JOURNAL OF PLASTIC SURGERY AND HAND SURGERY
2023, VOL. 57, NOS. 1–6, 95–102
https://doi.org/10.1080/2000656X.2021.1993868

ARTICLE

Deep wrist injuries from suicide attempts vs. accidents do not differ regarding sensorimotor outcome, but regarding patient-reported outcome measures

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ABSTRACT

Despite the clinical importance of deep wrist injuries (DWIs), data comparing the outcome of suicide attempt survivors vs. accident survivors are lacking. Patients admitted to our Clinic for acute treatment of a DWI from 2008 to 2016 were contacted for a follow-up assessment of sensory, motor and functional outcomes. Patients also completed the Disability of the Arm, Shoulder and Hand Questionnaire, the Modified Mayo Wrist Score, the Boston Carpal Tunnel Questionnaire, and the WHOQOL-BREF questionnaires. 51 patients could be followed up, on average 4.3 ± 2.9 years after their injury. Suicide attempt survivors did not differ from accidents survivors concerning two-point discrimination, grip and pinch strength, but showed poorer outcomes in self-reported disability, symptom severity, and quality of life. Patients with DWIs from suicide attempts vs. accidents do not differ in sensorimotor outcomes but patient-reported outcome measures. Level of Evidence: II

Abbreviations: BCTQ: Boston Carpal Tunnel Questionnaire; DASH: Disability of the Arm, Shoulder and Hand; DFT: deep flexor tendons; DWI: deep (palmar) wrist injury; FCR: flexor carpi radialis; FCU: flexor carpi ulnaris; FDP: flexor digitorum profundus; FDS: flexor digitorum superficialis; FPL: flexor pollicis longus; FSS: Functional Status Subscale; MMWS: Modified Mayo Wrist Score; PL: palmaris longus; SSS: Symptom Severity Scale; WHOQOL-BREF: World Health Organization-Quality of Life – short form

ARTICLE HISTORY
Received 17 December 2020
Revised 3 August 2021
Accepted 7 October 2021

KEYWORDS
Wrist injury; DASH score; peripheral nerve injury; quality of life; impairment

Introduction

Every year, 4% of the adult world population attempt suicide [1] which is defined as 'a potentially self-injurious behavior associated with at least some intent to die' [2].

Second, only to drug overdoses, injuring the blood vessels at the wrist is a common method to attempt suicide in high-income countries to die from exsanguination [3]. Recently was shown that deep wrist injuries (DWIs) related to suicide attempts differ from accidental ones concerning the injury pattern: Suicidal DWIs were more likely to involve the median nerve, radial artery, palmaris longus (PL), and flexor carpi radialis tendon, especially on the non-dominant hand, but were less likely to involve the ulnar artery and nerve on the dominant hand [4,5].

However, little is known about the outcome of suicidal DWIs compared to accidental DWIs. We hypothesized that the outcome would depend on the intentionality of the injury due to (a) differences in injury pattern, and (b) a greater delay of surgical treatment, as suicidal patients are likely to not actively seek help [6,7].

Also, as most suicidal DWIs occur in the context of a mental illness, such as a major depressive episode [5], psychiatric symptoms such as reduced energy and hopelessness might interfere with the patient's compliance with post-surgical treatment, e.g. physical therapy [8]. These uncertainties further add to the complexity of predicting the outcome of DWI patients, which is necessary for selecting the most appropriate course of treatment for each patient. To provide hand surgeons with an empirical base for these decisions, the present study aimed at comparing the long-term outcomes of suicidal vs. accidental DWIs at multiple levels of functioning (sensorimotor skills, activities of daily life) with multiple methods (clinical examination, questionnaires, actuarial data) and from multiple perspectives (patient, physician).

Methods

Sample

The study population consisted of all patients admitted to our Clinic of Plastic Surgery, for acute treatment of a deep wrist injury (DWI) from 2008 to 2016. A DWI was defined as a traumatic injury of at least one deeper anatomical structure (except for the palmaris longus tendon). Exclusion criteria were an amputation, being a minor (<18 years), ten unsuccessful attempts to contact the participant for the follow-up examination, and a lack of informed consent, which applied to 132 cases. Fifty-one of 183 patients could be followed up (response rate = 27.9%). Comparisons of the followed-up cases and the non-followed-up cases are presented in the Supplementary Tables 1 and 2.

