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The Impact of Attribution Training on Emotional and Functional Recovery in Elderly Patients Undergoing Total Knee Arthroplasty: A Single-Center Randomized Controlled Trial

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Abstract

Objective: This study aims to explore the effects of attribution training on postoperative negative emotions, attributional styles, and knee joint function in elderly patients who have undergone total knee arthroplasty (TKA). **Methods:** A total of 76 elderly patients who underwent TKA were selected and randomly divided into an intervention group and a control group in this prospective randomized controlled study. All patients received routine postoperative care, while the intervention group also underwent eight sessions of attribution training intervention, each lasting 60 minutes. The Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD), Attributional Style Questionnaire (ASQ) scores and Hospital for Special Surgery (HSS) knee joint function scores between the two groups before and after the intervention were compared. **Results:** The study revealed that after the intervention, the intervention group exhibited lower scores on the HAMA and the HAMD compared to the control group, a difference that was statistically significant ($P < 0.05$). Additionally, the intervention group scored significantly higher on the ASQ for positive events and demonstrated better knee joint function compared to the control group ($P < 0.05$). **Conclusion:** The results of the study indicate that attribution training can effectively enhance psychological resilience and rehabilitation adherence in elderly patients post-TKA, thereby promoting functional recovery of the knee joint. This suggests that attribution training can play a crucial role in optimizing postoperative care.

Keywords

knee replacement, attribution training, rehabilitation, psychological intervention

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Introduction

Total knee arthroplasty (TKA), a surgical procedure frequently employed to address degenerative knee osteoarthritis and rheumatoid arthritis, represents a significant advancement in orthopedic medicine.[1,2] By replacing damaged joint cartilage with artificial prostheses, TKA aims to alleviate pain, restore mobility, and enhance overall quality of life for affected individuals.[3-5] Despite the

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clinical success of TKA, a subset of elderly patients undergoing this procedure experiences considerable physiological distress, including prolonged joint pain and functional limitations, which may lead to the development of negative emotional states such as anxiety and depression.[6,7] Consequently, this population is predisposed to adopt maladaptive coping mechanisms during the surgical process, potentially exacerbating postoperative challenges.

Moreover, postoperative complications, including fear of movement (kinesiophobia) and poor adherence to prescribed exercise regimens, have been reported among elderly TKA patients, impeding optimal functional recovery.[8-10] Traditional rehabilitation programs, primarily focused on physical therapy and functional training, may inadequately address the psychological aspects of recovery and fail to promote long-term exercise compliance, thereby compromising postoperative outcome.[11,12] Therefore, there is a pressing need to implement comprehensive interventions targeting psychological well-being and rehabilitation adherence in this patient population.

Attribution training, a cognitive-behavioral intervention designed to modify attributional styles, has emerged as a promising approach in addressing negative emotions and promoting adaptive coping strategies.[13] The fundamental concept of attribution training is that individuals exhibit various attributional biases in their causal perceptions of their own behaviors. Through attribution training, individuals can receive various forms of attributional feedback information, thereby eliminating attributional biases and forming positive emotions and expectations. This is an important approach and method to enhance achievement motivation, correct inferiority complexes, and improve mental and physical health.[14,15]By guiding individuals to reinterpret and attribute events in a more positive and constructive manner, attribution training seeks to transform cognition, emotion, and behavior, ultimately facilitating psychological adjustment and improving treatment outcomes. The efficacy of attribution training has been increasingly recognized in various fields, including mental health, chronic disease management, and rehabilitation, highlighting its potential applicability in diverse clinical settings.[16,17] After reviewing extensive literature, it was found that the majority of current research focuses on the application of attribution training in student learning and the management of depression, with less attention given to the adjustment of postoperative emotions in surgical patients. We hypothesize that attribution training could have a significant impact on the postoperative recovery of surgical patients.

Given the aforementioned considerations, the present study seeks to explore the feasibility and effectiveness of implementing attribution training in elderly TKA patients postoperatively. Specifically, we aim to investigate the impact of attribution training on negative emotions, attributional styles, and functional recovery of the knee joint in this population. By elucidating the role of attribution training in promoting psychological resilience and rehabilitation adherence, our study endeavors to contribute valuable insights to the optimization of post-TKA care and enhance the overall well-being of elderly patients undergoing this procedure.

