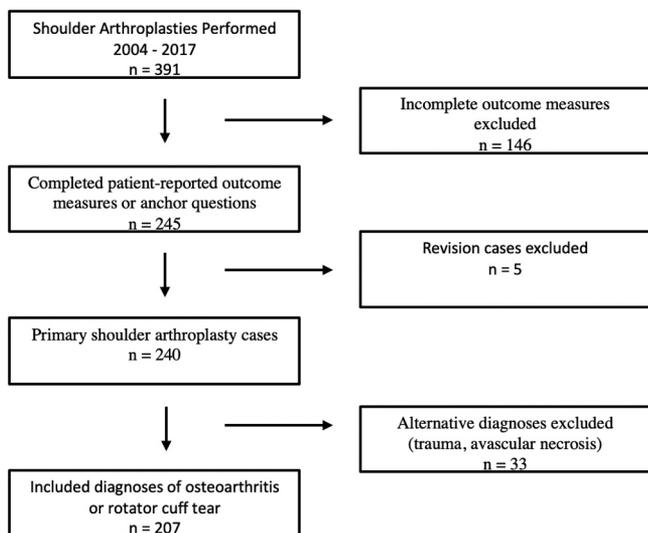
between the no change group and minimal improvement group were used to calculate the MCID. Differences between the no change group and substantial improvement group were used to calculate the SCB. In addition, patient satisfaction was also measured at the 1-year time point using the following binary anchor question, "Taking into account all activities you have done during your daily life, your level of pain, and also your functional impairment, do you consider that your current state is satisfactory?" Differences between patients with unsatisfactory outcomes and satisfactory outcomes were used to calculate the PASS.

Covariate analysis

Preoperative and intraoperative variables were measured to determine the correlation between the patient's achievement of MCID, SCB, and PASS. Preoperative variables include patient demographics such as age, body mass index, smoking status, symptom duration, surgery to dominant arm, and comorbidities. Intraoperative variables include receiving an anatomic vs. reverse shoulder arthroplasty, concomitant biceps tenotomy or tenodesis, implant used, and size of stem.

Statistical analysis

Statistical analysis was performed using RStudio software version 1.0.143 (R Foundation for Statistical Computing, Vienna, Austria). MCID, SCB, and PASS were calculated using a nonparametric receiver operating characteristic (ROC) curve with area under curve (AUC) analysis (Figs. 1 and 2). This analysis uses a logistic regression model with differences in the no change group, minimal change group, and substantial change group as a binary outcome, and each specific patient-reported outcome as a continuous variable. Youden's index was used to determine the cutoff threshold at which sensitivity and specificity are maximized for a given cutoff value in predicting either MCID, SCB, or PASS.[37] The AUC analysis defined an acceptable value as

Figure 2 Patient population undergoing shoulder arthroplasty after application of inclusion and exclusion criteria.

Table I Demographics of patients undergoing total shoulder arthroplasty and reverse total shoulder arthroplasty

Demographics	
Age (yr)	66.7 ± 10.3
BMI (kg/m^2)	31.5 ± 7.3
Symptom duration	34.9 ± 39.2
Dominant-sided injury	Y: 57
	N: 57
	NR: 95
Preoperative diagnosis	
Glenohumeral osteoarthritis	156
Rotator cuff deficiency/arthropathy	48
Proximal humerus fracture	5
Procedure	
Total shoulder arthroplasty	114
Reverse total shoulder arthroplasty	95
Biceps tenotomy	36
Biceps tenodesis	101

BMI, body mass index, *NR*, not reported.