After the start of data acquisition, one of the authors (ALW) suffered an accidental DWI. As she did not process surgical data

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/2000656X.2021.1993868.

before anonymization, we regarded the risk of bias as low and decided to include ALW's case in the study.

Study design & protocol

Before data acquisition, the study protocol was approved by the Ethics Committee of the University of Lübeck (reference number 13-054) and registered at clinicaltrials.gov with the ID NCT03038581. Details of the study design have been published elsewhere [5]. In short, patients gave fully informed written consent to have their administrative and clinical data used for research purposes during hospitalization. Later, patients with the relevant ICD-10 codes were informed about the purpose and procedure of this study by mail and phone and were asked to participate in the follow-up examination.

Assessment of outcomes

At the follow-up examination (performed by NM), patients gave written informed consent to participate in this study. Ranges of motion of all joints of the upper extremity were assessed with a goniometer, using the neutral-zero method [9]. Gripping and pinching strength were assessed with an analogue hydraulic dynamometer and a pinch gauge [10]. Two-point discrimination was assessed using compasses for all 20 finger nerve branches up to a maximum of 20 mm (signifying anesthesia) [11,12] and then categorized using the British Medical Research Council (MRC) classification (Medical, 1954) as proposed by [13].

We used the Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH) [14] in its German adaption [15] to quantify symptoms and impairment in daily life concerning the upper extremity and the preceding week. This self-report measure comprises 30 items and its mean is linearly transformed to yield a score ranging from 0 to 100. Additional DASH scales assess impairment at work and leisure activities. In addition, we used the Boston Carpal Tunnel Syndrome Questionnaire (BTCQ) with the subscales Symptom Severity Scale (SSS, 11 items) and Functional Status Scale (FSS, 8 items) [16,17] in its German version [18]. Although originally developed specifically for carpal tunnel syndrome, the BCTQ is now widely used for a variety of upper extremity pathologies [19]. Both the DASH and the BCTQ use five-point Likert items with lower values indicating a better outcome.

To assess the quality of life (QOL), we used the short form of the World Health Organization's QOL scale (WHOQOL-BREF; Permission ID: 336965 [20]), in its German version [21]. Two of the five-point Likert scale items assess QOL globally, and the other 24 items are averaged to four domain scores (physical health, psychological wellbeing, social relationships, and environment) and linearly transformed to a 0–100 scale with higher values indicating a better outcome.

We complemented these self-report measures with the modified Mayo Wrist Score (MMWS) [22], a physician-rated scoring system for pain, active flexion/extension, grip strength, and the ability to return to regular employment or activities. The resulting sum score ranges from 0 to 100, with higher values indicating a better outcome.

Operationalization

Injuries were coded dichotomously, e.g. partial injuries were coded like total injuries. Cases with DWI on one hand and superficial injury on the other were classified as one-sided injuries. Injuries of individual structures were aggregated into radial triad (median nerve, PL, flexor carpi radialis tendon (FCR)) and ulnar triad (ulnar nerve, ulnar artery, flexor carpi ulnaris (FCU)) according to [23,24]. Triads were deemed injured only when all individual structures in the triad were injured. The injuring object was categorized into the following categories: cutting tools (e.g. knives, scalpels), shards (of glass, porcelain, etc.), tearing machinery or tools (e.g. circular saw, bread slicer), and thermal injuries. Regarding employment status at follow-up, the following situations were coded as 'return to gainful occupation with restrictions': working in the same job with fewer tasks or responsibilities compared to before the accident, working in the same job for fewer hours per week, having changed jobs, or a combination of the above.

Statistical analysis

Post-hoc power analysis was carried out using G*Power [25]. Post-hoc power for R^2 increase in multiple regression was .46 (computed for DASH score with effect size $f^2 = 0.07$, non-centrality parameter $\lambda = 3.66$).