Materials and methods

Objectives

We conducted a prospective study from November 2021 to November 2022, including 84 elderly patients who underwent total knee arthroplasty (TKA) in our orthopedic department. (Haikou Orthopedics and Diabetes Hospital is a specialized public hospital, where both the Orthopedics and Diabetes departments have established small lecture forums. Training sessions were conducted for patients and their families at least once a month, and workshops were occasionally held. Guidance on pre- and postoperative cooperation was provided for patients and families during the perioperative period. Discharge health education and relevant rehabilitation training were offered for patients being discharged).

Sample Size Calculation. This study is a randomized controlled trial with the intervention group receiving attribution training and the control group receiving routine nursing care. The primary outcome measure is the post-treatment negative emotion score. According to literature review or results from a pilot study, the mean negative emotion score for the control group is 37.52 ± 5.34, and it is expected that attribution training will reduce this score by 16.58. With a two-sided alpha (α) of 0.05 and a power of 90%, the PASS 15 software was used to calculate the required sample size for the intervention group (N1) and the control group (N2), both at 31 cases each. Considering a 20% loss to follow-up and refusal rate, the final required sample size for both the intervention and control groups is at least 38 cases each, totaling at least 76 study subjects. The sample size included in this study is 76 cases, which meets the minimum sample size requirement.

At the time of admission, two charge nurses provided patient education and, upon obtaining informed consent, randomly assigned eligible patients meeting the inclusion and exclusion criteria to either the intervention group or the control group using a random number table method. Each group consisted of 38 patients. Patients were scheduled for surgery at different times or intervals to facilitate corresponding training and care. The study was approved by the hospital's medical ethics committee (The ethics approval

number: ZY-IRB-FOM-037), and informed consent was obtained from all participants and their families. All participants received uniform medical treatment, and none of them were administered any special drugs.

Inclusion Criteria

(1) Diagnosis of knee joint lesions confirmed by imaging examination. (2) Presence of symptoms such as recurrent knee joint pain, stiffness, swelling, and restricted joint movement. (3) Willingness to undergo total knee arthroplasty in our hospital. (4) Voluntary signing of informed consent. (5) No history of drug dependence. (6) Stable mental status, with sufficient reading, cognitive, and expressive abilities to communicate effectively with medical staff. (7) Age ≥60 years. (8) No other treatment received in the month before enrollment. (9) Complete medical records.

Exclusion Criteria

(1) Significant active infection in the knee or body. (2) Neurogenic joint lesions, immune dysfunction, or malignant tumors. (3) Hemiplegia, lower limb arterial embolism. (4) Poor overall health status. (5) Abnormal mental status. (6) Patients who are unable to use WeChat and cannot complete the required tasks accordingly.

Attribution Training Intervention

Both groups of patients received routine care after total knee arthroplasty, including dietary guidance, exercise, functional training, psychological counseling, discharge medication guidance, home rehabilitation guidance and regular follow-up examinations. Medical staff followed up with patients via telephone to monitor their post-discharge recovery. The control group did not participate in any form of attribution training activities. The intervention group was matched and grouped based on hospitalization time, gender, age, education level and other factors after consenting to participate in the study upon admission. Attribution training intervention groups were established and WeChat groups were created for each group, consisting of 3-4 patients. Before the study, detailed explanations of the attribution training process were provided to the intervention group patients, who then underwent 8 sessions of attribution training intervention, once a week for 60 minutes each session. Ensure that the first intervention is conducted within 3 days before or after surgery. Implementation after discharge mainly involved communication via WeChat and telephone. The specific interventions were shown in the Supplemental Table 1.

