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Effects of PERMA-Based Psychological Intervention Combined with Otago Exercise Training on Fall Risk Reduction in Stroke Patients

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Abstract

Objective: To explore the clinical effects of PERMA combined with Otago exercise training in reducing the risk of falls in stroke patients. **Methods:** A total of 56 stroke patients were randomly divided into a control group (28 cases, receiving routine health education and rehabilitation training) and an observation group (28 cases, receiving PERMA combined with Otago exercise training). Fall efficacy scores, fall incidence, BI index, IWB score, neurological function rating, and treatment compliance were observed and compared between the two groups. **Results:** Before intervention, there was no significant difference in fall efficacy scores between the two groups ($P > 0.05$). After intervention, the fall efficacy scores in the observation group were significantly higher than those in the control group before discharge, and at 1, 2, and 3 months after discharge ($P < 0.05$). Three months after discharge, the fall incidence was 7.14% (2 cases) in the control group and 0% (0 cases) in the observation group, with no statistically significant difference ($P > 0.05$). The BI index and IWB score were significantly higher in the observation group than in the control group after intervention ($P < 0.05$). Regarding neurological function, three months after discharge, the number of patients with grade 0 and grade 1 neurological function ratings was higher in the observation group, while the number of patients with grade 2 ratings was lower compared to the control group ($P < 0.05$). Treatment compliance scores in the observation group were significantly higher than those in the control group at 2 and 3 months after discharge ($P < 0.05$). **Conclusion:** The application of PERMA combined with Otago exercise training is clinically effective in stroke patients. It significantly reduces the risk of falls, improves neurological function, enhances daily living abilities and subjective well-being, and increases intervention satisfaction, making it a suitable clinical intervention.

Keywords PERMA; Otago Exercise Training; Stroke Patients; Fall Risk

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1 Introduction

Stroke is an acute cerebrovascular disease caused by the sudden rupture or blockage of cerebral blood vessels. It has a high incidence, mortality, and recurrence rate in China and is the leading cause of disability and death among Chinese adults[1]. The etiological factors of stroke are associated with cerebral arteriosclerosis, thrombosis, and cerebral embolism. The clinical manifestations include headache, dizziness, limb weakness or numbness, language impairment, consciousness disorders, paresthesia, and swallowing difficulties, all of which significantly impact patients' daily lives and overall health[2,3].

Currently, in the clinical treatment of stroke patients, in addition to routine surgical and pharmacological interventions, effective rehabilitation therapy is also crucial. The PERMA model is a comprehensive psychological intervention framework comprising five core elements: positive emotion, engagement, relationships, meaning, and achievement. By addressing these five aspects, patients can achieve holistic development and enhance their overall well-being[4].

Otago exercise training is a structured program designed to prevent falls by strengthening muscles and improving balance, thereby reducing fall risk and enhancing the quality of life in stroke patients. However, there is limited clinical research on the combined application of PERMA and Otago exercise training in mitigating fall risk among stroke patients. The lack of a robust theoretical foundation necessitates further investigation.

To assess the efficacy of PERMA combined with Otago exercise training in reducing fall risk among stroke patients, this study analyzed 56 stroke patients. The findings are reported below.

2 Information and Methods

2.1 General Information

A total of 56 stroke patients were selected, all of whom were treated in our hospital from June 2024 to October 2024. The patients were divided into two groups using a random number allocation method. The first 28 cases were assigned to the control group, while the remaining 28 cases were assigned to the observation group. Baseline data for both groups were compared, showing no significant differences ($P > 0.05$). See Table 1.

