Clinical measurements versus patient-reported outcomes: analysis of the American Shoulder and Elbow Surgeons physician assessment in patients undergoing reverse total shoulder arthroplasty

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Background: The American Shoulder and Elbow Surgeons (ASES) score is composed of a patient-reported portion and a physician assessment. Although the patient-reported score is frequently used to assess postoperative outcomes after shoulder arthroplasty, no previous studies have used the physician-assessment component. This study evaluated the relationship of the ASES physician-assessment measurements with patient-reported shoulder and general health outcomes.

Methods: A retrospective review of a prospectively collected multicenter database was used to analyze patients who underwent primary reverse total shoulder arthroplasty (RTSA) from 2012 to 2015 with a minimum 2-year follow-up. ASES physician-assessment and patient-reported components and 12-Item Short Form Health Survey (SF-12) general health questionnaires were obtained preoperatively and 2 years postoperatively. The relationship between ASES physician measurements with ASES patient-reported outcome (PRO) scores and SF-12 Physical and Mental domain scores was assessed with Pearson correlation coefficients.

Results: Included were 74 patients (32 men; mean age, 69.2 years; body mass index, 29.4 kg/m^2). Preoperative physician measurements and PRO scores were not significantly correlated. Postoperatively, only the ASES physician-measured active ($R = 0.54$, $P < .01$) and passive forward flexion ($R = 0.53$, $P < .01$) demonstrated moderate correlation with ASES patient scores. The remaining clinical measurements had no significant correlations with ASES patient or SF-12 scores. During the 2-year period, only improvements in active forward flexion correlated with improvements in ASES patient scores ($R = 0.36$, $P < .01$).

Conclusions: Little correlation exists between clinical measurements from the ASES physician component and PROs, including the ASES patient-reported and SF-12 general health surveys, in RTSA patients. Improvement in active forward flexion is the only clinical measurement correlated with PRO improvement at 2 years.

Shoulder arthroplasty, including reverse total shoulder arthroplasty (RTSA), has become increasingly used in the United States.[2,5,16] Patients experience improved function and outcomes after RTSA for conditions such as cuff tear arthropathy and glenohumeral arthritis in the setting of rotator cuff pathology.[3,6,15] The improvement in patient satisfaction has been correlated with functional recovery and resumption of regular activities.[1,4,20,22,23] To better measure and assess such patient outcomes after surgery, patient-reported outcomes (PROs) scores have become increasingly used in total joint arthroplasty and shoulder surgery.[8,9,12,23]

The American Shoulder and Elbow Surgeons (ASES) is one of the most commonly used PROs.[8] The ASES was introduced in 1996 and consists of 2 components: the patient-reported questionnaire and a physician assessment.[12] The ASES can be used without a licensing fee. The ASES score has been validated for its reliability and responsiveness[19]; however, the score is only tabulated with the patient-reported subjective visual analog scale for pain and 10 functional questions.[7,10] The physician assessment, which is the portion the physician completes, rather than the patient, focuses on functional parameters such as range of motion, strength testing, and instability. This physician component of the ASES assessment has

not been previously reported by any studies as an outcome measure in shoulder arthroplasty or undergone any validation.

As technical advancement has raised patient expectations for functional recovery, it has become increasingly important for physicians to counsel patients on the likely functional recovery and its relationship with postoperative subjective recovery and quality of life. Despite numerous previous articles evaluating PRO measurements after RTSA, no previous analysis has been conducted of the physician portion of the ASES score or of the correlation of these measurements with PROs.[9] The purpose of study was to examine the ASES physician-assessed functional measurements after RTSA and determine whether measurements correlate with patient subjective outcomes and general overall health. We hypothesized that improvements in ASES physician-assessed measurements would correlate with improved subjective scores and general overall health.

Materials and methods

Study design

Data for this study were obtained from a prospectively collected multicenter RTSA database by 5 different surgeons from 3 separate institutions. The study included 74 patients who were able to complete at least 2 years of follow-up. All patients provided consent before participation in the study.

