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Development and Reliability and Validity Analysis of an Assessment Tool for Postoperative Wound Healing in Adult Patients with Benign Anal Canal and Rectal Diseases

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Abstract: *Objective:* This study aims to develop an assessment tool for postoperative wound healing in adult patients with benign anal canal and rectal diseases and to validate its reliability and validity. *Methods:* Based on Levine's Conservation Model as the theoretical framework, an item pool was formed through literature review, and the initial draft of the scale was refined through two rounds of Delphi expert consultation. A total of 200 postoperative patients were selected for item analysis, internal consistency testing, content validity, and structural validity analysis. *Results:* The final tool comprises four dimensions: energy conservation, structural integrity, personal integrity, and social integrity, with a total of 24 items. It demonstrates good content validity (I-CVI 0.82–1.00, S-CVI/Ave 0.95, S-CVI/UA 0.87) and excellent internal consistency (Cronbach's α for the overall scale was 0.934). Exploratory factor analysis revealed a KMO value of 0.931, Bartlett's test of sphericity $\chi 2 = 4147.853$ ($p < 0.001$), and four common factors were extracted, accounting for a cumulative variance contribution rate of 64.345%, indicating ideal structural validity. *Conclusion:* The results indicate that the assessment tool has good reliability and validity and can systematically evaluate postoperative wound healing, providing a scientific basis for clinical individualized nursing interventions.

Keywords: Anal canal; Rectum; Benign diseases; Wound healing; Assessment tool; Reliability; Validity

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1. Introduction

Benign diseases of the anal canal and rectum (such as hemorrhoids, anal fissures, anal fistulas, perianal abscesses, and anal prolapse) are common and frequently occurring conditions, with an incidence rate of approximately

51.14% among adult urban residents in China [1]. Surgery is the primary treatment for cases where conservative treatment is ineffective [2]. However, postoperative wounds are often open and prone to contamination. Affected by multiple factors such as dressing packing, strain from defecation, and fecal residue, they frequently lead to delayed healing or recurrence, increasing the physical and mental burden on patients [3]. Wound assessment is a core component of scientific management, requiring a comprehensive consideration of both local characteristics and overall conditions [4]. Based on this, this study aims to develop and validate an assessment tool for postoperative wound healing in patients with benign anal canal and rectal diseases, providing a basis for the systematic evaluation of postoperative wound healing in this patient population.

2. Methods

This study is grounded in Levine's Conservation Model as its theoretical foundation [5]. An item pool was developed through a literature review, and the tool was refined through two rounds of Delphi expert consultations. Subsequently, 200 consecutive postoperative patients were recruited from the proctology department to test the reliability and validity of the tool. This study has been approved by the Ethics Committee of Ya'an People's Hospital (Approval Number: 2025053).

2.1. Theoretical framework

This study employs Levine's Conservation Model as its theoretical framework, interpreting the holistic nature of postoperative wound healing in benign anal and rectal diseases from four dimensions: energy, structure, individual, and social [5]. This model emphasizes the conservation of energy balance, tissue repair, self-integrity, and social function, which collectively promote patient recovery and provide theoretical support for the development and validation of the wound healing assessment tool.

2.2. Development of the item pool

Based on a literature review from Chinese and English databases, this study constructed an assessment tool for postoperative wound healing in adult patients with benign anal and rectal diseases under the guidance of Levine's Conservation Model. The tool comprises four primary indicators and 26 secondary indicators, utilizing a five-point scoring system to ensure scientific rigor and rationality.

2.3. Expert consultation

In this study, anorectal specialists, nurses, wound care experts, and nursing researchers were selected nationwide to establish a Delphi expert panel. The inclusion criteria were as follows.

(1) Doctors or nurses with over 10 years of experience in anorectal specialty and holding an associate senior or higher professional title

(2) Individuals with over 5 years of wound care experience and possessing wound/ostomy therapist qualifications

(3) Those with at least 5 years of research experience and holding a postgraduate degree or higher.

Expert consultations were conducted via email and the "Questionnaire Star" platform, with both rounds of questionnaires collected within one month. In the first round, 25 experts were involved, and items were screened and the questionnaire revised based on a mean score > 4.0 and a coefficient of variation < 2.0. In the second round,

statistical analysis was completed on this basis, ultimately resulting in the first draft of an assessment tool for postoperative wound healing in adult patients with benign anorectal and rectal diseases.