Missing questionnaire data were replaced with the group median if less than 10 % items per (sub-) scale and case were missing. In the DASH subscale 'impairment at leisure', the missing data rate was 45.1 % and the subscale therefore excluded from further analysis. The missing data rate was 5.6 % in the DASH subscale 'impairment at work' (when considering only participants who (a) had been (self-)employed before their injury and (b) were of working age at the time of follow-up). In all other scales, less than 0.2% of values were missing. We used Cronbach's alpha to assess the internal consistency of scales [26].

The MMWS, DASH, BCTQ and WHO-QOL-BREF subscales were skewed (all Kolmogorov-Smirnoff p's $\leq$ .048). Therefore, the Mann-Whitney U test was used to analyze differences between groups. Internal consistency of the MMWS, the DASH and the BCTQ subscales and the WHOQOL-BREF domains ranged from acceptable (Cronbach's $\alpha = .61$ for WHOQOL-BREF domain 'social relationships') to excellent (Cronbach's $\alpha = .98$ for DASH subscale 'symptoms and impairment'). Correlations between scales were heterogeneous in magnitude, ranging from low (|.13| between the DASH subscale 'impairment at work' and the WHOQOL-BREF domain social relationships) to high (|.79| between the WHOQOL-BREF domains physical health and psychological wellbeing).

To minimize the influence of confounding factors, such as age, gender and systemic disease, on grip strength, we calculated the grip strength ratio as proposed by [27], which necessitated the exclusion of cases with bilateral injuries. As strength ratios contained influential outliers (z >|3.29|), they were winsorized [28], that is, outliers were set to z =|3.29|.

For ranges of motion, differences between uninjured and injured sides were computed to reduce bias from systemic illnesses, and then re-coded dichotomously with substantial side differences (>10°) coded as 1. Substantial differences in ranges of motion between uninjured and injured sides occurred in 14.0–0.0 % of cases, depending on joint (Supplementary Table 3). Due to these low frequencies, we did not compute further analyses with ranges of motion.

To conservatively estimate the importance of intentionality for the outcome, we computed bloc-wise regression. In preparation, linear, quadratic, cubic, logarithmic, and growth curves were fitted to the data, with linear curves fitting best. Then, in the first bloc, patient-related (age at injury) and injury-related predictors of outcome (injury of the dominant hand, bilateral injury, arterial injury, ulnar or median nerve injury, number of injured tendons) and

length of follow-up were entered into the regression. Only with the variance explained by those known predictors partial out, length of follow-up entered (in the 2nd bloc).

We conducted the mediation analyses with the PROCESS Macro [4], testing the significance of the indirect effects with bootstrapped confidence intervals (indirect effects at the 2.5th and 97.5th percentiles of 5.000 bootstrap samples).

If not otherwise stated, tests were two-tailed and results were deemed significant when the type I error probability fell below .05. Confidence intervals are bias-corrected and accelerated (BCa) with a probability level of 95%.

Results

Comparisons of demographic and clinical characteristics between suicide attempt survivors and accident survivors are shown in Tables 1 and 2. The extent of the injuries was similar across groups, except for median nerve damage being more frequent among suicide attempt survivors. For more details on the injury patterns, please refer to [5].

Clinical examination

Regarding the grip and pinch strength ratio, there were no significant differences between suicide attempt survivors and accident survivors (Supplementary Table 4) and intentionality did not improve variance explanation in bloc-wise regression (Supplementary Table 5).

Regarding two-point discrimination, suicide attempt survivors scored lower than accident survivors, which reached significance in most localizations (Supplementary Table 6). However, this effect did not hold up after control for other predictors, such as nerve injury, in bloc-wise regression (Supplementary Table 7).

Table 1. Demographic characteristics of the follow-up sample.

