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Long-term functional, subjective and psychological results after single digit replantation

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ABSTRACT

Objective: The aim of this study was to analyse the long-term functional, subjective, and psychological results after single-digit replantation.
Methods: Thirty cases of digital replantation (14 thumbs, 12 index fingers, 2 middle fingers, 1 ring finger, and 1 little finger) in 30 patients (7 females and 23 males) with a mean age of 44.2 years (20–65 years) were evaluated at the end of a mean follow-up time of 36 months (19–50 months). The active range of motion of joints, grip and pinch strength, cutaneous sensibility, upper-extremity functioning, and subjective satisfaction were determined using the Disability of Arm, Shoulder, and Hand (DASH) questionnaire and the Michigan Hand Outcomes questionnaire (MHQ). Psychological sequelae, including depression, anxiety, and posttraumatic stress disorder (PTSD), were assessed. A correlation analysis among variables was also performed.
Results: The mean score for the DASH questionnaire was 6.6 (range: 0–39.2). The symptom of cold intolerance occurred in 53% of the patients. Two patients were diagnosed with depression, and only one patient exhibited PTSD. The DASH score had a good statistical correlation with total grip strength, pinch grip strength, and static two-point discrimination (S-2PD) ($P < 0.05$). Several aspects of the MHQ were also statistically relevant to some or all of the three objective results. Furthermore, the grip strength showed significant correlation with DASH and most aspects of the MHQ in multivariate logistic regression analysis ($P < 0.05$).
Conclusion: Total grip strength is the most important factor positively related to subjective outcomes. The incidence rates of psychological symptoms after digit replantation are very low at long-term follow-up.
Level of evidence: Level IV, therapeutic study.

Introduction

The focus of replantation surgery is survival during the early period. The functional recovery of the hand after the replantation of one or more digits has seen increasing attention with the increase in survival rate.[1] However, several discrepancies can be observed between subjective satisfaction and objective results, including the range of motion of digits, sense perception, and power of the hand. To date, a rigorous and comprehensive evaluation system of the functional outcomes of replantation has not been applied and accepted widely[2] because many confounding variables affect the comparison of functional outcomes, such as the mechanism of injury (guillotine, crush, and avulsion), types of amputation (total or partial), different injured digits or multiple-digit amputation (thumb or index, middle, ring, or little finger), different planes of amputation, and different evaluation methods.

Sebastin et al[2] summarised the challenges in assessing the outcomes of digital replantation and advised that the comprehensive evaluation of the hand function should include objective assessments, health-related quality of life, and psychological status. Truly successful replantation is achieved when the mind

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and body of the patient return to a functional state. Only a few studies comprehensively investigated long-term function recovery after digit replantation. Walaszek et al[3] assessed the long-term objective and subjective results of successfully replanted or revascularised digits. Unglaubt et al,[4] Haas et al,[5] and Ciclamini et al[6] reported the functional and subjective results of thumb replantations. These studies did not thoroughly analyse the relationship between objective and subjective outcomes and did not focus on the role of psychological factors. Previous studies assessed the short-term (1 year) post-operative psychological status of patients with hand injuries; they suggested that psychosocial factors correlate with pain and disability and that the psychological sequelae of hand trauma can persist long after the physical injury.[7–10] Patients want additional information about their psychological status and aesthetic appearance after replantation.[11]

Therefore, understanding the characteristics of long-term sequelae on the psychological status of patients after digit replantation is crucial. The aim of this study is to comprehensively present the long-term functional, subjective, and psychological outcomes after single-digit replantation and analyse the relationship among these results to understand the interrelationship among objective function, subjective satisfaction, and psychological symptoms.

Material and methods

Study design

We conducted a retrospective review of all patients who underwent successful replantation of a single digit from December 2011 to September 2014 in our department. To reduce the effect of other variables, the inclusion criteria were set as follows: (1) complete or incomplete amputations of a single digit, (2) digits surviving, (3) aged 18 years and above, (4) work-related trauma, and (5) the mechanism of injury is crush or avulsion. Patients were excluded when they had any of the following: (1) amputation involving multiple digits, (2) combination with other digit injuries, such as comminuted fracture, soft tissue defect, extensor or flexor tendon injuries, and (3) replantation of proximal to the metacarpophalangeal joint. The study was approved by the institutional review board.