The database includes demographic information (age, sex, body mass index) and PRO scores. Preoperative and 2-year postoperative ASES physician- and patient-reported scores, along with the 12-Item Short Form Health Survey (SF-12) Physical Component Summary (PCS) and Mental Component Summary (MCS) scores, were recorded from patients who underwent primary RTSA with the Zimmer Trabecular Metal Reverse Shoulder System (Zimmer Inc., Warsaw, IN, USA) between 2012 and 2015. Only patients with a minimum 2-year follow-up were included.

Outcome measures

The SF-12 evaluates overall general health and includes a Physical (PCS) and Mental Component Summary (MCS). The PCS and MCS scores are both calculated using a 12-question survey, with each score ranging from 0 (lowest health level) to 100 (highest level of health), as previously described.[21]

The ASES tool includes a patient-reported score with visual analog scale for pain and functional subscales ranging from 0 (worse pain and function loss) to 50 (no pain and excellent function). Both scores are summed for a maximum score of 100, as described previously.[12] A change in the ASES patient-reported score of 12 to 17 points is considered the minimal clinically important difference.[19]

The physician-assessment section of the ASES includes 3 functional sections (range of motion, strength testing, and instability grading) and 1 subjective section.[12] Passive and active range of motion (total combined glenohumeral and scapulothoracic) are assessed using a goniometer for forward flexion, external rotation (at side and 90° abduction), internal rotation (highest segment of spinal anatomy), and cross-body adduction (distance of antecubital fossa from the opposite acromion). Strength is tested and measured according to the Medical Research Council grade of 0 to 5, with 0 as no contraction, 1 as flicker, 2 as movement with gravity eliminated, 3 as movement against gravity, 4 as movement against some resistance, and 5 as normal power. Instability is graded as anterior, inferior, and posterior translation on a 0 to 3 scale, with 0 if absent, 1 if mild (0-1 cm), 2 if moderate (1- to 2-cm translation or to glenoid rim), and 3 if severe (>2-cm translation or over the glenoid rim). The physician is also asked to note whether the translation maneuvers reproduce the symptoms and whether the patient has voluntary instability, a positive result on the relocation test, or generalized ligamentous laxity.

The subjective section asks the physician to note signs, including supraspinatus or greater tuberosity tenderness, acromioclavicular joint tenderness, and biceps tendon tenderness or rupture, impingement, scars, atrophy, or deformity. This study did not include the ASES physician-reported measurements of tenderness and instability due to their subjective nature.

Surgical procedure

All surgical procedures were performed with Zimmer Reverse implants. Surgical indications were cuff tear arthropathy or glenohumeral arthritis with irreparable rotator cuff tears. Patients underwent a deltopectoralis approach. No patients required bone grafting. The subscapularis was not repaired. Patients were kept in a shoulder immobilizer for 6 weeks postoperatively and then began physical therapy. Dislocations occurred in 3 patients that required revisions.

Statistical analysis

Pearson correlation coefficients were made from each ASES physician measurement with the ASES patient score, and the SF-12 PCS and MCS scores, preoperatively and 2 years postoperatively. In addition, a Pearson correlation was performed to assess the change in ASES physician measurements with the change in ASES patient scores, SF-12 MCS, and SF-12 PCS during the 2-year course of the study.

Results

The study included 74 patients (43% male, 57% female) who completed a minimum 2-year follow-up. The cohort was an average age of 69.2 years (range, 54-88 years), and the mean body mass index was 29.4 kg/m² (range, 19.9-37.3 kg/m²). Average PRO scores (ASES patient, SF-12) and ASES physician measurements preoperatively and 2 years after the operation are provided in Table I.