Activity Quality Control

The entire attribution training intervention was conducted with the consent of the attending physician and the voluntary participation of the patients. A core attribution intervention team was established, consisting of one team leader and four team members, with a deputy chief nurse serving as the team leader. The core team was responsible for distributing tasks, guiding team members in attribution training interventions, receiving feedback, and adjusting intervention plans as needed. Additionally, two chief nurses were responsible for guiding questioning and answering queries, while two nurses were responsible for implementing the activities and preparing and collecting data. The questions asked were inclined towards general scientific knowledge, such as "Do you know what aspects of rehabilitation are needed after your knee joint surgery? Do you know why the surgery was performed? Do you know the structure and function of our knee joints?" and so on. All data were derived from paper questionnaires and telephone/online follow-ups, collected between November 2021 and November 2022, and the results were assessed in July 2023, with two measurements taken. The control group was also evaluated. Each intervention group was equipped with a psychologist and a rehabilitation instructor, responsible for emotional intervention and rehabilitation training guidance for patients. All team members received training in attribution theory from a chief physician of the psychosomatic medicine department of a tertiary hospital and were assessed as qualified. The activity plan was jointly developed by all team members, reviewed and approved by the overall director, and implemented according to the plan. Dynamic evaluation of the attribution training process was conducted to timely adjust intervention strategies and ensure the effectiveness of attribution training. Continuous tracking visits and feedback were conducted on the attribution activities and exercise plan execution of patients.

Observational Indicators

Comparison of anxiety and depression scale scores before and after intervention in both groups of patients at 8 weeks post-discharge, assessed using the Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD).[18] The HAMA and the HAMD were both developed by Hamilton in 1960. The HAMA is a commonly used clinical tool for diagnosing and assessing the severity of anxiety disorders. According to the data provided by our country's scale collaboration group, it consists of 14 items with a total score of 56. The total score is interpreted as follows: ≥29 points may indicate severe anxiety; ≥21 points,

definite significant anxiety; ≥14 points, definite anxiety; more than 7 points, possible anxiety; less than 7 points, no anxiety symptoms.

The HAMD is the most widely used scale for assessing depressive states in clinical practice. The total score is a good indicator of the severity of the condition, with lower scores indicating milder conditions and higher scores indicating more severe conditions. It includes 17 items that assess depressive mood, guilt, suicidal thoughts, difficulty falling asleep, sleep disturbances, early morning awakening, work and interest, retardation, agitation, psychic anxiety, somatic anxiety, gastrointestinal symptoms, general symptoms, sexual symptoms, hypochondriasis, weight loss, and insight. Each item is scored from 0 to 4, with a total score of 52. Higher scores indicate more severe anxiety and depressive symptoms. According to relevant literature, both the HAMA and HAMD scales have good reliability and validity, with the total score reliability coefficient r ranging from 0.88 to 0.99, and P values all less than 0.01.[19,20] Domestic data reports that for the assessment of depression, the experience validity coefficient reflecting the severity of clinical symptoms is 0.92. The assessments were conducted by a psychological counselor before and after the intervention.

Comparison of attribution style questionnaire (ASQ)[21] scores before and after intervention in both groups of patients to evaluate the positivity of attribution styles.

Comparison of knee joint function scores before and after intervention in both groups of patients, assessed using the Hospital for Special Surgery Knee Score (HSS)[22] to evaluate knee joint functional recovery.

Statistics

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Comparisons of categorical data such as gender, disease proportion, and site of onset were performed using the chi-square test ($\chi 2$ test); quantitative data such as negative emotion scores are expressed as mean ± standard deviation (±s), and were analyzed for normal distribution with a 95% confidence interval. Within-group comparisons were analyzed using effect size analysis, while between-group comparisons were conducted using Student' t-test. A significance level of $P < 0.05$ was considered to indicate statistical significance.

We followed the STROBE Guidelines when preparing the manuscript.

Results

Based on the exclusion criteria, 8 patients were excluded from the study: 3 due to the presence of neuroarthropathic joint lesions or active infections, 3 with hemiplegia, and 2 who had communication difficulties and declined to participate in the research. Ultimately, 76 patients were included in the study, with no participants withdrawing midway through the study. The flow chart was shown in the Figure 1.

The comparison of general clinical data between the two groups of elderly patients undergoing total knee arthroplasty showed no statistically significant differences ($P > 0.05$), as shown in Table 1.