Table II Clinically significant outcome thresholds at 1 year after shoulder arthroplasty

	MCID (anchor)	Specificity (%)	Sensitivity (%)	AUC (%)	MCID (distribution)
ASES	27.6	100.0	66.7	66.7	9.1
SANE	28.8	75.0	72.7	70.5	13.4
Constant	5.1	75.0	72.7	69.3	4.3
	SCB (anchor)	Specificity (%)	Sensitivity (%)	AUC (%)	
ASES	20.7	100.0	88.0	88.0	
SANE	50.2	85.7	57.0	70.5	
Constant	19.6	100.0	31.6	62.7	
	PASS (anchor)	Specificity (%)	Sensitivity (%)	AUC (%)	
ASES	81.9	100.0	73.5	91.7	
SANE	75.5	84.0	80.1	86.8	
Constant	24.5	85.2	67.6	80.9	

MCID, minimal clinically important difference; *AUC*, area under curve; *ASES*, American Shoulder and Elbow Surgeons score; *SANE*, Single Assessment Numeric Evaluation; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptomatic state.

AUC > 0.7, whereas an excellent prediction was defined as AUC > 0.8 as with previous publications.[2,3] Univariate analysis was then performed on retrospectively collected variables to determine which factors were most associated with patients who were able to achieve MCID, SCB, and PASS. Subsequent logistic multivariate regression analysis was performed to account for potential confounding variables. Variables with $P < .15$ were incorporated into the multivariate analysis. Odds ratios were created for each variable incorporated in multivariate analysis. A linear regression was used to determine the correlation between SANE and legacy scores of Subjective Constant and ASES after normalizing for each respective scale.[24] Scores were normalized by subtracting the mean from each score and dividing the result by the standard deviation. Proportions of patients who achieved MCID, SCB, and PASS were calculated.

Results

Demographics

An initial patient population of 391 patients who had undergone shoulder arthroplasty was evaluated. The final patient population was 207 patients following inclusion/exclusion criteria (Fig. 1). Patient demographics of the included population is demonstrated in Table I.

Establishing MCID, SCB, and PASS

There were 7 patients who reported "no change" after surgery. There were 21 patients who reported "minimal change" after surgery. There were 171 patients who reported "substantial improvement" after surgery. There were 186 patients satisfied with their surgery, and 26 patients dissatisfied. Only the SANE was found to have an adequate MCID threshold estimate by the anchor-based methodology. The calculated threshold from distribution-based calculation for MCID was used in further analysis so that the calculation method was consistent. Thresholds were determined to be 9.1, 13.4, and 4.3. These thresholds were validated by ROC/AUC curves and each demonstrated AUC = 100.0. SCB and PASS were calculated for ASES, SANE, and Constant. The Constant had an unacceptable AUC for the SCB calculation (AUC = 62.7). ASES had an excellent AUC (AUC = 88.0) and SANE had an acceptable AUC (AUC = 70.5). The calculated PASS was excellent for ASES (AUC = 91.7), SANE (AUC = 86.8), and Constant (AUC = 80.9), respectively (Table II).

Multivariate analysis of variables associated with achieving outcomes

Logistic regression analysis was performed on collected variables correlated with achieving MCID for ASES, SANE, and Constant; SCB by ASES and SANE; and PASS by ASES, SANE, and Constant. Increased body mass index correlated with the reduced likelihood of achieving MCID ASES and greater preoperative SANE score and worker's compensation status had reduced likelihood of achieving MCID SANE. Concomitant biceps tenodesis had greater likelihood of achieving MCID SANE. Greater preoperative ASES had reduced likelihood of achieving SCB ASES and concomitant biceps tenodesis, and greater age had greater likelihood of achieving SCB SANE. Greater preoperative Constant had greater likelihood of achieving PASS Constant, whereas a history of thyroid disorder had reduced likelihood of achieving PASS Constant. Worker's compensation status had reduced likelihood of achieving PASS SANE. Concomitant biceps tenotomy, tenodesis, and greater age had greater likelihood of achieving PASS SANE (Table III).