Patients

In accordance with these criteria, 42 patients who underwent single-digit amputation were surgically treated with replantation in this study. Twelve patients could not be contacted because of a change in address or phone number, or a refusal to accept follow-up. The follow-up rate was 71.4%. Finally, a total of 30 digits (14 thumbs, 12 index fingers, 2 middle fingers, 1 ring finger, and 1 little finger) in 30 patients (7 females and 23 males) with complete (13 cases) or incomplete (type III 3 cases, type V 14 cases) amputation were considered. The mean patient age was 44.2 years (20–65 years). The mean follow-up time was 36 months (19–50 months) after the operation. The mean interval from injury to replantation was 3.5 h (2.5–7 h). The right hand was the dominant hand in all patients. Ten patients injured their right hand, whereas 20 patients injured their left hand.

Because of traditionally held concepts of the people in the East, the majority of patients demand replantation although the amputated plane of a single digit is proximal to the flexor digitorum superficialis tendon. In the current study, five fingers were amputated proximal to the flexor digitorum superficialis tendon, seven fingers were amputated between the proximal interphalangeal and distal interphalangeal joints (DIP), and four fingers were amputated distal to the DIP. The number of cases for different amputated planes of thumbs was 4 (proximal phalanx), 7 (interphalangeal joint), and 3 (distal phalanx).

The classic method of surgical replantation was performed. The selected bone fixation was axial or cross K-wire. In several cases, vein grafts were required to detect artery defect. No patient underwent secondary corrective operations, such as tenolysis and secondary nerve repair.

Assessment of the objective outcome

The sensitivity of digit pulps was measured with Semmes–Weinstein (SW) monofilaments (Aesthesio Precision Sensory Evaluators, DanMic Global, Campbell, CA, USA). Static two-point discrimination (S-2PD) was measured in the centre of a pulp using the Disk-Criminator (North Coast Medical, Inc., Gilroy, CA, USA). The active ranges of motion (AROM) of the three joints of the injured fingers or two joints of injured thumbs were measured. Percentage ROM was defined as the ratio of the sum of ROM of injured digits over that of the contralateral hand. Total grip strength and pinch strength (lateral pinch) were measured with a Jamar manometer.

Assessment of the subjective outcome

The patients were asked to report on their satisfaction based on the appearance and function of the injured hand (5-point response scale) according to the Michigan Hand Outcomes Questionnaire (MHQ).[12,13] The Disability of Arm, Shoulder, and Hand (DASH) questionnaire was also used as a subjective outcome measure. Cold intolerance of the injured digits was measured by the self-administered Cold Intolerance Severity Score questionnaire. The maximum score is 100. The scores were grouped into four grades (0–25 mild, 26–50 moderate, 51–75 severe, and 76–100 extremely severe).[14]

Assessment of the psychological outcome

The psychological outcomes, including symptoms of depression, anxiety, and posttraumatic stress disorder (PTSD), were assessed.

Anxiety and depression in the preceding week were assessed with the revised Self-Rating Anxiety Scale[15] (SAS; Zung, 1971) and the Beck Depression Inventory[16] (BDI), respectively. SAS consists of 15 items that assess increasing anxiety and five items that assess decreasing anxiety; a score greater than 50 is considered indicative of clinical anxiety. BDI includes 21 items designed to assess mood symptoms; scores greater than 5 are considered indicative of depression.

The symptoms of PTSD were measured with the Screen for Posttraumatic Stress Symptoms (SPTSS). SPTSS is a 17-item instrument.[17] The content is brief and intelligible. It does not link symptoms to a single event and has been proved to have internal consistency and confirmed validity. A score of four or higher was adopted as the optimal cut-off score to classify participants as having PTSD.

Statistical analysis

The Pearson correlation coefficient was applied to compare the relationships among the objective data. The Spearman correlation coefficient was adopted to analyse the relations among subjective, objective, and psychological outcomes. The variables that independently influenced the subjective outcomes ($P < 0.05$ in univariate analysis) were entered into a multivariate logistic regression

analysis to evaluate their effect on the subjective outcomes. We set the level of significance to $P < 0.05$ in all the tests.

Results

The detailed characteristics of the patients and the objective and subjective results are presented in Tables 1–3.

Objective results

The average AROM for 13 replanted thumbs was 75° (30°–150°), which accounted for 53% of the AROM of the contralateral thumbs. The average AROM for 13 replanted fingers was 145° (70°–230°), which accounted for 58.2% of the AROM of the contralateral fingers.

