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The Application of Health Education Based on the Transtheoretical Model on Self-Management and Vascular Crisis in Patients Undergoing Finger Replantation Surgery

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Abstract: *Objective:* To investigate the effects of health education based on the Transtheoretical Model (TTM) on self-management and vascular crisis in patients undergoing finger replantation surgery. *Methods:* A total of 106 patients who underwent finger replantation surgery between January 2025 and December 2025 were randomly divided into control and intervention groups using a random number table method (control group, n = 52; intervention group, n = 54). The control group received standard perioperative nursing care, while the intervention group received TTM-based health education in addition to standard care. Self-management levels and incidence of vascular crisis were compared between the two groups. *Results:* After intervention, the Adult Health Self-Management Skills Rating Scale (AHSMSRS) scores in both groups increased significantly compared with baseline (control: 91.26 ± 5.49 to 116.97 ± 8.15; intervention: 90.39 ± 6.72 to 136.38 ± 9.36, $p < 0.001$). The intervention group showed significantly higher AHSMSRS scores than the control group (136.38 ± 9.36 vs. 116.97 ± 8.15, $p < 0.001$). Similarly, general self-efficacy scores increased significantly in both groups, with the intervention group demonstrating superior improvement (36.73 ± 4.78 vs. 28.49 ± 4.11, $p < 0.001$). The incidence of vascular crisis was significantly lower in the intervention group (5.5%) compared with the control group (19.23%, $\chi^2 = 3.421$, $p < 0.05$). *Conclusion:* Health education based on the Transtheoretical Model effectively enhances self-management abilities and self-efficacy in patients undergoing finger replantation surgery, and significantly reduces the incidence of postoperative vascular crisis.

Keywords: Transtheoretical model; Health education; Finger replantation; Self-management; Vascular crisis

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1. Introduction

Finger replantation is a comprehensive and highly precise traumatic surgical procedure. With the advancement

of microsurgical techniques, the success rate of finger replantation has significantly improved [1]. Vascular crisis is a serious pathological phenomenon that occurs after finger replantation surgery when the anastomosed blood vessels become occluded, thereby jeopardizing the survival of the replanted digit [2]. It represents the most severe postoperative complication and is a primary cause of replantation failure. Multiple factors contribute to the development of vascular crisis in the postoperative period, including smoking status, body positioning, pain control, and constipation [3].

The Transtheoretical Model (TTM) is a behavioral change framework that conceptualizes health behavior change as a process involving progress through stages of change: precontemplation, contemplation, preparation, action, maintenance, and termination [4]. This model provides a theoretical foundation for designing stage-matched interventions that are tailored to the patient's readiness for behavioral change. Stage-based interventions guided by TTM have demonstrated effectiveness in improving health behavior adoption and enhancing self-efficacy across diverse clinical populations and health conditions [4]. Within the context of postoperative care for finger replantation patients, educational interventions based on TTM principles offer a promising approach to reduce vascular complications by promoting patient engagement in preventive behaviors and self-management strategies.

This study aims to investigate the application and efficacy of health education based on the Transtheoretical Model in improving self-management and reducing vascular crisis in patients undergoing finger replantation surgery.

2. Subjects and methods

2.1. Study patients

Patients diagnosed with fingertip amputation and undergoing replantation at a tertiary hospital from January 2025 to December 2025 were enrolled as subjects.

2.1.1. Inclusion criteria

(1) Age 18–60 years;
(2) Unilateral amputation of fingers 1–3;
(3) Admission and replantation performed within 6 hours post-injury;
(4) Basic literacy and communication skills;
(5) Voluntary participation with signed informed consent.

2.1.2. Exclusion criteria

(1) More than three fingers amputated;
(2) Severe infection at the injury site prior to surgery;
(3) Unconsciousness or mental disorders;
(4) Medical personnel related to healthcare.

2.1.3. Study group

Patients were randomly assigned to either the control group (n = 52) or the observation group (n = 54) using a random number table. There were no significant differences in baseline characteristics between the two groups ($p > 0.05$).

2.2. Methods

2.2.1. Control group

Patients received routine perioperative care. This included standard health education upon admission, explaining preoperative preparations in a timely manner. Patients were advised to relax and avoid excessive anxiety. The potential intraoperative and postoperative risks, as well as precautions, were explained in detail. Postoperative monitoring primarily focused on peripheral skin temperature and color of the fingertips, closely observing for signs of vascular crisis. Daily life, dietary management, postoperative functional exercises, and discharge guidance were implemented accordingly.

