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High correlation of the subjective elbow value with Mayo Elbow Performance Score and Oxford Elbow Score in patients with elbow dislocation

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Background: The purpose of this study was to analyze the correlation of the Subjective Elbow Value (SEV) with 2 widely used elbow scoring systems: Mayo Elbow Performance Score (MEPS) and Oxford Elbow Score (OES) in patients following elbow dislocation.

Methods: In this retrospective single-center study, patients who sustained an elbow dislocation between January 2008 and December 2019 and were at least 2 years out from injury were included. SEV, OES and MEPS were assessed and statistical correlation was calculated using Pearson's correlation coefficient.

Results: A total of 114 patients (61 male, 53 female) with a mean age of 47.1 years (range, 16-70) were analyzed following elbow dislocation. The mean SEV was 87.4% (95% confidence interval (CI) 84.2-90.7), mean MEPS was 88.1 (95% CI 85.1-91.0) points and mean OES was 40.0 (95% CI 38.4-41.7) points. Both MEPS ($r = 0.710$, $P < .001$), and OES ($r = 0.764$, $P < .001$) demonstrated high correlation with the SEV.

Conclusion: This study demonstrates that the SEV is a valid tool to assess overall status of the elbow in patients following elbow dislocations and presents an expressive but easy to perform addition to more complex scoring systems.

Following the shoulder, the elbow joint is the second most frequently dislocated joint in adults.[21] Outcomes after elbow dislocation are generally satisfactory to good.[1,8,17,20] However, the optimal treatment of elbow dislocations remains a matter of debate and extensive research. Various elbow scoring systems are used to assess outcomes. One of the main goals of these outcome scores is to report treatment results in a standardized fashion thereby facilitating a "mutual language". A wide range of scores is available regarding elbow pathologies, the most commonly used are the Mayo Elbow Performance Score (MEPS), the Oxford Elbow Score (OES), the Disabilities of Arm, Shoulder and Hand (DASH) and the American Shoulder and Elbow Surgeons score (ASES).[2,3,11,14] Most scores incorporate subjective and objective parameters. Among the aforementioned scores validation data are scarce.[12,22] The OES is the only elbow score that is validated with high-quality methodology in a heterogenous population according to "*Consensus Based Standards for the Selection of Health Measurement Instruments*" (COSMIN) checklist criteria.[7,22] Following the evaluation of a wide variety of scores for shoulder and elbow conditions, the American Shoulder and Elbow Surgeons Value Committee recommended the use of a Single Assessment Numeric Evaluation.[9]

Recently in 2014, the subjective elbow value (SEV) was introduced by Schneeberger et al.[18] The main advantage of the SEV is that it comprises a single question only, thereby minimizing the effort for the patient and potentially increasing follow-up rates. Despite these potential benefits, its application and validation is limited to few studies.[5,6,18]

A large study with 555 patients with a variety of elbow pathologies showed a moderate correlation of the SEV with the ASES[15] and 2 other studies including 40 and 241 patients demonstrated high correlation with the MEPS.[6,18] Only 1 study investigated the correlation of the SEV with the OES in 86 patients and showed a high correlation.[16]

However, most of these investigations were performed on a heterogenous study population and there is no study that focuses

This study was approved by the Ethical Committee of the State Medical Association of Rheinland-Pfalz (Germany) (study no. 2020-15412).

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Table I
Oxford Elbow Score.

During the last 4 weeks.				
Have you had difficulty lifting things in your home, such as putting out rubbish, because of your elbow problem?				
No difficulty	Little bit of difficulty	Moderate difficulty	Extreme difficulty	Impossible to do
Have you had difficulty carrying bags of shopping, because of your elbow problem?				
No difficulty	Little bit of difficulty	Moderate difficulty	Extreme difficulty	Impossible to do
Have you had difficulty washing yourself all over, because of your elbow problem?				
No difficulty	Little bit of difficulty	Moderate difficulty	Extreme difficulty	Impossible to do
Have you felt like your elbow problem is "controlling your life"?				
No, not at all	Occasionally	Some days	Most days	Every day
How much has your elbow problem been "on your mind"?				
Not at all	A little of the time	Some of the time	Most of the time	All of the time
Have you been troubled by pain from your elbow in bed at night?				
Not at all	1 or 2 nights	Some nights	Most nights	Every night
How often has your elbow pain interfered with your sleeping?				
Not at all	Occasionally	Some of the time	Most of the time	All of the time
How much has your elbow problem interfered with your usual work or everyday activities?				
Not at all	A little bit	Moderately	Greatly	Totally
Has your elbow problem limited your ability to take part in leisure activities that you enjoy doing?				
No, not at all	Occasionally	Some of the time	Most of the time	All of the time
How would you describe the worst pain you have from your elbow?				
No pain	Mild pain	Moderate pain	Severe pain	Unbearable
How would you describe the pain you usually have from your elbow?				
No pain	Mild pain	Moderate pain	Severe pain	Unbearable

Each item can be scored 0-4 points where 0 points mark the greatest severity.