Table III Multivariate logistic regression of variables associated with achieving clinically significant outcomes

	Univariate regression (*P* value)	Multivariate regression (*P* value)	Odds ratio (95% CI)
Minimal clinically important difference			
ASES			
Preoperative ASES	.173	.373	0.997 (0.994, 1.000)
BMI	**.194**	**.028**	**0.968 (0.941, 0.996)**
Subjective Constant			
Preoperative Constant	.060	.142	0.995 (0.988, 1.002)
Age	.059	.439	1.002 (0.998, 1.006)
SANE			
Preoperative SANE	**<.001**	**<.001**	**0.996 (0.994, 0.998)**
WC	**.143**	**.041**	**0.834 (0.702, 0.991)**
Biceps tenodesis	**.129**	**.017**	**1.105 (1.019, 1.120)**
BMI	.195	.587	0.999 (0.993, 1.004)
Substantial clinical benefit			
ASES			
Preoperative ASES	.053	**.028**	**0.968 (0.941, 0.996)**
RTSA	.189	.493	0.644 (0.182, 2.270)
Biceps tenodesis	.189	.379	1.789 (0.490, 6.537)
SANE			
Preoperative SANE	<.001	.137	1.014 (0.996, 1.032)
WC	.006	.073	0.210 (0.038, 1.159)
Diabetes	.160	.344	0.530 (0.142, 1.973)
Thyroid	.036	.675	0.754 (0.201, 2.824)
Biceps tenodesis	**.172**	**.002**	**3.695 (1.603, 8.519)**
Eclipse component	.060	.995	N/A
Univers component	.098	.116	0.157 (0.015, 1.583)
Age	**.049**	**<.001**	**1.083 (1.038, 1.129)**
Patient acceptable symptomatic state			
ASES			
Preoperative ASES	.162	.148	1.018 (0.994, 1.044)
WC	.014	.989	N/A
HTN	.175	.327	1.730 (0.578, 5.184)
TSA	.116	.073	3.225 (0.896, 11.605)
Biceps tenotomy	.110	.195	0.420 (0.113, 1.560)
Biceps tenodesis	.186	.839	0.876 (0.244, 3.144)
Age	.186	.077	1.058 (0.994, 1.125)
Subjective Constant			
Preoperative Constant	**.024**	**.048**	**1.060 (1.001, 1.122)**
WC	.011	.056	0.204 (0.040, 1.045)
Diabetes	.057	.078	0.369 (0.122, 1.120)
Thyroid disorder	**.049**	**.029**	**0.293 (0.097, 0.884)**
TSA	.153	.713	1.138 (0.571, 2.267)
Biceps tenodesis	.109	.669	1.166 (0.577, 2.355)
Eclipse	.149	.999	N/A
SANE			
Preoperative SANE	.161	.215	1.011 (0.993, 1.031)
WC	**<.001**	**.024**	**0.132 (0.023, 0.770)**
Diabetes	.133	.509	0.635 (0.165, 2.443)
TSA	.022	.989	N/A
RTSA	.005	.988	N/A
Tenotomy	**.102**	**.007**	**4.518 (1.523, 13.403)**
Tenodesis	**.005**	**.004**	**3.889 (1.549, 9.760)**
Age	**.001**	**<.001**	**1.079 (1.033, 1.128)**

CI, confidence interval; *ASES*, American Shoulder and Elbow Surgeons score; *BMI*, body mass index (kg/m²); *SANE*, Single Assessment Numerical Evaluation; *WC*, worker's compensation; *RTSA*, reverse total shoulder arthroplasty; *N/A*, not applicable; *HTN*, hypertension; *TSA*, total shoulder arthroplasty; *AUC*, area under curve.
Bold values indicate statistical significance (*P* < .05).
Constant score logistical regression not included due to exclusionary AUC value.

Table IV Percentage of patients achieving clinically significant outcomes by score

	Achieved MCID (%)	Achieved SCB (%)	Achieved PASS (%)
ASES	92.3	79.3[*]	66.3[*]
SANE	91.0	50.1[†]	72.5[*]
Subjective Constant	89.4	26.9[‡]	61.5[*]

MCID, minimal clinically important difference; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptomatic state; *ASES*, American Shoulder and Elbow Surgeons score; *SANE*, Single Assessment Numeric Evaluation score, *AUC*, area under curve; *ROC*, receiver operating characteristic.