The results of the study exhibited significant differences in the Hamilton Anxiety Rating Scale (HAMA) and Hamilton Depression Rating Scale (HAMD) scores after intervention between the control and intervention groups. Before the intervention, the HAMA and HAMD scores were comparable between the two groups ($P > 0.05$). However, post-intervention, the intervention group reported lower scores on both HAMA (18.96 ± 3.37) and HAMD (17.58 ± 3.24) compared to the control group with HAMA (20.94 ± 3.45) and HAMD (19.89 ± 3.31) scores. The difference was statistically significant ($P < 0.05$). Based on the effect size results, we found that although both the control group and the intervention group showed improvements in depression levels after surgery compared to before surgery, the intervention group exhibited stronger improvement effects than the control group, as shown in Table 2. Therefore, the intervention had a more positive impact on reducing negative emotion scores in the intervention group than in the control group.

Before the intervention, there was no statistically significant difference in the ASQ scores between the two groups for positive and negative events ($P > 0.05$). After the intervention, the scores for positive events increased, with the intervention group scoring higher than the control group (24.56 ± 4.55 vs 22.14 ± 4.01), and the scores for negative events decreased, with the intervention group scoring lower than the control group (14.88 ± 2.98 vs 16.78 ± 3.21) ($P < 0.05$). Effect size analysis further revealed stronger improvements in the intervention group for both positive events (Cohen's $d = 2.73$ vs 4.39 in the control group) and negative events (Cohen's $d = -3.62$ vs -2.34 in the control group). These results indicate that the intervention had a significantly larger practical impact on the intervention group compared to the control group ($P < 0.05$), as shown in Table 3.

In terms of knee joint function scores, there was no significant difference between the control group and the intervention group before the intervention (39.26 ± 5.71 vs 39.68 ± 5.62, $P = 0.747$). However, after the intervention, the intervention group showed a significantly higher score than the control group (84.25 ± 7.02 vs 78.56 ± 6.39, $P < 0.05$). The effect size for the intervention group (Cohen's $d = 7.05$) was notably larger than that of the control group ($d = 6.49$), indicating a stronger clinical improvement in knee function. Both groups showed significant