Table II
Mayo Elbow Performance Score.

Variable	Definition	Points
Pain	None	45
	Mild	30
	Moderate	15
	Severe	0
Range of motion	Arc > 100°	20
	Arc 50-100°	15
	Arc < 50°	5
Stability	Stable	10
	Moderately unstable	5
	Grossly unstable	0
Function	Able to comb hair	5
	Able to feed oneself	5
	Able to perform personal hygiene tasks	5
	Able to put on shirt	5
	Able to put on shoes	5

on evaluating these scores in patients with elbow dislocations. In order to adequately use the SEV, validation is not only needed in general but also regarding different study populations and pathologies, since a score may provide reliable results in patients with fractures, but not degenerative pathologies.[22]

Therefore, the purpose of this study was to analyze the correlation of the SEV with 2 widely used elbow scoring systems: MEPS and OES in patients following elbow dislocation. We hypothesized that the SEV would show high correlation with the OES and MEPS in patients following elbow dislocation.

Methods

This retrospective single-center study was performed at a level-I trauma center and approved by the local ethics committee. Patients who sustained an elbow dislocation (simple or complex) between January 2008 and December 2019, were between the age of 16 and 70 years, and at least 2 years out of injury were included. Exclusion criteria were skeletally immature patients, a patient age <16 and >70 at time of injury, concomitant injuries of the ipsilateral extremity besides those involving the elbow, previous injuries to the elbow, open elbow dislocations (>1° according to Gustilo and Anderson) and mental conditions such as dementia.

Clinical evaluation and scores

The validated German version of the SEV, MEPS and OES were assessed at least 2 years after injury.[13,16,19]

The OES comprises 12 items regarding pain, function, and sociopsychological aspects. Each item can be scored from 0 to 4 points so that a maximum of 48 points can be reached equaling a normal/healthy elbow (Table I).[3]

The MEPS is a scoring system that involves subjective (70 of 100 points) and objective (30 of 100 points) parameters. It was initially developed for fractures of the elbow, but has also been validated using the ASES in a wide range of elbow pathologies since.[2] The score includes range of motion (ROM) (20 points), instability (10 points), function (activities of daily living) (25 points) and pain (45 points) (Table II). A maximum of 100 points can be reached and values between 90 and 100 points are considered excellent, whereas values of less than 60 points are considered poor.

The SEV is a single-question patient-administered tool to evaluate the current status of the elbow, similar to the Subjective Shoulder Value used for shoulder outcome assessment.[16] To record the SEV patients are asked to subjectively estimate the percentage of their elbow function in comparison to a healthy elbow (100%).

Statistical analysis

Data are presented with means and 95% confidence intervals (95% CIs) and means with range. Pearson's correlation coefficient was calculated to assess for correlation between scores. The level of significance was set at $P < .05$. Correlation strength was classified as follows: very high, $r \geq 0.90$; high, $r \geq 0.70$-0.89; moderate, $r \geq 0.50$-0.69; fair, $r \geq 0.30$-0.49; low, $r \geq 0.10$-0.29; or very low, $r < 0.10$.[10] Statistical analysis was performed using PRISM version 9.3.0 (GraphPad, San Diego, CA, USA).

Results

A total of 114 patients (61 male, 53 female) with a mean age of 47.1 years (range, 16-70) were included in this study. Of those, 58 patients (51%) had a simple elbow dislocation, 56 patients (49%) had a complex elbow dislocation and 95 of the patients (83%)

Table III
Mean outcome values for MEPS and correlation with SEV.

	Value mean (95% CI)	Pearson's correlation coefficient	*P* value
MEPS	88.1 (85.1-91.0)	0.710	<.001
Pain	36.6 (34.5-38.6)	0.651	<.001
Range of motion	18.8 (18.2-19.4)	0.649	<.001
Stability	8.6 (8.2-9.1)	0.455	<.001
Function (ADL)	23.8 (22.9-24.8)	0.185	.057

MEPS, Mayo Elbow Performance Score; *SEV*, Subjective Elbow Value; *CI*, confidence interval; *ADL*, activities of daily living.

Table IV
Mean outcome values for OES and correlation with SEV.

	Value mean (95% CI)	Pearson's correlation coefficient	*P* value
OES	40.0 (38.4-41.7)	0.764	<.001
Pain	13.1 (12.5-13.7)	0.586	<.001
Function	14.4 (13.9-14.9)	0.754	<.001
Psychosocial	12.6 (12.0-13.3)	0.757	<.001

OES, Oxford Elbow Score; SEV, Subjective Elbow Value; CI, confidence interval.

underwent surgery. Clinical results at a mean follow-up of 7.0 years (range, 2.0-12.9) were assessed. Mean SEV was 87.4% (84.2-90.7). Mean MEPS was 88.1 points (85.1-91.0) with a score of 36.6 points (34.5-38.6) for pain, 18.8 points (18.2-19.4) for ROM, 8.6 points (8.2-9.1) for stability and 23.8 points (22.9-24.8) for function. Mean OES was 40.0 points (38.4-41.7) with 13.1 points (12.5-13.7) for pain, 14.4 points (13.9-14.9) points for function and 12.6 points (12.0-13.3) regarding psychosocial aspects.