[*] Found to have acceptable AUC from ROC/AUC analysis.
[†] Found to have excellent AUC from ROC/AUC analysis.
[‡] Found to have poor AUC from ROC/AUC analysis.

Correlation of outcome achievement between ASES, SANE, and Constant

Percentage of patients who achieved each clinically significant outcome are reported in Table IV. Linear regression between normalized scores of SANE and subjective Constant scores ($R2 = 0.339$, $P < .001$) and ASES ($R2 = 0.131$, $P < .001$) demonstrated a significant linear correlation, although this correlation was weak. Comparison between ASES and Constant demonstrated a similar trend ($R2 = 0.257$, $P < .001$) (Fig. 3). In patients who achieved MCID by SANE, 94.5% (173/183) achieved this threshold by at least 1 other legacy score, whereas 62.8% (115/183) achieved this threshold from all 3 scores. In those who achieved SCB by SANE, 81.4% (83/102) achieved this threshold by at least 1 other legacy score, whereas 29.4% (30/102) achieved this threshold from all 3 scores. Lastly, in patients who achieved PASS by SANE, 85.7% (126/147) achieved this threshold by at least 1 other legacy score, whereas 49.0% (72/147) achieved this threshold from all 3 scores. Pairwise comparisons demonstrated a significant correlation between SANE and ASES for SCB and PASS ($P = .007$ and $P < .001$, respectively), between SANE and Constant for MCID, SCB, and PASS ($P < .001$, $P < .001$, $P < .001$, respectively), and between ASES and Constant for MCID and PASS ($P < .001$ and $P < .001$, respectively) (Table V).

Discussion

The primary finding of this study was that SANE was a representative and highly correlated method of measuring contemporary patient outcome after primary shoulder arthroplasty in comparison with legacy scores. The SANE was found to be a reliable measure of predicting clinical improvement. From analysis by ROC/AUC, the SANE provided an adequate model of predicting minimal improvement, substantial clinical improvement, and an excellent model of predicting the PASS via the anchor-based method. Our study demonstrated that a 28.8-point change in SANE scores defines the MCID after shoulder arthroplasty, 50.2 defines SCB, and a post-operative score of 75.5 defines the PASS. Concomitant biceps tenodesis, lack of worker's compensation insurance status, and preoperative scores (lower more likely to achieve MCID/SCB and higher more likely to achieve PASS) were associated with achieving clinically significant outcomes. Furthermore, although there was a poor linear correlation of raw changes in score between SANE, ASES, and Constant, achieving clinically significant outcomes with the SANE was significantly correlated to doing so with respect to the Constant and ASES scores with the exception of ASES MCID. This study was innovative with respect to correlating clinically significant stratifications established by global anchors with respect to the SANE, to that of the legacy outcome measures. These findings suggest that although the SANE is not a true substitute for legacy scores, there may be a role for this score to accurately reflect patient outcomes in situations where patient compliance is inherently poor.

The SANE is inherently limited in that it is an entirely subjective score, whereas other outcome scores are advantageous in monitoring objective measures such as difficulty with regard to specific daily activities in ASES or arm positioning in Constant-Murley. However, the SANE is the simplest form to complete as it is only a 1-question assessment of the patient's shoulder function. Werner et al[32] had similar difficulties with patient compliance (61.7%) to that of our study, in establishing these values to the present series, which warrant investigation into alternative modes of improving this metric. The SANE score provides an alternative solution to these compliance issues. Of all the available outcome scores, this may be the only score that is feasible to mobile reporting such as short message service, as it can be answered with a simple numerical response. This may help to improve patient compliance to provide an adequate data set that is more reflective of the outcomes of the given patient population.