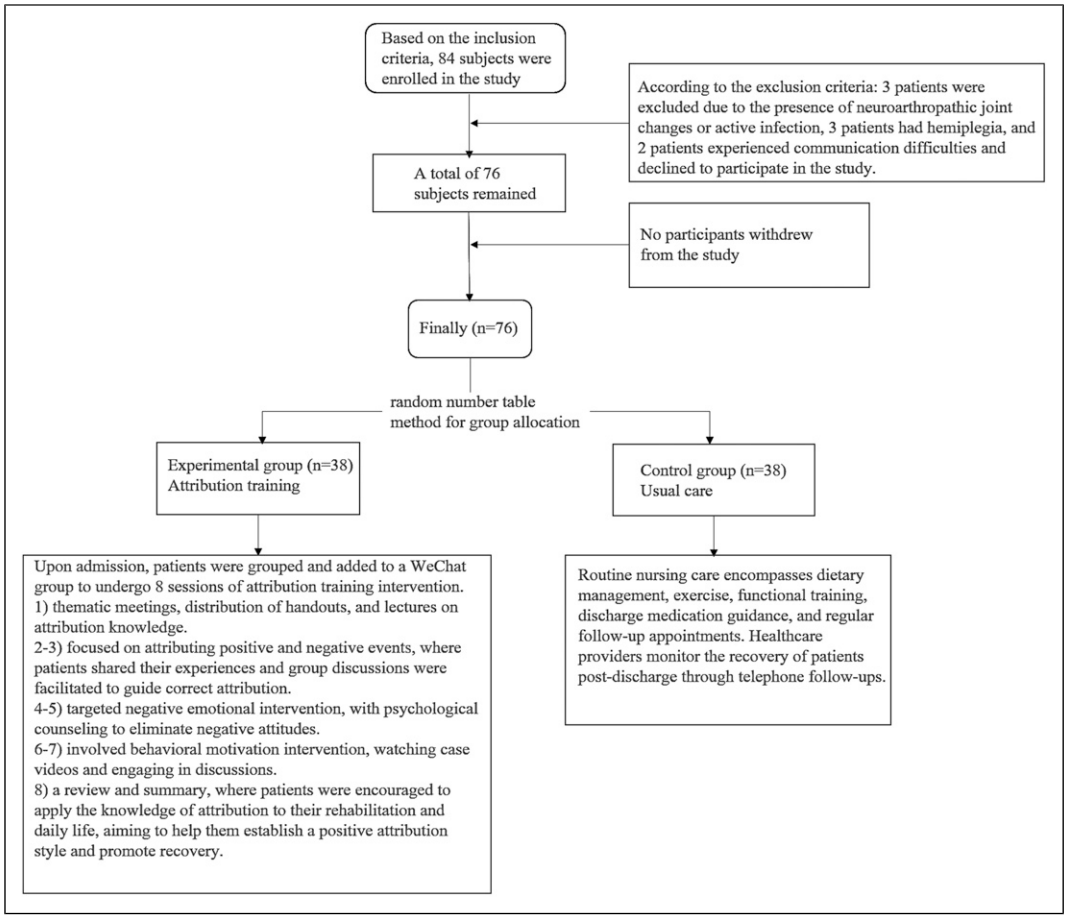

Figure 1. The flow chart of the study.

improvement in their scores after the intervention (both $P < 0.05$), as shown in Table 4.

Discussion

Total knee arthroplasty (TKA) is a common method for treating severe knee joint diseases, relieving knee joint pain, and restoring joint function. However, the postoperative recovery outcomes vary due to various factors such as patient psychology and exercise frequency.[14] As a crucial aspect of postoperative TKA, functional exercise relies on patients' independent completion. However, most elderly patients, enduring prolonged suffering from illness, exhibit significant negative emotions and lack proper understanding of postoperative exercise and treatment plans, resulting in poor treatment compliance.[23,24] Therefore, it is essential for health care providers to deliver positive messages regarding treatment and rehabilitation to elderly knee replacement patients, helping them overcome misconceptions and actively participate in postoperative functional exercise.

Conventional nursing interventions primarily focus on improving patients' compliance with functional exercise and the improvement of clinical symptoms, often overlooking the internal driving force behind changes in patients' self-management behaviors, thus rendering their effectiveness limited.[25]

Impact of Attribution Training on Patient Anxiety and Depression

Based on the effect size results, we found that although both the control group and the intervention group showed improvements in depression, the improvements in the study group were greater than those in the control group. The reasons for this are as follows: due to the severity of knee joint disease pain, patients often endure prolonged periods of illness. Moreover, elderly individuals have a lower sense of control and limited understanding of their illness, resulting in slow recovery of knee joint function. Additionally, limited social and family support further affects patients' enthusiasm and confidence in dealing with events.[26,27] Positive attribution provided

Table 1. Socio-Demographic and General Clinical Data of the Two Groups of Patients.

Item	Control Group (n = 38)	Intervention Group (n = 38)	X^2/t Value	*P* Value
Gender			0.216	0.642
Male	21	23		
Female	17	15		
Age	68.45 ± 6.26	68.53 ± 7.29	0.051	0.959
Disease proportion			0.246	0.970
Traumatic osteoarthritis	7	6		
Rheumatoid arthritis	12	11		
Degenerative knee osteoarthritis	14	15		
Others	5	6		
Average hospital stay (days)	6.17 ± 3.09	6.14 ± 3.12	0.042	0.967
Site of disease			0.066	0.596
Left side	10	11		
Right side	28	27		
BMIkg/m^2	23.32 ± 2.14	22.48 ± 2.56	1.771	0.079
Education level			0.083	0.959
Middle school	10	9		
High school	16	17		
College and above	12	12		
Medical payment method			0.983	0.612
Medical insurance	28	26		
Self-pay	6	5		
Others	4	7		
Kellgren-Lawrence (K-L) grading			0.053	0.832
Grade III	20	19		
Grade IV	18	19		

Note: Comparisons of categorical data were performed using the chi-square test; Intergroup comparisons were conducted using Student's t-test.