Table I
Preoperative findings versus postoperative findings

Assessments	Preoperative	Postoperative
	Mean (range)	Mean (range)
SF-12		
Physical (PCS)	33 (9.4-49.1)	45 (21.4-58.8)
Mental (MCS)	50 (18-71.1)	54 (33.4-66.5)
ASES patient	32 (24.8-86.5)	79 (27.3-100)
ASES physician (sections)		
Range of motion		
Forward flexion		
Active	74 (0-165)	141 (80-175)
Passive	108 (0-180)	149 (90-180)
External rotation		
Active	19 (0-75)	34 (0-90)
Passive	31 (0-90)	42 (0-90)
90° active	27 (0-90)	66 (10-90)
90° passive	37 (0-100)	74 (5-100)
Internal rotation		
Active	T10 (T2-L3)	T10 (T3-S1)
Passive	T10 (T4-L3)	T9 (T1-L5)
Strength		
Forward flexion	3 (0-5)	4 (0-5)
Abduction	3 (0-5)	4 (0-5)
External rotation	3 (0-5)	4 (0-5)
Internal rotation at side	3 (0-5)	4 (0-5)

SF-12, 12-Item Short Form Health Survey; *MCS*, Mental Component Summary; *PCS*, Physical Component Summary; *ASES*, American Shoulder and Elbow Surgeons.

Table II
American Shoulder and Elbow Surgeons physician score compared with patient score and 12-item Short Form Health Survey Physical and Mental scores

ASES physician subsection	ASES patient				SF-12 Physical (PCS)				SF-12 Mental (MCS)			
	Pre-op PCC (R)	P value	2-year post-op PCC (R)	P value	Pre-op PCC (R)	P value	2-year post-op PCC (R)	P value	Pre-op PCC (R)	P value	2-year post-op PCC (R)	P value
Range of motion												
Forward flexion												
Active	0.39	.01*	**0.54**	**<.01***	0.05	.67	0.36	<.01*	0.39	.01*	0.23	.05
Passive	0.21	.07	**0.53**	**<.01***	0.12	.30	0.28	<.01*	0.20	.08	0.27	.02*
External rotation												
Active	0.21	.07	0.18	.13	0.20	.08	0.04	.73	.21	.07	0.03	.79
Passive	0.24	.04*	0.21	.08	0.28	.01*	−0.002	1	0.24	.04*	0.08	.5
90° active	0.11	.35	0.11	.36	0.13	.26	0.16	.17	0.11	.34	-0.17	.15
90° passive	−.002	.98	0.01	.93	0.09	.44	0.06	.61	−0.003	.98	0.01	.93
Internal rotation												
Active	0.07	.59	−0.15	.22	0.04	.74	0.05	.68	0.09	.46	0.06	.62
Passive	0.06	.59	0.02	.87	0.03	.81	0.12	.32	0.08	.51	0.14	.25
Strength												
Forward flexion	0.34	.01*	0.01	.93	−.06	.60	−0.05	.67	0.34	.01*	0.02	.87
Abduction	0.35	.01*	0.04	.74	−.06	.60	0.01	.93	0.35	.01*	0.09	.41
External rotation	0.28	.02	0.08	.50	−.17	.14	0.06	.62	0.28	.01	−0.10	.38
Internal rotation at side	0.21	.07	0.04	.74	−.17	.14	0.05	.67	0.21	.07	0.15	.20

ASES, American Shoulder and Elbow Surgeons; *SF-12*, 12-Item Short Form Health Survey; *MCS*, Mental Component Summary; *PCS*, Physical Component Summary; *PCC*, Pearson correlation coefficients.
The ASES physician assessment subsections of range of motion and strength were compared with ASES patient, SF-12 Physical, and SF-12 Mental scores preoperatively and at 2 years postoperatively.
Boldfaced values indicate moderate correlation,
 * Significant at $P < .05$.

Outcome measure analysis

The preoperative and postoperative active forward flexion and the postoperative passive forward flexion subsections of the ASES physician assessment correlated more with the ASES patient score than SF-12 scores when compared over the 2-year period (Table II). The strongest correlation with ASES scores was found for the amount of active forward flexion preoperatively ($R = 0.39$, $P < .01$) and 2 years postoperatively ($R = 0.54$, $P < .01$; Fig. 1). Passive forward flexion showed a similar correlation ($R = 0.53$, $P < .01$) to the active forward flexion section postoperatively (Fig. 2). The other clinical measurements that showed statistically significant but small correlations with PROs included the preoperative measurements of passive external rotation ($R = 0.24$, $P = .04$) and strength of forward flexion ($R = 0.34$, $P < .01$), abduction ($R = 0.35$, $P < .01$), and external rotation ($R = 0.28$ $P < .01$).