We first found that the SANE score provided an accurate metric of assessing MCID, SCB, and PASS by ROC/AUC analysis. Then, we demonstrated achieving these clinical outcomes correlated with doing so in legacy score measures. Previous studies related to anterior cruciate ligament and general surgery[24,33-35] have found the correlation of the raw SANE score to other PROMs to be moderate to strong; however, this study found this relationship to be weak. Furthermore, in a recent analysis of a heterogeneous population of patients treated for multiple shoulder complaints, the SANE score was found to highly correlate to the ASES score and also had a similar rate of
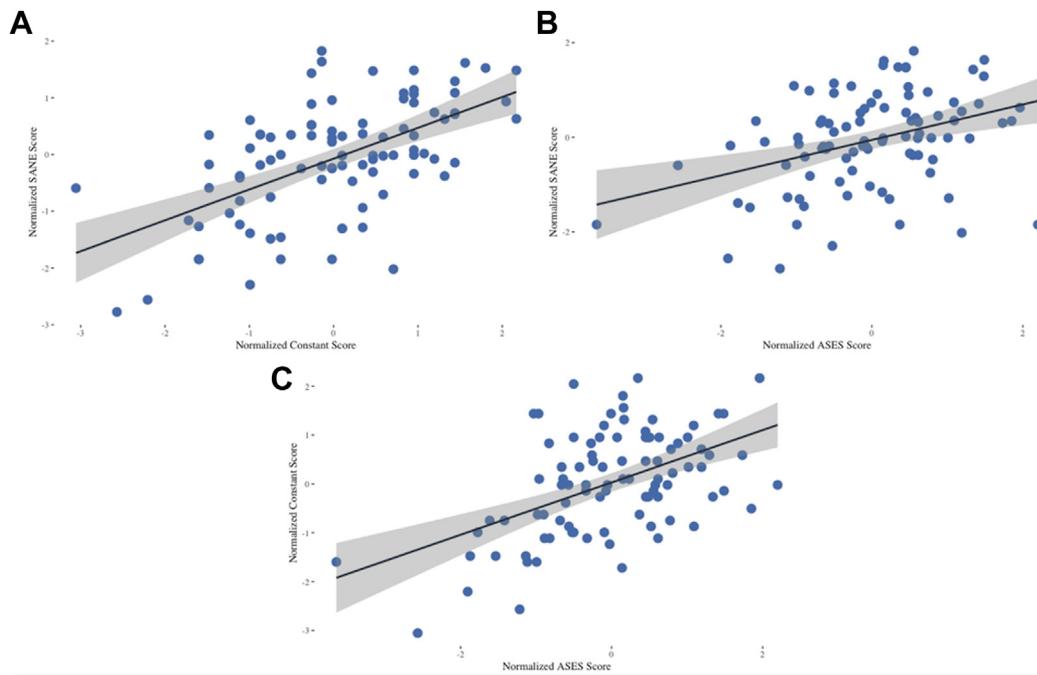
Figure 3 Correlation of the change in normalized patient-reported outcome measure between (**A**) Single Assessment Numeric Evaluation (SANE) and Constant, (**B**) SANE and American Shoulder and Elbow Surgeons (ASES), and (**C**) Constant and ASES.

MCID achievement.[30] However, it is important to note that each outcome score has inherent psychometric properties in measuring patient outcome, which may make comparison difficult. Sciascia et al[23] demonstrated inherently different

Table V Pairwise comparison of achieving clinically significant outcomes by each patient-reported outcome measure.

	ASES	Constant	SANE
ASES	N/A	**MCID: < 0.001** SCB: 0.201 **PASS: < 0.001**	MCID: 0.067 **SCB: 0.007** **PASS: < 0.001**
Constant	**MCID: < 0.001** SCB: 0.201 **PASS: < 0.001**	N/A	**MCID: 0.001** **SCB: < 0.001** **PASS: < 0.001**
SANE	MCID: 0.067 **SCB: 0.007** **PASS: < 0.001**	**MCID: 0.001** **SCB: < 0.001** **PASS: < 0.001**	N/A

ASES, American Shoulder and Elbow Surgeons score; *SANE*, Single Assessment Numeric Evaluation score; *N/A*, not applicable; *MCID*, minimal clinically important difference; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptomatic state.
Bold values indicate statistical significance (*P* < .05).

effect sizes, standardized response means, and internal validity of floor/ceiling effects with respect to SANE, ASES, and Western Ontario Osteoarthritis Index scores within a population of patients undergoing TSA for primary glenohumeral osteoarthritis. Therefore, the correlation of raw values between scores may not necessarily confer identical patient status. Achievement of MCID, SCB, and PASS is a binary outcome, and therefore, different scores may be able to demonstrate the same status and improvement equivocally. The advantage of this finding is that the SANE score demonstrates correlation to legacy outcome scores, specifically in regard to MCID, SCB, and PASS, and is a far simpler outcome score to perform.