Table 2. Intergroup and Intragroup Comparison of Negative Emotion Scores (mean ± sd, scores) (n = 38).

		HAMA			HAMD		
Group	n	Before intervention	After intervention	Effect size	Before intervention	After intervention	Effect size
Control group	38	37.52 ± 5.34	20.94 ± 3.45$^{\#}$	2.40	35.75 ± 4.47	19.89 ± 3.31$^{\#}$	0.94
Intervention group	38	37.45 ± 5.25	18.96 ± 3.37$^{*\#}$	2.66	35.84 ± 4.53	17.58 ± 3.24$^{*\#}$	1.18
t	-	0.058	2.531		0.087	3.074	
P	-	0.954	0.014		0.931	0.003	

Note: Intragroup comparisons were analyzed using effect size analysis, while intergroup comparisons were conducted using Student' t-test. Compared with the control group, $^{*}P < 0.05$, compared with before the intervention, $^{\#}P < 0.05$.

psychological support to patients during attribution training, guiding them to build confidence in facing life and subjective well-being. Through attributional evaluation, attributional analysis, and positive attribution guidance, negative attributions gradually transformed into positive attributions. Furthermore, patients were guided to re-evaluate their emotions and understanding of the illness postoperatively, thereby enhancing their treatment confidence. This finding is consistent with previous research.[28] Correct attributional guidance helped patients recognize the irrationality of their self-perception and understand the impact of emotional changes on event outcomes, thereby improving feelings of depression and enhancing their ability to resist negative emotions caused by past misconceptions. Additionally, the control group also showed some improvement in postoperative depression. We believe this may be due to the fact that our traditional postoperative rehabilitation care includes some elements of attribution training, such as cognitive education, even though the

Table 3. Intergroup and Intragroup Comparison of Attributional Style Questionnaire (ASQ) Scores (mean ± sd, Scores) (n = 38).

		Positive Events			Negative Events		
Group	n	Before intervention	After intervention	Effect size	Before intervention	After intervention	Effect size
Control group	38	14.69 ± 2.78	22.14 ± 4.01$^{\#}$	4.39	25.06 ± 3.88	16.78 ± 3.21$^{\#}$	−2.34
Intervention group	38	15.01 ± 2.45	24.56 ± 4.55$^{*\#}$	2.73	26.01 ± 3.26	14.88 ± 2.98$^{*\#}$	−3.62
t	-	0.532	2.158		1.156	2.674	
P	-	0.596	0.032		0.252	0.009	

Note: Intragroup comparisons were analyzed using effect size analysis, while intergroup comparisons were conducted using Student' t-test. Compared with the control group, $^{*}P < 0.05$, compared with before intervention, $^{\#}P < 0.05$.

Table 4. Intergroup and Intragroup Comparison of Knee Joint Function Scores (mean ± sd, Scores) (n = 38).

		HSS		
Group	n	Before intervention	After intervention	Effect size
Control group	38	39.26 ± 5.71	78.56 ± 6.39$^{\#}$	6.49
Intervention group	38	39.68 ± 5.62	84.25 ± 7.02$^{*\#}$	7.05
t	-	0.323	3.696	
P	-	0.747	0.000	

Note: Intragroup comparisons were analyzed using effect size analysis, while intergroup comparisons were conducted using Student' t-test. Compared to the control group, $^{*}P < 0.05$, compared to before intervention, $^{\#}P < 0.05$.

attribution training in traditional postoperative rehabilitation care is not systematic enough.