When the ASES physician-assessment sections were compared with the SF-12 PCS, active forward flexion postoperatively showed the greatest correlation ($R = 0.36$, $P < .01$). The 2 other subsections to show small correlations were postoperative passive forward flexion ($R = 0.28$, $P < .01$) and preoperative passive external rotation ($R = 0.28$, $P < .01$; Table II).

When the ASES physician-assessment sections were compared with the SF-12 MCS, the strongest correlation was for the active forward flexion preoperative section ($R = 0.39$, $P < .01$). Other significant but smaller correlated sections included the postoperative passive forward flexion ($R = 0.27$, $P = .02$), the preoperative measurements of passive external rotation ($R = 0.24$, $P = .04$), and strength subsections of forward flexion ($R = 0.34$, $P < .01$), abduction ($R = 0.35$, $P < .01$), and external rotation ($R = 0.28$, $P = .01$).

Further analysis examining the changes in the ASES physician-assessment sections during the 2-year period showed the greatest
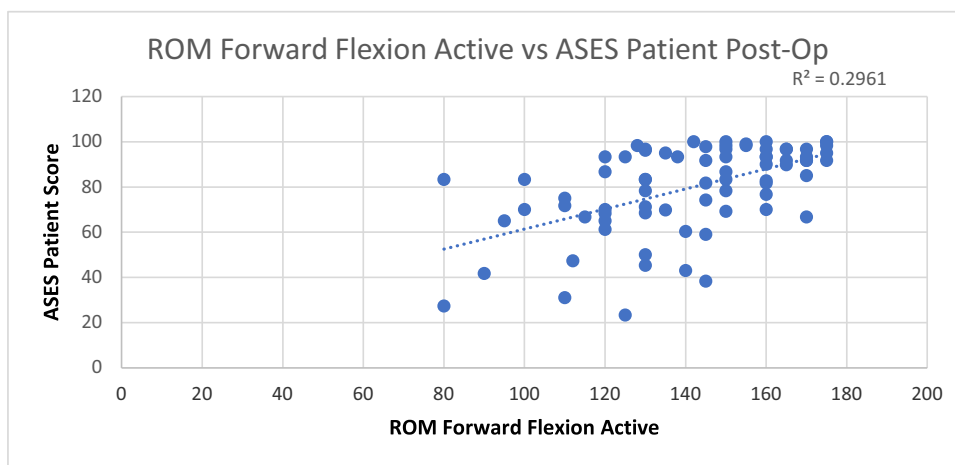