The average total grip strength of the injured hands was 39.6 kg (12–57 kg), which accounted for 90.5% of the contralateral hands. The average pinch grip strength of the injured hands was 8.1 kg (2–11 kg), which accounted for 81.5% of the contralateral hands.

The average S-2PD of the injured digits was 10.4 mm (2–20 mm). An S-2PD of less than 6 mm was recorded in five replanted digits. S-2PD was 6–10 mm in 14 digits, 11–15 mm in five digits, and greater than 15 mm in six digits.

The average size of the SW monofilament used for sensitivity measurement in the replanted digits was 3.7 (2.36–6.65). A normal sensation of touch, 0.07 g, was detected in eight digits, 0.4 g in ten digits, 2 g in nine digits, 4 g in one digit, and 300 g in two digits (loss of sensation).

Subjective results

The mean score for the DASH questionnaire was 6.6 (range: 0–39.2). The mean score of hand function, activities of daily living, pain, employment status, appearance, and satisfaction with degree of hand function for the MHQ was 82 (range: 35–100), 89.5 (range: 28–100), 10.8 (range: 0–75), 10.8 (range: 0–65), 79.1 (range: 38–100), and 80.7 (range: 46–100), respectively.

Age and cold intolerance had no statistical effect on any objective and subjective measured values. The DASH score had a good statistical correlation with total grip strength, pinch grip strength, and S-2PD. Several aspects of the MHQ were also statistically relevant to some or all the three objective results (Table 4). Furthermore, the grip strength showed significant correlation with DASH and the most important aspect of MHQ in multivariate logistic regression analysis was grip strength (Table 5).

The symptom of cold intolerance was observed in 16 patients, which accounted for 53% of all patients. One patient was ranked particularly serious, nine patients were ranked serious, and six patients were ranked moderate. A total of 28 patients returned to work, 17 of whom returned to their previous occupation.

Psychological results

According to the corresponding questionnaires, among all patients, the mean score of anxiety, depression, and PTSD was 20.8, 1.4, and 0.5, respectively. None of the patients met or exceeded the cut-off for clinically noteworthy symptoms of anxiety. Only two patients (cases 6 and 9) were found to have depression, and the scores were 7 and 12, respectively (incidence rate: 6.7%). Only one patient (case 9) met the criteria for PTSD according to SPTSS (incidence rate: 3.3%). One patient (case 9) met the criteria for both PTSD and depression.

Discussion

Many factors such as the predicted morbidity, functional outcome of replanted digits, appearance, psychological effects, and

Table 1
Patient summary.

Case	Sex	Age (y)	Follow-up time (mo)	Injured digit	Amputated plane	Type of amputation
1	Male	48	40	Right index finger	PIP	IA (Type V)
2	Male	46	34.5	Right index finger	DIP	IA (Type V)
3	Male	65	26	Left thumb	Proximal phalanx	IA (Type V)
4	Male	32	25	Left thumb	IP	CA
5	Male	46	39.5	Right thumb	IP	IA (Type V)
6	Male	60	36	Left index finger	Middle phalanx	IA (Type V)
7	Male	51	36	Left thumb	Nail base	IA (Type V)
8	Male	44	49	Left thumb	IP	CA
9	Female	44	49	Left index finger	DIP	IA (Type V)
10	Male	27	46	Right index finger	Middle phalanx	IA (Type V)
11	Male	65	48	Left index finger	Proximal phalanx	CA
12	Male	40	28	Left thumb	IP	CA
13	Female	53	47	Left index finger	PIP	CA
14	Male	30	48	Left index finger	DIP	IA (Type III)
15	Female	51	27	Right thumb	Nail base	IA (Type V)
16	Female	46	26	Left middle finger	PIP	IA (Type III)
17	Male	20	25	Left middle finger	Middle phalanx	CA
18	Male	46	48	Left thumb	Proximal phalanx	IA (Type V)
19	Female	48	25	Right index finger	Proximal phalanx	CA
20	Male	43	35	Right thumb	Nail base	CA
21	Female	54	19	Left thumb	IP	IA (Type V)
22	Male	43	19	Left thumb	Proximal phalanx	CA
23	Male	35	20	Left index finger	Middle phalanx	CA
24	Male	53	24	Left thumb	Proximal phalanx	IA (Type V)
25	Male	28	25	Right thumb	IP	IA (Type III)
26	Male	45	48	Right little finger	Middle phalanx	IA (Type V)
27	Male	53	48	Right thumb	IP	CA
28	Female	38	42	Left index finger	Middle phalanx	CA
29	Male	29	50	Right index finger	Nail base	CA
30	Male	44	47	Right ring finger	Middle phalanx	IA (Type V)

Abbreviations: PIP, proximal interphalangeal; DIP, distal interphalangeal; IP, interphalangeal; CA; complete amputation; IA, incomplete amputation.

