Single Assessment Numeric Evaluation Correlates with American Shoulder and Elbow Surgeons Score for Common Elbow Pathology

A Retrospective Cohort Study

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Background: There are currently a variety of patient-reported outcomes (PROs) for elbow pathology, without any established gold standard. The Single Assessment Numeric Evaluation (SANE) is a single question assessment of the patient's perceived overall function compared with normal. The SANE score has been correlated with PROs from the shoulder and knee literature.

Purpose: To correlate the SANE score for a variety of elbow pathologies with a traditionally reported elbow outcome measure, the American Shoulder and Elbow Surgeons–Elbow score (ASES-E).

Study Design: Cohort study (diagnosis); Level of evidence, 3.

Methods: A retrospective review was performed of all patients identified at a single center between April 2016 and January 2019 who presented as a new patient with elbow pathology. All patients prospectively completed the ASES-E along with the SANE score for elbow (SANE-E) at the time of initial consultation. Spearman correlations (*r*) were performed to evaluate the correlation between the ASES-E and the SANE-E score for specific elbow pathology, along with descriptive data such as age, sex, and chronicity of the problem.

Results: A total of 555 patients (166 women, 29.9%) with a mean ± SD age of 51.0 ± 11.7 years with the diagnoses of medial epicondylitis (n = 72; 13.0%), lateral epicondylitis (n = 224; 40.4%), biceps tendon rupture (n = 139; 25.0%), triceps tendon rupture (n = 21; 3.8%), and elbow arthritis (n = 99; 17.8%) were included in this analysis. There was moderate correlation between the SANE-E and the ASES-E ($r = 0.623$; $P < .001$), with strongest correlation with the visual analog scale (VAS) ($r = -0.518$; $P < .001$) compared with any individual question and moderate to strong correlations based on specific diagnoses. SANE-E and ASES-E scores for the entire cohort were 42.9 ± 26.7 and 56.9 ± 21.4, respectively ($P < .001$). Age ($r = 0.027$; $P = .526$), sex ($r = 0.026$; $P = .555$), VAS ($r = -0.106$; $P = .013$), and chronicity of the problem ($r = -0.037$; $P = .384$) were not found to be correlated with differences in ASES-E and SANE-E.

Conclusion: The SANE-E score is a simple way to assess patient-perceived function relative to normal. The findings of this study demonstrated moderate to strong correlation between the ASES-E and the SANE-E score for a variety of commonly encountered elbow conditions.

Keywords: patient-reported outcome; elbow; SANE; ASES; epicondylitis; arthritis

Patient-reported outcomes (PROs) are increasingly utilized in orthopaedic surgery to quantify clinically meaningful changes in a patient's function as a result of a particular pathology or intervention.[10,12,14] PROs allow patients the opportunity to describe their function and perception of disability in a standardized fashion.[29] Outcome measures can vary considerably from simple 1-question assessments to complex scoring systems that may be time- and labor-intensive.‡ Increasing complexity of outcome assessment tools may adversely affect patient responsiveness because of survey fatigue.[3,4,16] The ideal outcome tool should be

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easy to use, reproducible (ie, produce similar values on test-retest), veracious (ie, as close to the true value as possible), and validated for the particular pathology/intervention and should reflect clinically meaningful change over time.

The Single Assessment Numeric Evaluation (SANE) is a single question assessment of the patient's perceived overall function relative to normal. This is expressed as a percentage (0%-100%), where 100% reflects normal.[5,7,27] The SANE was originally described as a postoperative tool after shoulder instability; however, this tool has subsequently been validated for a variety of pathologies.[7] Recent literature has demonstrated that the SANE score after rotator cuff repair (RCR) and total shoulder arthroplasty (TSA) correlate well with traditional outcome measures such as the American Shoulder and Elbow Surgeons (ASES), Constant, and Western Ontario Rotator Cuff Index scores.[7,8,19,22,27] Furthermore, SANE has shown good pretreatment reliability and veracity with ASES score in patients with shoulder pathology; a minimal clinically important difference of 15% for SANE was reported in this patient population.[22]

There is currently an array of PRO measures utilized for elbow pathology, without any considered a gold standard metric of assessment. SANE has been correlated with PROs from shoulder,[5,8,18,19,22,24,25] knee,[1,20,28] hip,[23] and foot[2,15] literature, but, to date, the score has only been validated for specific elbow pathology in 1 study.[18] The purpose of this study was to evaluate the association between SANE scores and ASES–Elbow (ASES-E) scores in patients with various elbow pathology diagnoses. We hypothesized that a correlation would exist, allowing surgeons to utilize SANE–Elbow (SANE-E) score as a simple means to screen for more robust clinical assessment and/or PRO for patients presenting with common elbow pathologies.