Figure 1 American Shoulder and Elbow Surgeons (*ASES*) physician-assessed 2-year postoperative subsection for active forward flexion compared with the ASES patient-assessed 2-year postoperative scores. ASES patient scores are plotted against the ASES physician subsection of active forward flexion at 2 years postoperatively. The ASES patient score is assessed from 0 to 100, with range of motion (*ROM*) measured in degrees.
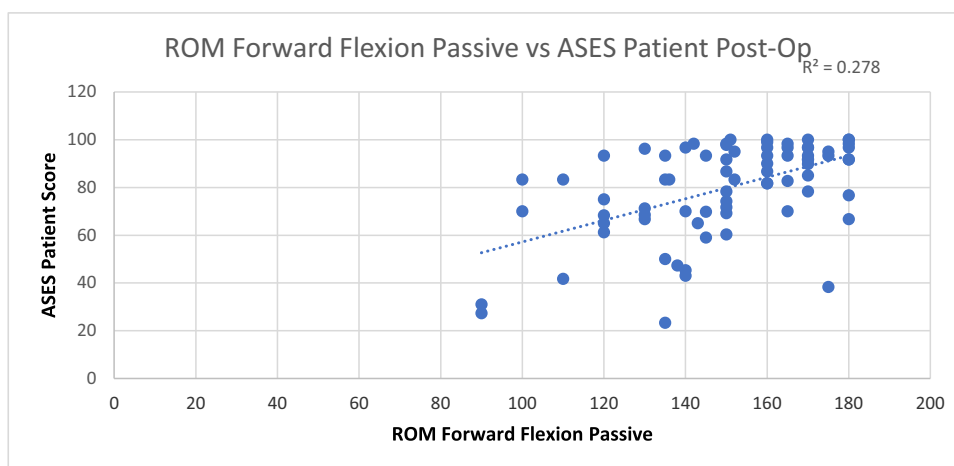
Figure 2 American Shoulder and Elbow Surgeons (*ASES*) physician-assessed subsection passive forward flexion compared with the ASES patient-assessed 2-year postoperative scores. The ASES patient scores are plotted against the ASES physician-assessed subsection of passive forward flexion at 2 years postoperatively. The ASES patient score is assessed from 0 to 100, with range of motion (*ROM*) measured in degrees.

correlation when improvements in active forward flexion were compared with improvements in the ASES patient scores ($R = 0.36$, $P < .01$; Table III). This was the only section of the ASES physician assessment that correlated with changes in PRO, because changes in clinical measurements had no correlation with changes in SF-12 PCS or MCS. There was no trend toward significance when the other sections of the ASES physician assessment were analyzed compared with the ASES patient scores, SF-12 Mental, and SF-12 Physical, as reported in Table III.

Discussion

PRO scores are increasingly used to assess the success of total joint arthroplasty in conjunction with the clinical assessments by physicians. The ASES physician-assessment component includes rigorous measurements of shoulder range of motion and strength that are collected before and after RTSA, but to date, this clinical assessment has not been evaluated as a predictor of PRO in shoulder arthroplasty. The findings from this study show that measurements

from the ASES physician assessment demonstrate sparse correlation with the ASES patient assessment and patient-reported general health as assessed by SF-12 Physical and Mental sections.

Shoulder forward flexion range was the only measurement that demonstrated moderate correlations with PROs in our study. Improvements in ASES patient scores only correlated with improvements in active forward flexion. Active forward flexion has been used in prior studies as a distinct category in the assessment of RTSA success and as a measure of overall shoulder function after RTSA.[11,18] Prior studies that have used the ASES patient score as a PRO have reported distinct range of motion and strength category outcomes in the results of their studies as a separate measurement done outside of the ASES physician report. This study supports that there is added value to tracking forward flexion range of motion outcome when assessing the success of patients' surgery.

The forward flexion active and passive range of motion subsections both also showed a small correlation with the SF-12 PCS. Similarly, the SF-12 MCS also showed a small but positive correlation with the passive postoperative forward flexion subsection of

Table III

Change in American Shoulder and Elbow Surgeons physician scores from preoperatively to 2 years postoperatively compared with changes in the patient scores and 12-Item Short Form Health Survey Physical and Mental scores

ASES physician subsections	ASES patient		SF-12 Physical (PCS)		SF-12 Mental (MCS)	
	PCC (*R*)	*P* value	PCC (*R*)	*P* value	PCC (*R*)	*P* value
Range of motion						
Forward flexion						
Active	0.36	<.01*	0.18	.14	0.08	.56
Passive	0.14	.25	0.06	.65	0.17	.13
External rotation						
Active	0.21	.08	0.16	.22	–0.01	.92
Passive	0.23	.05	0.10	.44	0.01	.92
90° active	0.10	.40	0.23	.08	–0.13	.35
90° passive	0.04	.72	0.11	.44	0.02	.90
Internal rotation						
Active	0.03	.81	0.07	.56	0.01	.93
Passive	0.05	.68	0.04	.74	0.08	.51
Strength						
Forward flexion	0.20	.08	0.01	.95	0.08	.59
Abduction	0.22	.06	–0.01	.95	0.17	.21
External rotation	0.13	.27	0.03	.92	–0.03	.83
Internal rotation at side	0.02	.87	0.01	.98	0.14	.30

ASES, American Shoulder and Elbow Surgeons; *SF-12*, 12-Item Short Form Health Survey; *MCS*, Mental Component Summary; *PCS*, Physical Component Summary; *PCC*, Pearson correlation coefficients.