When the 3 outcome modalities were compared with normalized values, linear regression demonstrated a weak linear correlation of the normalized values. This likely stems from the added complexity in shoulder assessment that the ASES and Constant scores have as opposed to the simplicity of the SANE score. Still, the findings of this study demonstrate that the SANE has a role in outcomes reporting of MCID, SCB, and PASS. The expediency and simplicity of the SANE still provides a reliable way to evaluate if a patient achieves SCB. One drawback of the SANE scoring is that it is based on asking the patient how the extremity is functioning. Patients may slowly lose some function with age, especially after RTSA, and this may lead to lower standards of 100% function. Further analysis of whether the SANE score has the capability to

demonstrate patient improvement or satisfaction at longer follow-up is needed. Regardless, the ease of administering the SANE questionnaire allows clinicians to quickly evaluate the SCB and when a PASS, with very low patient burden.

Health care reform has caused renewed focus on the efficacy of treatment based on patient-reported outcomes, which have led to a focus on establishing what constitutes a successful intervention.[8,25] Clinically significant outcomes of MCID, SCB, and PASS have been previously established for the ASES and Constant scores with regard to shoulder arthroplasty populations. These calculated thresholds are largely dependent on the anchor question used and the generalizability of the population. The present study's threshold in MCID ASES (9.1) and SCB ASES (20.7) was agreeable to how patients responded to Werner et al's[32] "activities" anchor question (MCID: 9.1; SCB: 20.2). Conversely, Tashjian et al[29] and Simovitch et al[26,27] both used a generic global anchor question where patients were asked to rate their shoulder improvement as on a 5-point Likert scale for improvement. The global anchor score achieved similar results to Werner's satisfaction anchor, though both of these established thresholds were more than 4 points greater than our ASES MCID and 10 points greater than our ASES SCB.[26,27,32] Overall, it is important to recognize that anchor question phrasing can substantially impact the threshold values that result. When selecting threshold values for MCID, SCB, and PASS for use in outcomes reporting or power analysis in studies, attention should be paid to the appropriate anchor.

There are a few critical limitations to this study. The main limitations stem from cohort size, which may affect the strength of our analysis. Previous studies have ranged from 60 to 1568 patients.[16-19,26,27,29,31,32,36] Our cohort falls in the median of this group. Furthermore, there is a risk of selection bias with patients who were noncompliant with completing postoperative questionnaires and anchors at the 1-year time point. Although the present study was retrospective in nature, data were collected prospectively at fixed intervals and should minimize recall bias. In addition, our study does reflect a heterogeneous group of arthroplasty patients with 2 different platforms (Arthrex, Wright-Tornier), which adds to our data's ability to be generalizable to the greater population. Separate diagnoses for arthroplasty were included, which may add to the heterogeneity of the population; however, previous studies have also similarly grouped patient populations.[26,27,29,32] Previous studies have also had follow-up time points of 2 years postoperatively, whereas the follow-up of the present study is at 1 year; however, this is likely noncontributory due to maximal medical improvement being established at 1 year.[21] In addition, some differences in reported outcome thresholds may also be attributable to the anchor question used, as previously discussed.

Conclusion

The present study establishes clinically significant outcomes for SANE. Achievement of clinically significant outcomes in SANE was correlated with achieving meaningful outcomes with legacy measures of ASES and Constant scores. SANE may be used as a simple and efficient measure of patient outcome after TSA.

Disclaimer

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