		Cause of injury			
		All	Accident	Suicide attempt	Test statistic
n		51	37	14	
Age at injury [years]	M [95% CI]	42.2 [37.6; 46.8]	38.3 [33.6; 43.3]	52.5 [44.3; 60.2]	$Z = 2.55$, $p = .011$
Gender					
Male	%	72.5	75.7	64.3	n.s.
Female		27.5	24.3	35.7	
Handedness					
Right-handed		88.0	88.9	85.7	n.s.
Left-handed		12.0	11.1	14.3	
Ethnicity					
Caucasian		92.2	89.2	100.0	n.s.
Asian		7.9	10.8	0.0	
Employment status at injury					
(Self-) employed		68.1	80.0	33.3	χ^2 (3) = 13.6, $p = .004^{\circ}$
Unemployment benefits or invalidity pension		14.9	5.7	41.7	
Old-age pension		14.9	14.3	16.7	
Other		2.1	0.0	8.3	

Notes. Test statistic refers to the comparison of suicide attempt survivors with accident survivors. Z = standardized test statistic of the Mann-Whitney-*U*-Test, n.s. = not significant. $^{\circ}$ = 4 cells had an expected frequency lower than 5.

Table 2. Clinical characteristics of the follow-up sample.

		Cause of injury			
		All	Accident	Suicide attempt	Test statistic
n		51	37	14	
Interval between injury and follow-up [years]	M [95% CI]	4.2 [3.5; 4.9]	4.4 [3.5; 5.2]	3.8 [2.2; 5.4]	n.s.
Injuring object					
Cutting tool	%	44.7	25.7	100.0	χ^2 (3) = 20.0, $p < .001$
Shard		38.3	51.4	0.0	
Tearing machinery or tool		10.6	14.3	0.0	
Other		6.4	8.6	0.0	
Injured side					
Only dominant hand		28.0	33.3	14.3	χ^2 (2) = 11.7, $p = .003$
Only non-dominant hand		64.0	66.7	57.1	
Both hands		8.0	0.0	28.6	
Extent of injury					
Number of injured structures	M [95% CI]	4.7 [3.6; 5.9]	4.4 [3.2; 5.8]	5.6 [2.8; 8.8]	n.s.
Radial triad	%	13.7	5.4	35.7	χ^2 (1) = 7.9, $p = .005$
Ulnar triad		7.8	8.1	7.1	n.s.
Radial artery		25.5	21.6	35.7	n.s.
Ulnar artery		29.4	32.4	21.4	n.s.
Any artery		51.0	51.4	50.0	n.s.
Median nerve		33.3	24.3	57.1	χ^2 (1) = 4.9, exact $p = .045$
Ulnar nerve		19.6	24.3	7.1	n.s.
Superficial branch of the radial nerve		17.6	21.6	7.1	n.s.
Any nerve		64.7	64.9	64.3	n.s.
Any superficial flexor tendon		41.2	45.9	28.6	n.s.
Any profound flexor tendon		29.4	32.4	21.4	n.s.
Any tendon		78.4	78.4	78.6	n.s.

Notes. Test statistic refers to the comparison of suicide attempt survivors with accident survivors. n.s. = not significant.

Regarding the Modified Mayo Wrist Score (MMWS), suicide attempt survivors scored significantly lower ($p < .001$, Figure 1, Supplementary Table 8). In a bloc-wise regression, intentionality improved variance explanation of the MMWS ($\Delta R^2 = .34$, $p < .001$, Table 3).

Patient reported outcomes

Regarding the BCTQ, suicide attempt survivors scored significantly higher on both subscales ($p's < .001$, Figure 1, Supplementary Table 8). In bloc-wise regression, intentionality improved variance explanation of both subscales ($\Delta R^2 \geq .41$, $p < .001$, Table 3). To further dissect the effect of intentionality on the outcome of DWIs, we computed ordinal logistic regression with the above-mentioned predictors on each BCTQ item (Table 4).

Regarding the DASH Score, suicide attempt survivors scored significantly higher on all three subscales (all $p's \leq .027$, Figure 1, Supplementary Table 8). In bloc-wise regression, intentionality improved variance explanation of the DASH subscale 'symptoms and impairment' ($\Delta R^2 = .37$, $p = .028$, Table 3). To further dissect the effect of intentionality on the outcome of DWIs, we computed ordinal logistic regression with the above-mentioned predictors on each DASH item. The highest regression coefficients of intentionality were highest on items from the functional-physical DASH domain (e.g. managing transportation needs, turning a key) and from the functional-psychosocial domain (e.g. recreational activities with little effort, sexual activities).