* Significant $P < .05$.

the ASES physician assessment. These results support a previous study of RTSA that demonstrated up to 93% of patients being satisfied and reporting higher SF-12 scores as long as they had improved forward flexion despite less than full postoperative range of motion in other parameters.[13] The findings from our current study substantiate previous findings and suggest that forward flexion measurements can be used to predict patient quality of life and used in adjunct with the ASES patient-reported score to assess surgical outcomes.

No other subsections of the ASES physician score correlated with the change in ASES patient scores from preoperative to postoperative stages. This may indicate that these other measurements might be useful but do not reflect patients' activities of daily living, pain, and function after RTSA. Furthermore, when change in the ASES physician subsections compared with the change in the SF-12 PCS and SF-12 MCS was assessed, no significant correlations were noted. The results of this study show that the change in preoperative and postoperative forward flexion correlates with shoulder function but may not reflect the change in overall general health. A possible explanation for this may be that small changes in forward flexion produce large increases in perceived general health.[17] As such, there may be a low threshold of improved range of motion that a plateau effect on general health is seen. Therefore, although patients experienced a large gain in range of motion, nearly 2-fold, there was limited correlation with the change in SF-12 scores during the 2 years postoperatively.

Previous studies have also reported that patients with greater isokinetic shoulder strength participate in higher-demand recreational or sports activity and report fewer difficulties with activities of daily living.[20] Conversely, patients with lower isokinetic shoulder strength were reported to be more likely to have reduced range of motion[1] and also associated inferior clinical outcomes after RTSA.[1] Our study found little correlation between shoulder strength assessed clinically with PROs. Because the ASES physician assessment asks for strength measurements according to the Medical Research Council grade of 0 to 5, the results may be affected by the physician performing the examination. The subjective nature of this grading may have affected the correlation between measurements and PROs.

Further, because functional assessment is multifactorial, including glenohumeral and scapulothoracic motion, accurate assessment and documentation of functional outcomes based on these variables can be difficult and time intensive. A recent study of the optimal shoulder outcome score for RTSA, however, identified the objective physician-assessed Constant-Murley range of motion and strength in abduction to have the strongest correlation with functional outcome of the arm compared with ASES PROs and Subjective Shoulder Value PROs.[14] The study did not include the physician score of the ASES. The authors concluded that face-to-face evaluation with the incorporation of certain objective clinical examinations was important in the assessment of outcomes. Therefore, although this study only demonstrates a correlation between forward flexion measurements and PROs, it should be maintained that a careful clinical examination be undertaken for all patients both before and after the operation.

Several limitations should be noted when the findings of this study are interpreted. Data were collected from 5 different surgeons with different surgical techniques. These differences are minor; however, all of the surgeons used the same Zimmer Trabecular Metal Implant, and the surgical approach and main steps of the procedure are the same. Measurements were made using goniometers as per standardization with the ASES physician score, and the inclusion of multiple evaluators make this study more generalizable.

In addition, we did not include the instability or tenderness assessment of the ASES physician component, which might have added value to practitioners to assess surgical outcomes. These measurements were excluded from this study due to their highly subjective nature in recording because we aimed to assess only objective clinical measurements.

Radiographic assessment of postoperative implant position, which might have affected range of motion and strength in patients, was not included in this study because it was not accessible.

Conclusions

There is little correlation between clinical measurements obtained for the physician component of the ASES assessment and PROs scores, including the ASES patient assessment and SF-12 general physical and mental surveys after RTSA. Improvement in active forward flexion is the only clinical measurement correlated with improvement in patient reported outcomes 2 years after RTSA.

Disclaimer

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