TABLE 1
ASES-E and SANE-E Questions[a]

Survey	Question
SANE-E	How would you rate your elbow today as a percentage of normal (0%-100%, with 100% being normal)?
ASES-E	Are you having pain in your elbow?
	How bad is your pain today? (VAS)
	Rate your ability to perform the following:
	Put on a coat (coat)
	Sleep on your painful or affected side (sleep)
	Wash back/do up bra in back (wash back)
	Manage toileting (toileting)
	Comb hair (comb hair)
	Reach a high shelf (high shelf)
	Lift 10 lb above the elbow (10 lbs)
	Throw a ball overhand (throw)
	Do usual work (work)
	Do usual sport (sport)

[a]ASES-E, American Shoulder and Elbow Surgeons–Elbow; SANE-E, Single Assessment Numerical Evaluation–Elbow; VAS, visual analog scale for pain.

METHODS

Study Population

After institutional review board approval (No. 20E.329), all patients evaluated at a single institution for elbow pathology between April 2016 and January 2019 were retrospectively identified. During this period, all new patients prospectively completed a standardized survey that contained both the SANE-E and the ASES-E scores and was stored in an electronic database (Outcomes Based Electronic Research Database; Universal Research Solutions). The ASES questionnaire is composed of 11 questions—1 visual analog scale for pain (VAS) that asks the patient to report his or her pain that day and 10 functional questions that assess the patient's ability to perform certain tasks. The score is out of 100 points and is weighed equally for pain and function.[30] The ASES questions for the elbow (ASES-E) are exactly the same as those for the shoulder; however, the questions are focused on the ability of the patient to use the elbow to perform tasks. The ASES-E has been validated for use in elbow pathology (Table 1).[24,25]

Patients with both sets of outcome scores obtained as part of a new patient visit for an elbow-only problem (ie, any patients with concomitant shoulder diagnoses during the visit were excluded) and survey completion within 3 months of the visit date were included. All surveys were completed during an in-person visit. Patients who had nonelbow pathology (including shoulder diagnoses), fractures, infections, open wounds, neoplasms, and unspecified diagnoses and who had a previous operation on the elbow of interest were excluded. The remaining diagnoses were categorized into the following: epicondylitis (ie, lateral and medial), tendon tears (ie, biceps and triceps), and arthritis

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TABLE 2
Correlation Analysis Between SANE-E and Components of the ASES-E Score[a]

	SANE-E											
	Overall		Medial Epicondylitis		Lateral Epicondylitis		Biceps		Triceps		Arthritis	
	r	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value
ASES-E	0.623	<.001	0.669	<.001	0.591	<.001	0.592	<.001	0.509	.019	0.629	<.001
VAS	–0.518	<.001	–0.615	<.001	–0.498	<.001	–0.500	<.001	–0.218	.343	–0.579	<.001
ASES questions												
Coat	0.486	<.001	0.519	<.001	0.492	<.001	0.394	<.001	0.370	.099	0.499	<.001
Sleep	0.424	<.001	0.596	<.001	0.288	<.001	0.392	<.001	0.439	.047	0.470	<.001
Wash back	0.417	<.001	0.533	<.001	0.409	<.001	0.414	<.001	0.374	.094	0.305	.002
Toileting	0.232	<.001	0.270	.022	0.231	<.001	0.215	.011	0.353	.116	0.220	.030
Comb hair	0.335	<.001	0.465	<.001	0.330	<.001	0.290	.001	0.080	.732	0.305	.002
High shelf	0.418	<.001	0.526	<.001	0.391	<.001	0.361	<.001	0.233	.308	0.458	<.001
10 lbs	0.477	<.001	0.531	<.001	0.419	<.001	0.480	<.001	0.470	.031	0.470	<.001
Throw	0.496	<.001	0.587	<.001	0.420	<.001	0.550	<.001	0.307	.176	0.498	<.001
Work	0.427	<.001	0.381	.001	0.376	<.001	0.503	<.001	0.276	.226	0.453	<.001
Sport	0.446	<.001	0.497	<.001	0.373	<.001	0.527	<.001	0.528	.014	0.435	<.001