In bloc-wise regression, intentionality improved variance explanation of the DASH subscale 'impairment at work' ($\Delta R^2 = .13$, $p = .023$). Of patients who had been (self-) employed before their injury and were of working age at the time of follow-up ($n = 36$), 77.8% had returned to their previous occupation without restrictions and another 16.7% had returned to gainful occupation with some restrictions. All of the patients who did not return to gainful occupation belonged to the suicide attempt survivors group ($\chi^2(1) = 10.6$, exact $p = .024$).

Regarding the WHOQOL-BREF, suicide attempt survivors scored significantly lower on all domains (all $p's < .001$, Figure 1, Supplementary Table 8). Regarding the domain of physical health, this relationship was partially mediated by the DASH sum score (all $p's < .001$, Figure 2). This relationship was not found in analogous mediation analyses for the other WHOQOL-BREF subscales (Supplementary Figure 1).

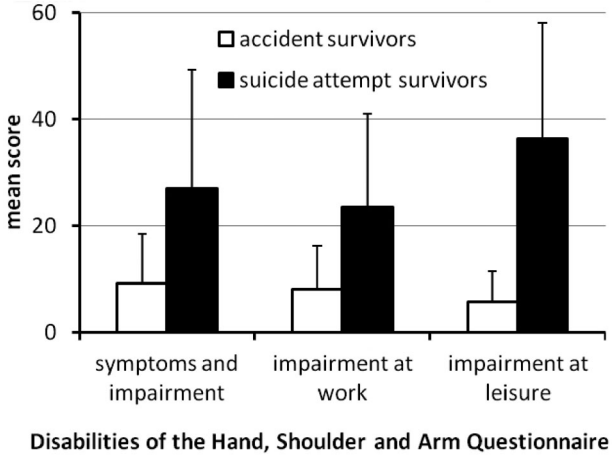

Figure 1. Global outcome measures as functions of the intentionality of the injury. Shown here are mean scores of the three subscales of the DASH, the two subscales of the BCTQ, the MMWS and the four subscales of the WHOQOL-BREF. The intercept of the axes is located at the optimal outcome value, that is, at $y = 0$ for the DASH and BCTQ, and $y = 100$ for the MMWS and the WHOQOL-BREF. All comparisons between accident survivors (white) and suicide attempt survivors (black) were significant at the .05 level (not shown in graphs, for numerical values and test statistics, see Supplementary Table 5). Error bars indicate standard deviation.

Discussion

In our study, outcomes after suicidal vs. accidental DWIs did not differ regarding clinical outcome measures, such as two-point discrimination, grip and pinch strength. However, patients after suicidal DWIs showed significantly poorer outcomes regarding more abstract outcome measures, such as physician-assessed and self-report questionnaires. This effect was more pronounced in psychosocial functioning and fine motor skills rather than with symptoms.

When controlling for the presence or absence of nerve injury, the intentionality of the injury was not a significant predictor of two-point discrimination (Supplementary Table 7). Regarding sensory outcomes, suicide attempt survivors scored 0.6 points higher concerning neuropathic symptoms, as measured using the BCTQ subscale SSS (Figure 1). Concerning motor outcomes, we did not find significant differences between the groups for a range of motion and pinch strength ratio (Supplementary Table 4). On the other hand, significant differences were found in the FSS subscale of the BCTQ.

In the global outcome, the group of patients with deep wrist injuries showed significantly poorer MMWS results after suicide attempts. This finding was confirmed by the evaluation of the DASH score about the subscales 'symptoms and impairment', 'impairment at work' and 'impairment at leisure' (Figure 1).

The authors' opinion is that pain is an important influencing factor. When pain is moderate to severe, impairs function and/or

Table 3. Regression of the intentionality of the injury on global outcome measures.