Table 2
Postoperative objective results of the injured hand.

Case	Total grip strength (kg)	Pinch grip strength (kg)	S-2PD (mm)	SW (g)	AROM of thumb (MP + IP) (°)	AROM of finger (MP + PIP + DIP) (°)
1	36	9	>20	4	–	80
2	43	7	4	0.4	–	185
3	38	7	5	0.07	65	–
4	52	9	10	300	95	–
5	53	8	9	2	65	–
6	43	9	8	0.4	–	135
7	45	10.5	2	0.4	150	–
8	57	9.5	13	0.4	90	–
9	22	2.5	12	0.4	–	80
10	50	11	6	0.07	–	145
11	28	8	7	2	–	80
12	39	15	10	2	65	–
13	38	7	4	0.07	–	70
14	52	8.5	6	0.07	–	230
15	32	7	7	2	120	–
16	18	6	12	2	–	165
17	36	9	7	0.07	–	175
18	42	7.5	8	2	50	–
19	22	3	>20	300	–	90
20	42	2	>20	2	35	–
21	12	2	>20	2	55	–
22	43	6	>20	0.4	30	–
23	40	10	10	0.4	–	145
24	38	9	>20	0.4	50	–
25	54	10	15	0.4	100	–
26	44	11	5	0.07	–	220
27	35	10	9	0.4	80	–
28	44	8	6	0.07	–	180
29	52	10	7	0.07	–	190
30	38	12	12	2	–	145

Abbreviations: S-2PD, static 2-point discrimination; SW, Semmes–Weinstein monofilament; MP, metacarpophalangeal; IP, interphalangeal; PIP, proximal interphalangeal; DIP, distal interphalangeal; AROM, active ranges of motion.

Table 3
Post-operative subjective results.

Case	DASH scores	MGH scores						Cold intolerance
		Hand function	ADL	Pain	Employment status	Appearance	SDHF	
1	4.2	85	98	25	0	94	75	64
2	9.2	85	89	45	0	50	83	62
3	0.8	85	100	0	35	81	92	68
4	1.7	100	100	0	0	75	83	0
5	1.7	80	98	0	0	100	88	64
6	3.3	90	95	0	0	100	96	0
7	0	100	95	0	0	63	100	38
8	1.7	90	92	0	0	81	88	46
9	39.2	35	28	75	65	40	46	87
10	0	100	100	0	0	100	100	0
11	6.7	70	78	25	0	75	67	0
12	15	50	70	25	35	75	50	68
13	3.3	100	100	0	0	100	100	50
14	0	100	85	0	0	81	88	0
15	0	100	91	0	0	100	92	0
16	10.8	55	87	50	40	38	58	68
17	2.5	85	100	0	0	69	83	0
18	2.5	70	100	0	0	100	79	0
19	18.3	60	100	0	20	69	63	68
20	16.7	60	88	55	30	81	46	0
21	17.5	65	60	0	50	50	50	40
22	5.8	75	75	0	0	94	92	54
23	5	85	100	0	0	63	88	0
24	6.7	85	70	0	25	56	79	0
25	0	100	96	0	0	94	100	0
26	0	100	100	0	0	100	100	0
27	6.7	85	100	0	0	100	88	0
28	3.3	100	100	0	0	94	88	40
29	4	85	100	25	0	81	75	62
30	10.8	75	91	0	25	69	83	50

Abbreviations: ADL, activities of daily living; SDHF, satisfaction degree of hand function.

Table 4
Correlation between objective and subjective results.