[a]Full ASES questions are provided in Table 1. ASES, American Shoulder and Elbow Surgeons; ASES-E, ASES–Elbow; *r*, Spearman rho; SANE-E, Single Assessment Numeric Evaluation–Elbow; VAS, visual analog scale for pain.

(ie, elbow osteoarthritis, rheumatoid arthritis, or post-traumatic osteoarthritis). Additional descriptive data collected from patient charts included age, sex, and chronicity of the problem at first visit (chronic problems, in this study, were defined as those that had ≥1-year history of the problem before presentation).

Statistical Analysis

Correlation analyses were performed among SANE-E, ASES-E, and VAS and on age, sex, chronicity at presentation, and VAS scores to evaluate if these metrics influenced absolute differences in SANE-E and ASES-E scores. Due to the nonparametric nature of our data, as determined using Shapiro-Wilk and histogram evaluation, Spearman correlations were performed. Correlation values were interpreted as follows: 0.00-0.20, negligible; 0.21 to 0.40, weak; 0.41 to 0.60, moderate; 0.61 to 0.80, strong; and 0.81 to 1.00, very strong. The same analysis was performed on the entire the cohort and by each specific diagnosis. All statistical analyses were carried out using SPSS Version 26 (IBM Corp). Statistical significance was defined as $P < .05$ for all output.

RESULTS

Following the inclusion and exclusion criteria, 555 patients (166 women, 29.9%) with a mean ± SD age of 51.0 ± 11.7 years were included. Elbow diagnoses included medial epicondylitis (n = 72, 13%; mean age, 49.0 ± 16.3 years; 21 women, 29.2%), lateral epicondylitis (n = 224, 40.4%; mean age, 51.5 ± 9.6 years; 111 women, 49.6%), biceps rupture (n = 139, 25.0%; mean age, 50.0 ± 10.9 years; 8 women, 5.8%), triceps rupture (n = 21, 3.8%; mean age, 50.5 ± 8.6 years; 1 woman, 4.8%), and elbow arthritis (n = 99, 17.8%; mean age, 52.9 ± 13.3 years; 51 women, 51.5%).

The mean ± SD SANE-E and ASES-E scores for the entire cohort were 42.9 ± 26.7 and 56.9 ± 21.4, respectively, and were found to be significantly different ($P < .001$). Moderate to strong positive correlations were found between SANE-E and ASES-E for the entire cohort ($r = 0.623$; $P < .001$), as well for each diagnosis (Table 2 and Figure 1). Correlation analysis based on each respective question showed weak to moderate positive correlation with SANE-E. Questions about the ability to toilet and comb/brush hair showed the weakest correlations. Of note, SANE-E had a stronger correlation with VAS than any of the individual functional questions ($r = -0.518$ vs $r = 0.232$-0.496, respectively). The mean SANE-E score for each diagnosis is as follows: 45.3 ± 25.8, 45.0 ± 27.7, 35.6 ± 23.1, 41.0 ± 25.6, and 44.2 ± 28.7 for medial epicondylitis, biceps tendon rupture, triceps tendon rupture, lateral epicondylitis, and arthritis, respectively ($P = .387$).

Age ($r = 0.027$; $P = .526$), sex ($r = 0.026$; $P = .555$), VAS ($r = -0.106$; $P = .013$), and chronicity of the problem ($r = -0.037$; $P = .384$) were not found to be correlated with differences in ASES-E and SANE-E scores for the entire cohort. On subgroup analysis based on diagnosis, there were no strong correlations between age, sex, VAS, or chronicity of the problem and differences between ASES-E and SANE-E scores (Table 3).