2.4. Expert authority level

The expert authority coefficient (Cr) was calculated using the formula Cr = (Cs + Ca) / 2, where Cs represents the expert's familiarity with the content and Ca represents the reliability of the judgment basis [6]. Familiarity was graded on a 5-point scale (0–1 point), and the judgment basis was categorized into three levels: "large", "medium", and "small", with assigned values of 0.30, 0.20, and 0.10, respectively.

2.5. Evaluation of the scale's reliability and validity

In this study, 200 patients were consecutively recruited in the order of their visits to the anorectal ward, and a numbered table was established for sequential registration. The inclusion criteria were as follows: confirmed diagnosis of benign anorectal disease with surgical treatment; age ≥ 18 years; postoperative period ranging from 1 day to 4 weeks; clear consciousness; and voluntary signing of the informed consent form. The exclusion criteria were patients with malignant tumors, pregnancy or lactation, and mental disorders. This study examined three aspects: content validity, internal consistency, and structural validity. First, content validity was assessed through expert consultation, calculating item-level (I-CVI) and scale-level (S-CVI/Ave, S-CVI/UA) indices. An I-CVI ≥ 0.78 and S-CVI/Ave ≥ 0.90 indicated good content validity [7]. Second, internal consistency was tested using Cronbach's α coefficient, with α ≥ 0.70 considered as high reliability [8]. Finally, exploratory factor analysis was employed to evaluate the construct validity. After passing the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests, principal component analysis and maximum variance rotation were utilized. The number of factors was determined based on eigenvalues > 1 and the scree plot, with factor loadings ≥ 0.40 considered indicative of a reasonable structure [9].

3. Results

3.1. Average importance ratings and coefficients of variation for each indicator

Based on expert recommendations, three new secondary indicators were added (adding "Personal Autonomy and Participation" and "Perception of Privacy Protection" under the "Personal Integrity" dimension, and adding "Primary Healthcare Support" under the "Social Integrity" dimension); "Self-awareness of Wounds" was merged into "Adherence to Nursing Behaviors"; and "Anxiety/Depression" was split into "Anxiety Level" and "Depression Level". Some suggestions were not adopted after discussion, such as the overlap between "Home Care Capacity" and the connotation of "Social Integrity", and the redundancy between "Recent Bowel Movement Patterns" and "Defecation-related Injuries". After two rounds of consultations, expert opinions converged. The response rate and authority coefficient of experts are shown in **Table 1**, and the coordination degree is shown in **Table 2**. Ultimately, four primary indicators and 29 secondary indicators were established (see **Table 3**).

Table 1. Response rate and authority degree of expert consultation

Consultation round	Questionnaire recovery rate (Recovered/Responded)	Ca	Cs	Cr
Round 1	88.00% (22/25)	0.92	0.85	0.91
Round 2	100% (22/22)	0.96	0.87	0.92

Table 2. Coordination degree of expert consultation

Consultation round	Kendall's W	χ^2 value	*p*-value
Round 1	0.60	365.40	< 0.001
Round 2	0.81	493.29	< 0.001

Table 3. Average importance ratings and coefficients of variation for each indicator [points, mean ± standard deviation (SD)]

Dimension	Indicator	Mean ± SD	Coefficient of variation
Energy conservation	Age (≥ 60 years)	4.73 ± 0.42	0.089
	Comorbidities	4.86 ± 0.35	0.072
	Smoking history	4.58 ± 0.47	0.103
	Obesity (BMI ≥ 28)	4.69 ± 0.44	0.094
	Nutritional status	4.82 ± 0.36	0.075
	Pain condition	4.64 ± 0.48	0.104
	Sleep quality	4.56 ± 0.50	0.110
	Mobility	4.71 ± 0.43	0.091
	Multiple surgeries/Recurrence	4.72 ± 0.41	0.087
Structural integrity	Wound type	4.78 ± 0.40	0.084
	Wound location	4.80 ± 0.38	0.079
	Area & Depth	4.79 ± 0.39	0.081
	Exudate volume & character	4.73 ± 0.42	0.089
	Wound Edge Status	4.74 ± 0.41	0.087
	Granulation tissue	4.76 ± 0.40	0.084
	Epithelialization	4.68 ± 0.46	0.098
	Local signs of infection	4.77 ± 0.39	0.082
	Defecation-related injury	4.70 ± 0.44	0.094
	Complication occurrence	4.83 ± 0.36	0.075
Personal Integrity	Anxiety	4.62 ± 0.49	0.106
	Depression	4.62 ± 0.49	0.106
	Shame	4.59 ± 0.50	0.109
	Personal autonomy & participation	4.71 ± 0.43	0.091
	Perception of privacy protection	4.74 ± 0.41	0.087
Social Integrity	Family care support	4.69 ± 0.45	0.096
	Self-care ability	4.73 ± 0.42	0.089
	Return to social roles	4.61 ± 0.49	0.106
	Nursing compliance behavior	4.72 ± 0.43	0.091
	Primary healthcare support	4.66 ± 0.47	0.101