SEV demonstrated a high correlation with a Pearson's correlation coefficient of r = 0.710 ($P < .001$) with MEPS. Regarding subcategories, significant correlation ($P < .001$) was found for all except function (r = 0.185, $P = .057$). A moderate correlation was found in the subcategories of pain (r = 0.651, $P < .001$) and motion (r = 0.649, $P < .001$) and fair correlation was found in the subcategory of stability (r = 0.455, $P < .001$) (Table III).

SEV also demonstrated a high correlation with OES (r = 0.764, $P < .001$). High correlation was found regarding the subcategories of function (r = 0.754, $P < .001$) and psychosocial aspects (r = 0.757, $P < .001$), whereas moderate correlation was found for pain (r = 0.586, $P < .001$) (Table IV). Correlation between MEPS and OES was also high (r = 0.812, $P < .001$).

Discussion

The most important finding of this study was that the SEV as a single assessment numeric evaluation highly correlated with the MEPS and OES. Even though OES and MEPS are administered by a physician and comprise objective criteria as well, the SEV seems to adequately reflect the status of the elbow.

Correlation of the SEV with each of the subcategories of MEPS was lower compared to correlation with the total score of MEPS. Pain and range of motion showed moderate correlation whereas stability demonstrated fair correlation and function (ADL) showed no significant correlation. Since the SEV represents a subjective assessment of the overall status of the patients' elbow, the high correlation with the total MEPS is somewhat logical. Pain is a factor that subjectively affects the patient profoundly, whereas more objective parameters such as stability may not be noticed as much by the patient himself.[4] This is also reflected by the fact that pain contributes most to the total MEPS compared to the other subcategories. Interestingly, the subcategory of function that assesses the ability to perform activities of daily living, does not correlate with SEV. This is different for the OES function subcategory for which a significant and high correlation was found. The MEPS item regarding function focusses mainly on personal hygiene/getting dressed whereas OES includes a wider variety of activities of daily living. Correlation regarding sociopsychological aspects of OES was high, which is not surprising as this aspect of the score is highly subjective similar to the overall assessment of one's elbow function using the SEV is as well.

These results demonstrate that SEV provides a sufficient overview of the subjective status of the elbow but does not represent any specific aspect more profoundly. More complex scores such as MEPS and OES arrive at the same conclusion as SEV but provide a more detailed assessment of where the deficits are. High correlation between these scores demonstrate that both scores adequately assess status of the elbow in patients with elbow dislocation.

The results of the present study are in line with the findings of Razaein et al, who found a very high correlation (r = 0.903) between SEV and OES in 86 patients who had any type of elbow pathology.[16] In the aforementioned work the authors demonstrated high correlation in all subcategories (function, r = 0.847; psychosocial aspects, r = 0.885; pain, r = 0.804). Interestingly, Pearson's correlation coefficient in the study from Razaein et al is also highest in the respective total scores.[16]

Schneeberger et al examined the correlation between SEV and MEPS in 241 patients with any elbow pathology and found a moderate correlation (r = 0.671).[18] Correlation was high in our study but comparing Pearson's correlation coefficient, the difference is not very distinct (r = 0.71 vs. 0.671). In the subcategories the authors found the strongest correlation in pain (r = 0.576) which is categorized as a moderate correlation similar to this study. Correlation for the other subcategories was fair to low. In summary, these results are comparable to our findings. Of note, Schneeberger et al demonstrated that differences in SEV and MEPS were most profound in patients with limited pronation and supination with significantly lower values for SEV. Interestingly, forearm motion is not included in MEPS, leading to the assumption, that the MEPS may not adequately represent the elbow status in patients with restricted forearm rotation.

Gathen et al analyzed correlation between different elbow scores in 40 patients with olecranon fractures.[6] Similar to our results, the authors showed a high correlation between SEV and MEPS (r = 0.80). Gathen et al were also able to demonstrate a high inverse correlation of SEV with the widely used DASH Score (r = −0.85). However, no further analysis regarding correlation of subcategories was presented in their study.

Overall, the results of this study demonstrating high correlation of SEV with MEPS and OES in patients with elbow dislocations corroborate prior work assessing these correlations in different study populations.

This study has limitations. Intraobserver reliability was not assessed which is another important criterion for a valid scoring system. Interobserver reliability does not apply in patient-administered scoring systems. We also did not include an evaluation of responsiveness. Because of the retrospective design of this study, no data before nonoperative or surgical treatment were available. Additionally, the scores were only assessed at 1 timepoint during follow-up, therefore correlation at specific timepoints (eg, at 1 year, 2 years) remains unclear.

Conclusion

This study demonstrates that the SEV is a valid tool to assess overall status of the elbow in patients following elbow

dislocations at a mean of 7 years follow-up and presents an expressive but easy to perform addition to more complex scoring systems.

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