Impact of Attribution Training on Patient ASQ Scores

The results of this study showed that after intervention, the intervention group had higher scores for positive events and lower scores for negative events compared to the control group, indicating effective relief of negative emotions and the formation of a positive attributional style after intervention. Due to the poor physical activity status of elderly patients, their self-exercise efficacy and motivation levels are generally low, resulting in slow recovery of knee joint function.[29] The reasons for this are as follows: conventional nursing care primarily focuses on promoting the physiological recovery of patients and often neglects their subjective feelings. In most cases, patients passively engage in rehabilitation exercises. Some patients postoperatively worry about treatment costs and the effectiveness of exercise, coupled with factors such as physical strength and age, leading to ineffective release of negative emotions and hindering self-regulation. Attribution training alleviates postoperative tension, doubts, and excessive worries through emotional intervention, reduces psychological burdens, enhances patients' understanding of their illness and prognosis, and helps patients realize the adverse effects of their negative emotions on disease recovery and rehabilitation compliance.[30,31] By utilizing the power of family members and peers to support and supervise patients, attribution training encourages patients to adopt healthy behavior motivations, correct erroneous behavior motivations, and improve human behavior motivation, increase expectations of future success, and enhance behavior persistence. This is similar to the findings of Wu et al.,[32] attribution training explains learning motivation based on success and failure attributions.[33] Through group discussions and positive feedback, patients attribute their own behavioral causality, eliminate attribution biases, reduce the occurrence of negative events, change patients' cognitive perceptions, guide patients to view treatment correctly, enhance their understanding of the disease and prognosis, and increase their motivation for success, viewing their illness in a positive attributional manner.

Impact of Attribution Training on Patient Knee Joint Function Scores

The results of this study showed that after intervention, the intervention group had higher HSS scores and lower VAS scores compared to the control group, indicating a significant improvement in knee joint stability, muscle strength, and flexion function in patients who received attribution training after elderly total knee arthroplasty. The reasons for this are as follows: attribution training allows patients to face various postoperative problems and conduct attributional learning and analysis, helping them establish adaptive attributional behaviors. This assists

patients in correctly attributing various symptoms during rehabilitation training, adhering to the rehabilitation exercise plan, adjusting cooperation in a timely manner, mastering the correct exercise techniques, and continuously providing feedback to nursing staff and psychological counselors regarding the issues they encounter. This minimizes the negative factors caused by improper training and promotes patients' active cooperation in treatment and rehabilitation training, thereby achieving rapid recovery of knee joint function.[31] Postoperative patients establish and consolidate correct attributional styles, resulting in good psychological states and increased compliance with rehabilitation training and precautions, contributing to disease prognosis.

Despite significant findings, this study has limitations. The small sample size may limit generalizability, suggesting the need for larger studies. Additionally, the short study duration and reliance on self-reported measures introduce biases. Future research should consider longer follow-up periods, objective measures, and confounding variables like comorbidities. While the randomized controlled trial design minimizes bias, blinding was not feasible. Future studies could explore alternative designs. Finally, long-term effects and broader outcomes like quality of life warrant investigation. Addressing these limitations will enhance the validity and applicability of attribution training in knee replacement patients.

Conclusions

In summary, attribution training plays a significant role in the rehabilitation of elderly knee replacement patients, demonstrating innovation and applicability worthy of clinical promotion. However, due to the limited sample size, the study results have certain limitations. Future research should expand the sample size and use structural equation models to verify potential factors, accurately assess the effects of attribution training, and increase evaluations of patients' subjective feelings. By considering changeable factors, more effective intervention plans can be developed to provide personalized services and guidance, thereby better promoting comprehensive physical and mental recovery in patients.

Appendix

Abbreviations

ASQ	Attributional style questionnaire
HAMA	Hamilton anxiety rating scale
HAMD	Hamilton depression rating scale
HSS	Hospital for special surgery knee score
SD	Standard deviation
TKA	Total knee arthroplasty.

Author Contributions

FJY contributed to the conception and design of the study; XC performed the experiments, collected data, analyzed data and wrote the manuscript; FJY revised the manuscript. All authors reviewed and approved the final version of the manuscript.

Declaration of Conflicting Interests

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

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Ethical Statement

Ethical Approval

This study protocol was in accordance with the Declaration of Helsinki of the World Medical Association. This study was approved by the medical ethics committee of Haikou Orthopedic and Diabetes Hospital of Shanghai Sixth People's Hospital (Ethics Approval No. ZY-IRB-FOM-037). Prior to participation in the study, patients and their guardians provided informed consent, demonstrating their willingness to be included in the research.

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Supplemental Material

Supplemental material for this article is available online.

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