DISCUSSION

The major findings of this study demonstrated moderate to strong positive correlation between SANE-E and ASES-E, a widely utilized PRO, with no differences in correlation based on age, sex, chronicity of the problem, or current

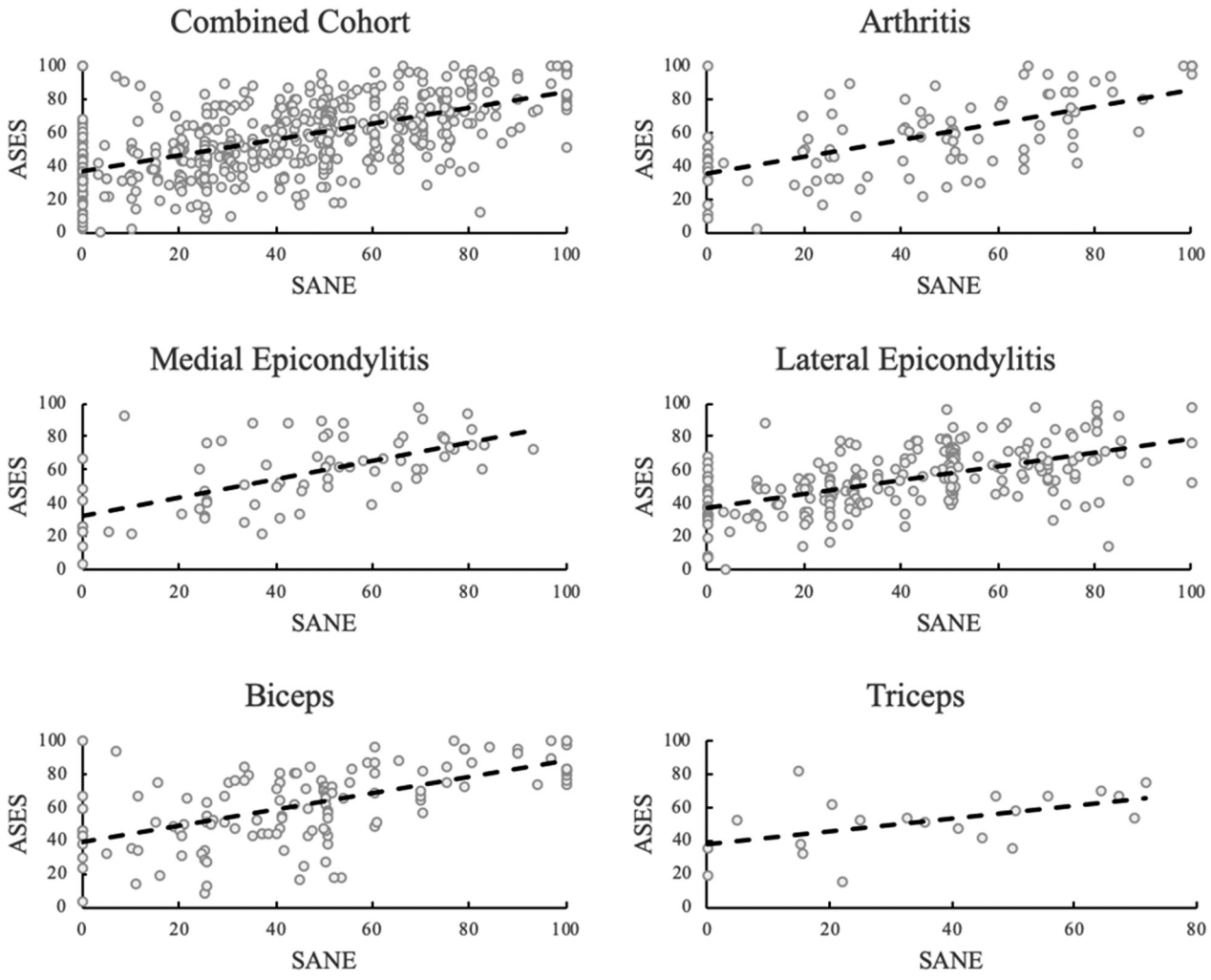

Figure 1. Correlation scatter plots of ASES-E versus SANE-E based on pathology. ASES-E, American Shoulder and Elbow Surgeons–Elbow; SANE-E, Single Assessment Numerical Evaluation–Elbow.

pain level at time of visit and the introduction of SANE-E score data for widely common elbow pathologies.