Outcome measure	Subscale		ANOVA	Corr. R^2	ΔR^2	ΔF	p_F	ß
Mayo-Wrist-score	–	Model 1	$F(7, 41) = 1.84$, $p = .106$	.11	.24	1.84	.106	n.a.
		Model 2	$F(8, 40) = 4.04$, $p = .001$	.34	.21	15.05	<.001	−.55*
DASH	Symptoms and impairment	Model 1	$F(7, 41) = 4.01$, $p = .002$	.31	.41	4.01	.002	n.a.
		Model 2	$F(8, 40) = 4.53$, $p = .001$	.37	.07	5.23	.028	.32*
	Impairment at work	Model 1	$F(7, 32) = 1.01$, $p = .446$	.00	.18	1.01	.446	n.a.
		Model 2	$F(8, 31) = 1.73$, $p = .130$	.13	.13	5.77	.023	.44*
SSS	Symptom severity	Model 1	$F(7, 41) = 2.63$, $p = .024$	.19	.31	2.63	.024	n.a.
		Model 2	$F(8, 40) = 5.08$, $p < .001$	.41	.19	15.62	<.001	.53*
	Functional status	Model 1	$F(7, 41) = 4.29$, $p = .001$	.32	.42	4.29	.001	n.a.
		Model 2	$F(8, 40) = 6.44$, $p < .001$	.48	.14	12.85	.001	.45*

Notes. DASH = Disabilities of the Arm, Shoulder and Hand Questionnaire. SSS = Symptom Severity Scale. Model 1 = Regression model with the predictors' age at injury, injury of the dominant hand, bilateral injury, arterial injury, nerval injury, number of tendons injured, and length of follow-up. Model 2 = Model 1 with the intentionality of the injury as an additional predictor (positive values indicating higher scores on the MMWS, DASH, or SSS in the subsample with suicidal DWIs). ß = standardized regression coefficient of the intentionality of the injury. * = significant at .05 error level. n.a. = not applicable.

Table 4. Ordinal logistic regression of the intentionality of the injury on SSS items.

Subscale	Item	Item content	χ^2 (8)	p_χ	Pseudo R^2	Estimate	$Wald_{INTENTION}$	$p_{INTENTION}$
SS	11	Difficulty with the grasping and use of small objects	37.09	<.001	.53/.62	4.57*	14.86	<.001
FS	Buttoning	Buttoning of clothes	41.73	<.001	.57/.65	4.11*	14.80	<.001
SS	1	Severity of pain at night	26.71	.001	.42/.58	4.00*	9.49	.002
FS	Telephone	Gripping of a telephone handle	24.42	.002	.39 7 .70	3.55	2.15	.142
FS	Dressing	Bathing and dressing	23.76	.003	.38/.49	3.45*	9.79	.002
SS	4	Frequency of pain during daytime	33.61	<.001	.50/.55	3.31*	12.42	<.001
FS	Household	Household chores	32.16	<.001	.48/.58	3.17*	8.75	.003
SS	3	Intensity pain during daytime	25.61	.001	.41/.48	3.07*	10.00	.002
FS	Jars	Opening jars	35.94	<.001	.52/.58	3.03*	9.97	.002
FS	Grocery	Carrying of grocery bags	28.38	<.001	.44/.50	2.66*	8.80	.003
SS	8	Intensity of tingling	19.83	.011	.33/.40	2.64*	7.96	.005
SS	5	Duration of pain during daytime	25.23	.001	.40/.46	2.34*	7.61	.006
SS	6	Intensity of numbness	23.91	.002	.39/.42	2.12*	6.59	.010
FS	Book	Holding a book while reading	18.67	.017	.32/.50	1.95	2.63	.105
SS	9	Severity of numbness at night	10.42	.237	.19/.28	1.52	2.16	.142
SS	7	Intensity of weakness	9.91	.272	.18/.22	0.84	0.89	.346
FS	Writing	Writing	25.14	.001	.40/.52	0.54	0.20	.655
SS	10	Frequency of awakening at night due to numbness or tingling	11.74	.163	.21/.44	0.34	0.03	.863
SS	2	Frequency of awakening at night due to pain	9.76	.282	n.a.			