3.2. Screening results of initial tool items

3.2.1. General information of subjects

This study included 200 patients with an average age of 45.7 ± 12.6 years. Among them, there were 118 males (59.0%) and 82 females (41.0%). The ethnic composition was predominantly Han Chinese, with 186 cases (93.0%), and 14 cases (7.0%) from ethnic minorities. In terms of marital status, there were 148 married cases (74.0%), 36 unmarried cases (18.0%), 10 divorced cases (5.0%), and 6 widowed cases (3.0%). In terms of residence, there were 124 cases (62.0%) in urban areas and 76 cases (38.0%) in rural areas. Regarding educational attainment, there were 61 cases (30.5%) with high school/technical secondary school education, 52 cases (26.0%) with junior high school education, 36 cases (18.0%) with junior college education, and 39 cases (19.5%) with undergraduate education or above. In terms of medical insurance or payment methods, there were 78 cases (39.0%) with urban employee medical insurance, 64 cases (32.0%) with urban and rural resident medical insurance, 38 cases (19.0%) with the New Rural Cooperative Medical Scheme, 12 cases (6.0%) paying out-of-pocket, and 8 cases (4.0%) with other payment methods. Regarding religious beliefs, there were 182 cases (91.0%) without any religious beliefs. The primary caregivers were mainly spouses, accounting for 126 cases (63.0%), followed by children, accounting for 48 cases (24.0%). The main diagnoses included hemorrhoids in 86 cases (43.0%), anal fistula in 54 cases (27.0%), anal fissure in 28 cases (14.0%), perianal abscess in 22 cases (11.0%), and others in 10 cases (5.0%).

3.2.2. Item analysis

This study employed the discrete trend method, discrimination method, correlation coefficient method, and Cronbach's α coefficient method to screen items. The standard deviations for all items were greater than 0.8, indicating good discrimination. The differences between high and low groups were statistically significant, and no items needed to be deleted. Correlation coefficient analysis revealed that five items ("history of multiple surgeries/recurrence", "local manifestations of infection", "defecation-related injuries", "occurrence of complications", and "feelings about privacy protection") had a correlation coefficient (r) with the total score of less than 0.4. Cronbach's α analysis also showed a slight increase in the overall scale α after deletion. Based on the results of the four methods, the aforementioned five items were ultimately deleted to optimize the scale structure. In this study, methods such as correlation coefficient analysis were used as preliminary screening tools to eliminate items with low correlation with the overall scale. Subsequently, exploratory factor analysis was conducted on the remaining items to ensure the robustness of the factor analysis results and the clarity of the scale structure.

3.2.3. Exploratory factor analysis for construct validity

After eliminating inappropriate items, exploratory factor analysis was conducted on 200 samples. The KMO value was 0.931, and the Bartlett's test of sphericity yielded $\chi^2 = 4147.853$, df = 276, $p < 0.001$, indicating that the data were suitable for factor analysis. Four factors with eigenvalues greater than 1 were extracted using the principal axis factoring method, with a cumulative variance contribution rate of 60.46%. The factor structure became clear after maximum variance orthogonal rotation (**Table 4**). Although some items did not meet the factor loading criteria, they were retained in the final scale to ensure clinical comprehensiveness.