Multiple studies have evaluated the use of SANE in comparison with other PROs, with many reporting a correlation between SANE and ASES for shoulder pathology.[8,19,22,27,30] Williams et al[28] reported a moderate to very strong correlation between SANE and the Lysholm score for 130 patients who underwent anterior cruciate ligament reconstruction. Most recently, Razaeian et al[18] showed a very strong correlation between SANE and Oxford Elbow Score in 87 patients with a variety of elbow pathologies. They found that both scores were correlated highly (r = 0.903), with a strong correlation found between SANE and the pain domain (r = 0.804), similar to our findings. In addition, they reported that SANE and VAS were moderately correlated (r = −0.631). Wickman et al[26] evaluated the association between ASES and SANE in 333 patients who underwent RCR. The authors reported strong correlations in the preoperative period. Hence, the correlation between SANE-E and ASES-E that we show in this study is not surprising given the results found in the literature for SANE and other PROs in the preoperative period.

Although there was a strong positive correlation between SANE-E and ASES-E in this report, SANE-E scores were significantly lower than were ASES-E scores. The SANE survey does not ask specifically about any functional limitations but rather is a subjective measure based on what each patient defines as normal. In the preoperative period, patients may still be able to perform the functional tasks that make up the ASES survey; however, they may still rate their elbow as not acceptable because of either pain or limitations in activities that they find important. In addition, when looking at correlations between SANE-E and VAS or individual functional questions in the ASES-E survey, SANE-E was correlated most with the VAS pain score across all cohorts, further suggesting the subjective nature of SANE-E. It is important to note here that although SANE-E is associated with VAS pain score, which highlights the interplay between function and pain, the SANE

TABLE 3
Correlation Analysis Between Absolute Difference Between Scores and Patient Characteristics

	Absolute Difference Between SANE-E and ASES-E											
	Overall		Medial Epicondylitis		Lateral Epicondylitis		Biceps		Triceps		Arthritis	
	r	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value	*r*	*P* Value
Age	0.027	.526	–0.004	.975	0.004	.954	–0.033	.702	0.543	.011	0.004	.973
Sex	0.026	.555	0.148	.215	0.008	.901	–0.234	.006	0.037	.874	0.036	.725
VAS	–0.016	.013	–0.148	.214	–0.053	.428	–0.204	.016	0.001	.996	0.024	.810
Chronicity	–0.037	.384	–0.123	.305	–0.002	.971	–0.231	.006	0.180	.435	–0.090	.376

[a]ASES-E, American Shoulder and Elbow Surgeons–Elbow; *r*, Spearman rho; SANE-E, Single Assessment Numeric Evaluation–Elbow; VAS, visual analog scale for pain.

score is still largely a functional assessment, as it challenges patients to grade their shoulder with respect to normal use.

One of the benefits of SANE is that the score is unhindered by irrelevant questions and/or physical examination maneuvers that cloud how debilitating the patient's respective injury is in the context of his or her lifestyle. For instance, a throwing athlete may lose 20° of range of motion after repair of an ulnar collateral ligament but be otherwise fully able to throw, thus producing a higher SANE. However, a gymnast in the same situation might be significantly hindered by that loss of motion and produce a lower SANE score. Both of these athletes likely will have high ASES scores; however, the true effect (ie, veracity) of the injury is better captured using SANE.

We found varying correlations based on elbow diagnoses, suggesting that differing diagnoses play a role in discrepancies between ASES-E and SANE-E; however, the differences were small ones. In studies involving shoulder diseases, Cunningham et al[5] and Thigpen et al[22] found that correlations varied from strong to very strong based on diagnoses and associated interventions (ie, RCR, physical therapy, labral surgery, revision RCR, or TSA). In these studies, as well as in the current one, although correlations differed based on pathology, there were still correlations regardless of diagnosis. Further investigation is required to elucidate the factors that cause such discrepancies.