Notes. Items are sorted by regression coefficient in descending order. SSS = Symtoms Severity Score. The ordinal logistic regression models were computed with the predictors' age at injury, injury of the dominant hand, bilateral injury, arterial injury, nerval injury, number of tendons injured, length of follow-up and intentionality of the injury. SS = Symptoms Severity (white background), FS = Functional Status (light grey background). Estimate = estimate of the regression coefficient of the intentionality of the injury (positive values signifying that participants after suicide attempts reported higher scores). Pseudo R^2 = Cox & Snell/Nagelkerkes. * = significant at .05 error level. n.a. = not applicable (could not be computed due to low variance in the SSS item).

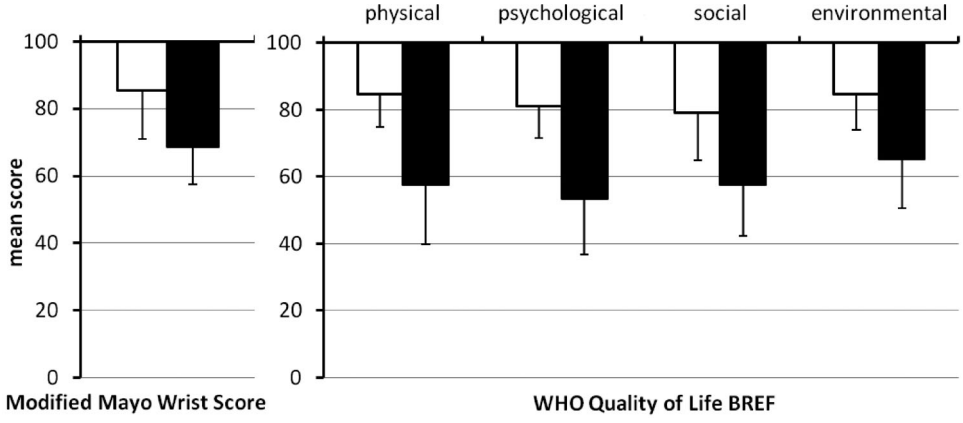

Figure 2. Relationship between intentionality and health-related quality of life as mediated by hand function. Suicide attempt survivors scored significantly lower on the physical health domain of WHOQOL-BREF (Figure 1, Supplementary Table 8). To assess whether this effect of intentionality was dependent on hand function (measured with the DASH), we conducted mediation analyses. The standardized regression coefficients for the direct effects of the intentionality on the DASH and of the DASH on physical health were significant (test statistics shown as labels on the arrows). This resulted in a significant indirect effect of the intentionality on the physical health domain (test statistics shown in parentheses). As the direct effect of the intentionality on the physical health remained significant after controlling for the DASH, the association of intentionality of the injury on the physical health subscale was partially mediated by the DASH.

is refractory to treatment, it is associated with more depressive symptoms and poorer depression outcomes (e.g. lower quality of life, decreased work function and increased health care utilization) [29]. Especially in patients with a higher risk/prevalence of depression, this may worsen their mental problems.

Consequently, besides the already mentioned longer interval to medical treatment, poor outcomes may also be explained by the suicide attempt itself which seems to be an important factor. Suicidal behavior is closely associated with psychiatric conditions, especially depression [8]. In the acute phase, for example, the symptoms of depression (lack of drive, loss of interest, depressed mood) [30] may impede early mobilization. Also, pain and depression share biological pathways and neurotransmitters [31,32], and psychological distress mediates the relationship between pain and disability in upper limb injuries [33]. This may account for the differences in subjective disability, pain and quality of life between accident and suicide attempt survivors and should be considered when making treatment decisions because of its implications for all patients with DWI.

Patients with mental illness may less frequently be able to recover and develop and implement compensatory maneuvers on their own due to potentially lower levels of frustration tolerance and motivation [34,35].

On the other hand, trick movements on the elbow [36], even after DWIs, could compensate for motor deficits and thus minimize the potentially negative influence of motor limitations [5], especially during the period of motor recovery.

Furthermore, it is known that employed adults are healthier than unemployed adults [37] and less likely to suffer from psychological problems [38,39]. In our study population, patients after a suicide attempt were more often unemployed and this status may be a relevant factor in posttraumatic recovery [37].