	Total grip strength	Pinch grip strength	S-2PD	SW	AROM
DSAH	−0.63*	−0.54*	0.43*	0.12	−0.30
MHQ-Hand function	0.63*	0.44*	−0.45*	−0.03	0.42*
MHQ-ADL	0.49*	0.38*	−0.35	−0.17	0.31
MHQ-Pain	−0.34	−0.39*	0.14	−0.14	−0.05
MHQ-Employment status	−0.66*	−0.46*	0.39*	−0.01	−0.32
MHQ-Appearance	0.53*	0.32	−0.21	−0.10	−0.08
MHQ-SDHF	0.61*	0.48*	−0.50*	−0.13	0.34
Cold intolerance	−0.27	−0.21	0.13	0.03	−0.14
Age	−0.20	−0.23	0.01	−0.13	−0.34

All data are expressed by correlation coefficient. *$P < 0.05$.
Abbreviations: S-2PD, static 2-point discrimination; SW, Semmes–Weinstein monofilament; AROM, active ranges of motion; ADL, activities of daily living; SDHF, satisfaction degree of hand function.

Table 5
The objective results correlated with DASH and MHQ in multivariate logistic regression analysis.

	Total grip strength	Pinch grip strength	S-2PD	SW
DSAH	0.016*	0.279	0.366	0.999
MHQ-Hand function	0.006*	0.918	0.350	0.661
MHQ-ADL	0.083	0.548	0.404	0.243
MHQ-Pain	0.439	0.136	0.807	0.481
MHQ-Employment status	0.005*	0.661	0.417	0.801
MHQ-Appearance	0.017*	0.780	0.366	0.945
MHQ-SDHF	0.015*	0.626	0.130	0.978

All data are expressed by *P* value. *$P < 0.05$.
Abbreviations: S-2PD, static 2-point discrimination; SW, Semmes–Weinstein monofilament; AROM, active ranges of motion; ADL, activities of daily living; SDHF, satisfaction degree of hand function.

cost can influence the clinical decision of replantation in treating digital amputation.[18] Although many articles on the various outcomes involving hand function have been published, just a few long-term outcome studies concerning digital replantation have been presented.[19] The current study investigated the long-term outcomes of digital replantation involving objective, subjective, and psychological aspects and analysed the relation of these results.

In Urbaniak et al's study,[20] the average AROM was 13% of the AROM of healthy digits after single-digit replantation at the level proximal to the FDS insertion, and the average AROM was 30% of the AROM of healthy digits after replantation distal to FDS insertion. Walaszek et al[3] reported that the average AROM of replanted digits was 50% of the contralateral digits. In the current study, the average AROM of replanted thumbs was 75°, which accounted for 53% of the AROM of the contralateral thumbs. The average AROM of replanted fingers was 148°, which accounted for 58% of the AROM of the contralateral fingers. This result is better than that in most previous studies. To our knowledge, the best AROM of replanted digits in previous studies was reported by Holmberg et al.[21] In their study, the average AROM was 84% of the AROM of unaffected digits. However, the report had a high rate of incomplete amputations (35 of 39), resulting in good activity of replanted digits.

Walaszek et al[3] reported that the average total grip approaches two-thirds of the power of the healthy hand. Holmberg et al[21] stated that the average total grip strength is 72% of the power of the healthy hand and that pinch grip strength is 69% of the pinch grip of the healthy hand. In our study, the average total grip strength of the injured hands was 91% of the grip strength of the contralateral hands, and the average pinch grip strength of the injured hands was 82% of that of the contralateral hands. This result is the best among all the results of previous studies. The probable reason for this outcome is that the grip strength of a hand is influenced by the number of replanted digits. Single-digit replantation was selected in our study, and half of all cases were successfully replanted thumbs.

The recovery of sensation following digit replantation is influenced by many factors, including the mechanism of injury, nerve defect, and quality of nerve repair. Blomgren et al[22] reported an S-2PD of 10 mm or less in only 2 of 23 replanted/revascularised fingers. Molski[23] obtained an S-2PD of 5–12 mm in 9 of 11 replanted fingers. In Walaszek et al's study,[3] the number of S-2PDs less than 6 mm was three and that of 6–10 mm was 33 in 59 replanted/revascularised digits. In our series, the mechanism of injury was crushing or avulsion by a machine. Our study determined that the average S-2PD of the injured digits was 10.4 mm. The number of S-2PDs less than 6 mm was five and the number ranging from 6 to 10 mm was 14. In general, 10 mm is considered satisfactory sensation recovery. Our result is similar to that in the study of Walaszek et al. Most patients (63.3%) had a satisfactory feeling of light touch in the SW monofilament test.