Although not explored in this study, correlations between SANE and ASES may be stronger in the postoperative period compared with those preoperatively. Retzky et al[19] evaluated correlations between ASES and SANE, preoperatively and postoperatively, in patients undergoing RCR or TSA. The authors reported moderate to very strong correlations for both surgical cohorts in the postoperative period, while they found weak correlations preoperatively. Similar results were found in the studies by Williams et al,[27] Thigpen et al,[22] and Wickman et al.[26] In the study by Williams et al,[27] the authors reported the strongest correlations at 6 months and 1 year between SANE and ASES for patients who underwent shoulder surgery. This finding is likely due to the subjective nature of SANE. In the preoperative period, patients may still be able to perform the functional tasks that make up the ASES survey; however, they may still rate their elbow as not acceptable due to either pain or limitations in activities that they find important, whereas in the postoperative period, a good surgical outcome leads to the ability to perform these activities.

As health care reform continues to move toward a value-based system with emphasis on patient-centric quality measures and methods of documenting outcomes (ie, via PROs), it becomes imperative that additional assessments performed by medical staff be of high quality and not impede the patient encounter.[6,8,21] The SANE score is a simple 1-question survey, similar to the VAS score, that is easy to administer (ie, via telephone, tablet, in person); takes <1 minute to answer; facilitates physician-patient interaction, as patients are able to communicate how close to or far from normal they feel; and reduces patient frustration and risk of incomplete forms.[5,20] Studies utilizing computer adaptive modeling have demonstrated that common PROs can be generated using fewer questions.[11,17] In a meeting by the ASES Value Committee in 2017,[9] >25 PROs for shoulder and elbow pathology were evaluated to set forth recommended PROs to be used in the clinical or research settings. The committee based their report on finding PROs that are patient-reported entirely, standardized, easy to use, and have published validation and psychometrics. For patients with elbow pathology, the committee endorsed the use of SANE-E, alongside the shortened version of Disabilities of the Arm, Shoulder and Hand and the Veterans RAND 12-Item Health Survey for clinical assessments.[9] The findings of the current study indicate that the SANE-E can be a simple and easy way to supplement a more comprehensive functional PRO such as the ASES-E.[13] For instance, SANE-E evaluation can be completed at every subsequent visit, as it is not time-consuming or a burden to the patient, and if the score is concerning, the surgeon can be indicated to perform a more robust assessment of the patient's function in the form of a PRO and/or history and physical examination. In addition, SANE-E, in this context, can be utilized to monitor patient progress after an intervention; however, future investigation is needed to ascertain the minimal clinically important difference to accurately follow patients as they plateau in terms of function.

This study has several limitations. First, this was a retrospective study of prospectively recorded data and thus

has limitations that are inherent in the design. However, the biases inherent to the retrospective nature of the study were mitigated somewhat by the prospective nature of the data collection. Second, although the ASES-E survey has not been validated for elbow pathology, it has been widely utilized in the literature. Third, our study population was mainly composed of male patients, given the disproportionate number of biceps tears that occur in men. However, we selected the most common orthopaedic elbow diagnoses that presented at our institution, suggesting external validity of our sample. In addition, sex was not found to significantly affect absolute differences between SANE-E and ASES-E scores. These are important limitations to consider when evaluating the external validity of our findings. Fourth, given that the SANE-E score is a single question administered using a tablet via an analog scale, patients may have inadvertently chosen the opposite score and thus influenced our findings.

The strength of this study lies in its being one of the first to evaluate the correlation between SANE-E and ASES-E PROs. In addition, a large sample size was included in this study, allowing for more robust statistical comparisons. Another strength is that this study included a variety of the most common elbow pathologies that present at an orthopaedics office, thus improving the external validity of our findings and allowing clinicians to directly apply the results to their respective patient population. Finally, the major strength and clinical relevance of our work is that we demonstrated that a single, easy-to-use functional assessment can serve as a screening tool and/or a surrogate for more extensive examination and questionnaires, allowing surgeons to follow their patients' subjective improvements without burdening them and the clinical staff with unnecessary surveys.

CONCLUSION

The preoperative SANE-E score demonstrated moderate to strong correlation with the ASES-E score for a variety of commonly encountered elbow pathologies. SANE-E was correlated more strongly with the pain component of ASES-E than with any of the questions in the functional domain, suggesting the subjective nature SANE-E scores. Future studies should be geared toward better understanding the role SANE-E has in subsequent follow-up visits after an intervention.

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