Especially the association of depression with missed appointments supports this hypothesis [40]. In addition, the presence of

some of the depression symptoms [41] e.g. fatigue or loss of energy, feelings of worthlessness or inappropriate guilt, diminished ability to think or concentrate, indecisiveness, and recurrent thoughts of death or suicide) possibly strengthen reduced compliance. We already know that up to 70% of patients who leave the hospital after a suicide attempt do not attend their first follow-up appointment [42]. Optimization of follow-up care, for example by implementing new concepts of care and staying in touch through home visits, phone calls or letters, is a promising approach [42].

On the other hand, accident survivors were younger and more often working. The negative influence of aging on nerve regeneration is already known [43]. We think that, besides age, the socioeconomic circumstances of patients also influence their motivation and compliance after a wrist injury. We assume that patients who were at a younger age and employed before the accident are highly motivated to get back to their job and their previous lifestyles.

About vascular injury, reduced perfusion of the anatomical structures distal to the wound is to be assumed in the interval between injury and surgical treatment. The fundamental importance of vascularization during nerve regeneration is well-established [44].

Blood vessels are commonly found to precede Schwann cell migration as well as axonal extension, suggesting an important link between neurite growth and vascular perfusion and growth [45,46].

In the opinion of the authors, the partial and prolonged hypoxia associated with the delayed initiation of medical treatment negatively affects the growth and regeneration of the nerve [47], despite good surgical coaptation of the corresponding nerve. This could lead to a poorer outcome for peripheral nerve regeneration and increase the likelihood of neuropathic pain and functional limitations [48] and is one of the conceivable reasons for the above-mentioned results.

Consequently, these patients require a balanced, multimodal and multidisciplinary treatment concept [49] that comprises not only appropriate surgical treatment but also the assessment and treatment of mental disorders and pain. In our department, we involve a psychosomatic liaison service if required and have made good experiences with this strategy.

As shown by previous research, the concept of dialectical behavior therapy, for example, is effective in the treatment of suicidal behavior and can be useful not only in an outpatient setting but also as a first-line treatment of suicidal behavior and in psychiatric emergency care [50]. Furthermore, patients presenting with emotional regulation deficits as comorbidity are likely to benefit from cognitive-behavioral therapy (CBT) [51].

This also means that considerable effort is needed to improve the assessment and treatment of suicidality in the behavioral health sector, including the training of nurses and doctors involved in the care of these patients [50].

As Westermair et al. [52] pointed out, suicide attempt survivors should be monitored for symptoms of posttraumatic stress disorder (PTSD), especially because PTSD is associated with an increased suicide risk even in the absence of a depression [53]. One possible hypothesis could be that both mental illnesses have a negative impact on patient outcomes. For the management of PTSD, well-established treatment concepts are already available [54].

In case of accidental wrist injuries with a low occurrence of PTSD [52], in our opinion, psychiatric consultation is not regularly needed and should be reserved for patients with clinical suspicion of mental illness. In conclusion, the treatment and optimization of mental health represent an important cornerstone of the multimodal treatment concept and should be continued consistently beyond the inpatient stay, also in a community care setting.

About the motor outcome, a good to very good overall result was achieved in both groups. Significant differences in motor function were not found.

Future research should identify determinants of outcome in intentional DWIs, e.g. severity of depressive symptoms, several physiotherapy sessions, compliance with doctor's orders, development of trick movements, and level of prejudice against psychiatric illnesses among medical staff. In addition, further research is needed to optimize the treatment of mental disorders across the full spectrum of conditions and its implementation not only in psychiatric care but also in early surgical management.

Conclusion

Patients with DWIs from suicide attempts vs. accidents do not differ in sensorimotor outcomes but patient-reported outcome measures. Consequently, these patients require a balanced, multimodal and multidisciplinary treatment concept that comprises not only appropriate surgical treatment but also the assessment and treatment of mental disorders and pain. Considerable effort is needed to improve the assessment and treatment of suicidality in the behavioral health sector, including training of nurses and doctors involved in the care of these patients. In addition, further research is needed to optimize the treatment of mental disorders.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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