Previous studies assessing the short- or long-term outcomes of replanted digits rarely evaluated the subjective experience of patients. The Carlsson questionnaire was used to evaluate the function of the hand from the patient's perspective in the article by Walaszek et al.[3] The authors of three other articles assessing the outcomes of replanted thumbs selected the DASH or the Quick DASH questionnaire.[4–6] The MHQ was not selected in previous articles. Unglaub et al,[4] Hanns et al,[5] and Ciclamini et al[6] reported a mean DASH score or Quick DASH score of 16.7, 11.3, and 11.06 for thumb replantation, respectively. In the current study, the mean DASH score of 14 patients for thumb replantation was 5.5. This result is superior to those of other studies because our cases did not include any replantation proximal to the metacarpophalangeal joint of thumbs. The mean DASH score of all patients in our study was 6.6. This result indicates a markedly reduced disability level after single-digit replantation.

The six aspects of the MHQ can comprehensively assess the subjective outcome. The results suggest that most patients achieved a high score in the aspects of hand function, satisfaction with hand function, and appearance. Likewise, the patients subjectively believed that the current recovery of the hand function minimally affected employment and activities of daily life. At our final follow-up, 28 patients (93%) had returned to work, and 17 patients (57%) had returned to their previous occupation.

We analysed the objective indicators that affect the subjective outcome of the patients. The results indicate that total grip strength is the most important related factor. Haas et al[5] reported a significant correlation between Quick DASH scores and pinch strength and ROM measures. Unglaub et al[4] identified a correlation between DASH scores and SW testing. No correlation was observed between SW testing and DASH, but we found a correlation between the degree of satisfaction in MHQ and SW testing. Unglaub et al[4] reported that age could play a decisive role in the recovery of sensitivity, motion of joints, and strength. However, in the current study, age was not significantly correlated with the objective and subjective data. These discrepancies may be caused by the different types of digit amputation and self-requirements of patients.

The phenomenon of cold intolerance is a common complication after digital replantation. Walaszek et al[3] determined that 65% of their patients complained of mild or moderate cold intolerance of replanted digits at the average of 3.5 years after surgery. Lutz et al[24] reported that almost all of their patients complained of cold sensitivity at an average of 12.6 years after finger replantation. In the current study, the symptom of cold intolerance was observed in 53% of all patients. This discrepancy in the incidence of cold intolerance may have resulted from many factors, such as seasonal temperature, smoking habits, and time. Similar to previous studies,[3–5] no correlation was found between cold intolerance and S-2PD in our study.

To our knowledge, previous studies did not evaluate the psychological status of patients after digit replantation. Williams et al[9] estimated the prevalence of depression and PTSD among hand-injured patients at an average follow-up time of 75 days and found that nearly one third of patients met diagnostic criteria for PTSD, depression, or both. Richards et al[10] assessed the incidence rates of depression and PTSD after severe hand trauma at an average follow-up time of 16 months. The results showed that 29% of patients had high levels of both depression and PTSD. According to the modified hand injury severity scoring system,[25] digit amputation is more serious than the majority of cases in the study of Richards et al. However, in the current study, the incidence of psychological symptoms was extremely low at an average follow-up time of 36 months. There may be two reasons for this difference: one is the longer follow-up time for the current study; the psychological symptoms of patients may decrease gradually over time. The other reason may be related to patient education, occupation, and other factors. Opsteegh et al[26] investigated which biomedical factors relate to symptoms of acute PTSD in hand-injured patients and found that pain and aesthetics statistically predict symptoms of acute PTSD. We found that the patient in case 9 had poor objective results and the highest DASH score. However, because of the low incidence rate of psychological symptoms, we could not analyse the related factors influencing the psychological results.

The current study has several limitations. First, this study is retrospective, and the sample is small. The incidence rates of psychological results were not recorded and assessed at different stages after injury. In addition, many factors influence the curative effect of digit replantation, and analysing the explicit role of a certain factor is difficult. Another drawback is that similar to other related studies, this study lacks a control group and is at the lower end of the hierarchy of evidence. However, a randomised controlled trial design is not possible in digital replantation because of ethical considerations.

In summary, our study showed that most patients obtain satisfactory objective and subjective outcomes at the long-term follow-up after single-digit replantation. Total grip strength is the most important factor positively related to subjective outcomes. Further, the incidence rates of psychological symptoms after digit replantation are very low at long-term follow-up.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical approval

The institutional review board approved this study.

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