2.2.2. Observation group

In addition to the routine care provided to the control group, patients in the observation group received health education based on the transtheoretical model (TTM). The specific interventions included:

(1) Precontemplation stage (at admission)
Patients and their family members' needs and acceptance levels of health education were assessed, and a tailored health education plan was developed based on individual circumstances.

(2) Contemplation stage (within 6 hours before surgery)
Patients were introduced to the significance of preoperative preparations (e.g., skin disinfection, fasting, medication, blood transfusion), along with explanations of the surgical procedure and the importance of postoperative cooperation.

(3) Preparation stage (within 8 hours post-operation)
Education was provided on prohibiting smoking, bed rest, limb elevation, and managing negative emotions, emphasizing their roles in the success of replantation. Pain control methods were also explained. The goal was for patients to understand postoperative vascular crisis prevention and strictly adhere to preventive measures, maintaining a good psychological state.

(4) Action stage (from postoperative to discharge)
The focus was on strengthening self-management, timely identification of problems, and intervention. Patients were guided to implement nursing measures such as posture management, pain control, abstinence from smoking, dietary adherence, and other preventive strategies against vascular crisis, as well as to gradually learn scientific functional exercises.

(5) Maintenance stage (1–3 months post-discharge)
The emphasis was on guiding patients to perform routine home-based functional exercises, prevent injuries to the replanted finger, adopt self-management methods at home, and inform about the expected removal time of internal fixation.

2.3. Evaluation indicators

2.3.1. Self-management ability

Assessed through the Adult Self-Management Scale (the Rating Scale of Health Self-Management Skills for Adults, AHSMSRS), which includes 38 items across three dimensions: behavior, cognition, and environment. Each item ranges from 1 to 5 points, with a total score of up to 190 points. Higher scores indicate better self-management ability.

2.3.2. General self-efficacy

Measured by the Chinese version of the Self-Efficacy Scale developed by Zhang Jinxin and Schwarzer in 1995, consisting of 10 items with a Likert 4-point scoring system (1–4 points). The total score ranges from 10 to 40, with higher scores representing stronger self-efficacy.

2.3.3. Judgment of vascular crisis in replanted finger

Vascular crisis was classified into arterial and venous types. Arterial crisis was characterized clinically by a "pale and shriveled" appearance: pale, dull skin color, significantly lower temperature compared to the healthy side, low tension with deeper wrinkles, slow capillary response or absence thereof, and minimal bleeding at the incision (dark red). Venous crisis was characterized by "cyanosis and edema": cyanotic or dark-red skin color, high tension with swelling and blisters, rapid capillary response (less than 1 second) that subsequently disappeared, and dark purple bleeding from the incision that was relatively rapid.

2.4. Statistical methods

Data were analyzed using R3.4.3 software. Continuous variables were expressed as mean ± standard deviation and compared using t-tests. Categorical data were expressed as counts or percentages and analyzed with the χ^2 test. The significance level was set at $\alpha = 0.05$, with $p < 0.05$ indicating statistically significant differences.

3. Results

3.1. Comparison of self-management ability between groups

Following the intervention, AHSMSRS scores in both groups increased significantly compared to baseline. The observation group demonstrated significantly higher scores than the control group, and the difference was statistically significant ($p < 0.001$). (**Table 1**)

Table 1. Comparison of AHSMSRS scores between groups [mean ± SD (points)]

Group	N	AHSMSRS score		t	p
		Pre-intervention	Post-intervention		
Control	52	91.26 ± 5.49	116.97 ± 8.15	28.316	< 0.001
Observation	54	90.39 ± 6.72	136.38 ± 9.36	44.65	< 0.001
t value		0.728	11.369		
p value		0.468	< 0.001		

3.2. Comparison of self-efficacy scores between groups

Following the intervention, self-efficacy scores in both groups increased significantly compared to baseline. The observation group demonstrated significantly higher scores than the control group, and the difference was statistically significant ($p < 0.001$). (**Table 2**)

Table 2. Comparison of self-efficacy scores between groups [mean ± SD (points)]

Group	N	Pre-intervention	Post-intervention	*t*	*p*
Control	52	23.48 ± 4.43	28.49 ± 4.11	9.433	< 0.001
Observation	54	24.15 ± 4.17	36.73 ± 4.78	22.885	< 0.001
t value		-0.802	9.5		
p value		0.424	< 0.001		

3.3. Comparison of vascular crisis incidence between groups

In the control group, 10 patients (19.23%) developed vascular crisis, while in the observation group, 3 patients (5.5%) developed vascular crisis. The incidence of vascular crisis in the observation group was significantly lower than in the control group, and the difference was statistically significant ($\chi^2 = 3.421$, $p < 0.05$).