Table 4. Exploratory factor analysis of construct validity

Indicator	Factor 1	Factor 2	Factor 3	Factor 4
Age (≥ 60 years)	0.352	0.086	0.900	0.145
Comorbidities	0.408	0.214	0.161	0.835
Smoking history	0.432	0.081	0.184	0.199
Obesity (BMI ≥ 28)	0.348	0.200	-0.027	0.152
Nutritional status	0.269	0.920	0.186	0.135
Pain condition	0.560	0.242	0.147	0.240
Sleep quality	0.623	0.227	0.163	0.205
Mobility	0.613	0.329	0.153	0.229
Wound type	0.740	0.271	0.284	0.259
Wound location	0.732	0.254	0.276	0.201
Wound area & depth	0.770	0.154	0.248	0.199
Exudate volume & character	0.252	0.928	0.180	0.144
Wound edge status	0.698	0.213	0.289	0.255
Granulation tissue	0.296	0.095	0.910	0.195
Epithelialization	0.378	0.226	0.140	0.877
Anxiety	0.183	0.287	0.002	0.244
Depression	0.277	0.073	0.152	0.181
Shame	0.319	0.411	0.139	0.165
Personal autonomy & participation	0.115	0.103	0.256	-0.006
Family care support	0.740	0.249	0.313	0.199
Self-care ability	0.777	0.169	0.283	0.180
Return to social roles	0.715	0.297	0.267	0.249
Nursing compliance behavior	0.655	0.162	0.238	0.260
Primary healthcare support	0.496	0.203	0.230	0.027
Eigenvalue	11.438	1.602	1.298	1.105
Variance explained	47.659%	6.674%	5.408%	4.603%
Cumulative variance	47.659%	54.333%	59.741%	64.345%

3.2.4. Reliability and validity

Experts consulted in the second round were invited to evaluate the content validity of the assessment tool, with an I-CVI ranging from 0.82 to 1.00, an S-CVI/Ave of 0.95, and an S-CVI/UA of 0.87, indicating good content validity. The Cronbach's α for the overall scale was 0.934, with all four dimensions exceeding 0.87, suggesting good internal consistency.

4. Discussion

This study constructed an assessment tool for postoperative wound healing in adults with benign anorectal diseases

based on Levine's Conservation Model and systematically evaluated its reliability and validity through two rounds of Delphi expert consultations, item analysis, and exploratory factor analysis.

During the expert consultation phase, the response rate for the two rounds of the Delphi method was high, with authority coefficients (Cr) all exceeding 0.9. Kendall's W increased from 0.60 to 0.81 ($p < 0.001$), indicating that expert opinions tended to converge, the item system was reasonable, and the theoretical framework provided strong guidance. Feedback from multidisciplinary experts ensured the scientific rigor and representativeness of the items while validating the applicability of Lewin's Conservation Model in postoperative wound assessment. Item screening utilized methods such as the discrete trend method, discrimination method, correlation coefficient method, and Cronbach's α coefficient method. Multidimensional analysis revealed that five items had low correlations with the total score ($r < 0.4$). After their removal, the overall reliability of the scale improved, the structure was optimized, discrimination was enhanced, and both practicality and statistical performance were better.

The construct validity analysis showed that the KMO value was 0.931, and the Bartlett's test of sphericity yielded $p < 0.001$, indicating suitability for factor analysis. Four common factors were extracted, with a cumulative variance contribution rate of 64.345%. The factor loadings were clear, corresponding to the energy conservation, structural integrity, personal integrity, and social integrity dimensions of Lewin's model, thus verifying theoretical consistency. In terms of content validity, the Item-Content Validity Index (I-CVI) ranged from 0.82 to 1.00, the Scale-Content Validity Index/Average (S-CVI/Ave) was 0.95, and the Scale-Content Validity Index/Universal Agreement (S-CVI/UA) was 0.87, all exceeding recognized standards. This indicates a high degree of alignment between the items and the research objectives, as well as comprehensive coverage of core wound healing domains. Reliability analysis revealed a Cronbach's α of 0.934 for the overall scale, with all four dimensions exceeding 0.87, demonstrating good internal consistency.

From a clinical perspective, this tool provides a systematic and standardized framework across multiple dimensions, including wound characteristics, function, psychology, and social support. Previous studies have suggested that wound assessment tools can enhance assessment consistency and decision-making confidence among non-specialist nurses, optimize clinical interventions, and improve healing outcomes [10]. Compared to general-purpose tools, this tool combines specialization with systematization, offering strong clinical applicability and guidance value.

5. Conclusions and limitations

The assessment tool developed in this study demonstrates good reliability and validity, with a well-structured design that encompasses energy conservation, structural integrity, personal integrity, and social integrity. It provides a scientific basis for postoperative nursing assessment and individualized interventions. However, the study is limited by its single-center design and relatively small sample size. The construct validity requires further refinement through confirmatory factor analysis with a larger sample. Additionally, the tool's applicability across different regions, healthcare institutions, and in long-term follow-up settings requires further validation.

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Disclosure statement

The authors declare no conflict of interest.

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