4. Discussion

Finger replantation is a highly specialized surgical procedure that assists in restoring the normal function of amputated digits and improving patient quality of life. The success of replantation not only depends on excellent microsurgical techniques but also relies critically on scientifically sound and systematic postoperative management to ensure digit survival and functional recovery. Vascular crisis, representing the most severe postoperative complication, is a major determinant of replantation failure, and its prevention represents the core challenge in postoperative nursing care. This study applied the Transtheoretical Model (TTM) to health education for finger replantation patients. The results demonstrated that TTM-based interventions significantly enhanced patients' self-management ability and self-efficacy, and effectively reduced the incidence of vascular crisis.

Self-management comprises a series of behavioral, cognitive, and emotional strategies that individuals actively employ to maintain health. The findings of this study revealed that the observation group achieved significantly higher AHSMSRS total scores following the intervention compared to the control group. This suggests that stage-matched interventions based on the TTM framework possess distinct advantages. During the precontemplation and contemplation stages, assessment and needs analysis activated patients' motivation for behavioral change. In the preparation and action stages, individualized guidance and reinforcement targeting specific health behaviors, such as body positioning management, pain control, and strict smoking cessation, facilitated the transition from "awareness" to "action" among patients. This educational model, which follows the principles of behavior change, transcends the unidirectional knowledge transmission of traditional health education, thereby promoting more active patient participation in personal health management. Recent research has confirmed that stage-based interventions aligned with the TTM framework can deliver precise support tailored to each patient's stage of behavioral change, thereby effectively enhancing self-management ability [5].

Self-efficacy refers to individuals' confidence in their ability to execute specific behaviors and achieve expected outcomes, which directly influences the persistence of health behaviors. In this study, the improvement in self-efficacy scores among the observation group was notably greater than in the control group following the intervention. The TTM intervention accomplished this through establishing stage-appropriate, achievable goals that allowed patients to accumulate confidence through repeated successful experiences. Continued encouragement and problem-solving support from nursing staff during the action stage further strengthened patients' sense of control. Research has established that self-efficacy serves as an important mediating variable in health behavior

change, and self-efficacy-centered comprehensive interventions effectively enhance patient self-efficacy, thereby promoting the adoption and maintenance of health behaviors [6]. High levels of self-efficacy enable patients to adopt more active coping strategies when facing postoperative challenges such as pain and limited mobility, which is particularly crucial for replantation patients requiring long-term commitment to functional rehabilitation.

The occurrence of vascular crisis results from the interaction of multiple factors. Beyond technical surgical considerations, postoperative behavioral compliance is paramount. In this study, the incidence of vascular crisis in the observation group was merely 5.5%, significantly lower than in the control group (19.23%). Health education based on TTM transformed knowledge about vascular crisis prevention into stable, sustained health behaviors. For example, through TTM intervention, patients developed a profound understanding and strict adherence to smoking cessation requirements, maintained appropriate body positioning, and acquired effective pain management strategies. Recent comprehensive analysis of factors affecting early necrosis after finger replantation demonstrated that postoperative smoking is an independent risk factor for vascular crisis, with smoking history significantly increasing the odds ratio (OR = 7.255, 95% CI: 1.767–29.782) of digit necrosis after replantation [5]. Smoking impairs vascular function through multiple mechanisms, including inhibition of vasoactive substance secretion, hindrance of vascular endothelial cell synthesis, and reduction of blood vessel elasticity, ultimately compromising blood circulation in the replanted digit. Furthermore, preoperative ischemia time of 8 hours or more emerged as a critical risk factor (OR = 15.714, 95% CI: 3.095–79.798), underscoring the urgency of comprehensive preoperative and perioperative education to optimize patient knowledge and behavioral compliance throughout all stages of recovery [5]. Systematic health education has been shown to substantially improve patients' recognition ability of early vascular crisis symptoms, such as pale, shriveled appearance or cyanosis and edema, as well as changes in skin temperature, thereby facilitating timely patient participation in disease management [7].

5. Conclusion

In conclusion, health education based on the Transtheoretical Model represents an evidence-based and highly effective nursing intervention approach for finger replantation patients. Through stage-specific, individualized educational strategies, this model successfully enhanced patients' self-management abilities and self-efficacy, translated health knowledge into stable health behaviors, and significantly reduced the postoperative incidence of vascular crisis. This approach merits further application and dissemination within microsurgical clinical nursing practice [8]. However, this study has certain limitations, including a relatively limited sample size. Future multi-center, large-scale studies are needed to further validate the generalizability of these conclusions across diverse clinical settings and patient populations [9].

Disclosure statement

The authors declare no conflict of interest

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