Table 1 Comparison of general information between the two groups

Group	sexuality/[n(%)]		Age/years old	Course of disease/d
	Male	female		
Observation group(n=28)	20	8	50.30±1.73	28.26±4.81
Control group(n=28)	21	7	49.70±2.81	28.44±4.93
χ^2 or t	0.091		0.962	0.138
P	0.763		0.340	0.891

2.2 Inclusion and Exclusion Criteria

The inclusion criteria were as follows: all selected patients met the diagnostic criteria for stroke as outlined in the Chinese Guidelines for the Diagnosis and Treatment of Acute Ischemic Stroke (2018)[5,6]. The diagnosis was confirmed by MRI or CT examination, with complete imaging data, including head MRI and CT. The patients were aged between 40 and 60 years and had clear consciousness, adequate verbal communication skills, and the ability to comprehend and follow intervention instructions. They were able to walk independently or with the assistance of auxiliary tools. Additionally, their vital signs were stable, with no severe dysfunction of the heart, liver, kidneys, or other major organs. Patients and their families were informed about the study and provided consent. The Modified Rankin Scale (MRS) score was adjusted to be 4 points or less.

The exclusion criteria included patients in the acute stage of stroke or those with autoimmune diseases. Patients with mental disorders, cognitive impairments, language dysfunction, or consciousness disturbances were also excluded. Those diagnosed with organic diseases or requiring hospitalization for more than four weeks were not included. Additionally, patients with severe concomitant conditions, such as heart failure, liver and kidney insufficiency, or myocardial infarction, were excluded from the study.

2.3 Methods

The control group received routine health education and rehabilitation training. The nursing staff provided routine health education to the patients and their families, introducing the causes of stroke, treatment options, intervention methods, and potential sequelae. Routine guidance on medication, diet, and daily living activities was also provided to maintain a hygienic ward environment. Based on the patients' recovery progress, they were guided through rehabilitation training. Initially, passive exercises targeting the hips, knees, and ankles were performed. As their condition improved, they progressed to active training, including sitting, standing, and walking exercises. Each training session lasted 30 minutes and was conducted twice daily. The intervention period was three months.

The observation group underwent PERMA combined with Otago exercise training.

The intervention team was composed of one master's supervisor, one psychological consultant, two neurologists, one rehabilitation therapist, one head nurse from the neurology depart-

ment, four nurses with intermediate or senior titles from the neurology department, and the researchers themselves. The team members had clearly defined roles: the supervisor provided nursing guidance and quality control, the neurologists assessed patients' conditions and provided treatment guidance, the rehabilitation therapist developed and supervised the daily rehabilitation plan, and the psychological consultant addressed patients' psychological well-being. Neurology nurses guided patients through Otago exercises and provided comprehensive health education. The researchers were responsible for reviewing literature, designing expert consultation questionnaires, analyzing expert meeting results, and formulating and implementing the intervention plan.

The specific nursing interventions were structured as follows:

In the first week (upon patient discharge), the nursing staff actively communicated with patients, encouraging them to express their thoughts and concerns, followed by targeted psychological counseling. Rehabilitated patients were invited to share their experiences to boost patients' confidence in treatment. Patients were provided with an Otago exercise instruction manual and received individualized verbal explanations about the exercises, emphasizing their importance and benefits.

In weeks two and three, lectures on positive emotions were organized. Patients who actively improved their emotional state were praised, and they were encouraged to participate in Otago exercise training via video demonstrations. Small-group sessions were conducted to introduce Otago exercise techniques and safety precautions.

During weeks four and five, interventions focused on understanding patients' interests and organizing related activities, such as reading, singing, and listening to music. Video-based guidance was used to reinforce Otago exercise training. Small-group discussions were held to emphasize key aspects of the exercises and reinforce safety precautions.

In weeks six and seven, interpersonal relationship-oriented interviews were conducted to illustrate four different response styles: active, constructive, passive, and destructive. Role-playing exercises were used to help patients improve their ability to perceive happiness. Through WeChat video sessions, patients were guided and reminded about precautions for walking and stair training.

In weeks eight and nine, sessions on the theme of life meaning were conducted to help patients recognize their uniqueness and view life challenges optimistically. Video guidance continued to encourage Otago exercise training, and patients were advised on the importance of balance training to prevent falls.

During weeks ten and eleven, experienced patients were invited to share their insights. Video sessions continued to guide and encourage adherence to Otago exercise training. Patients were educated on the long-term benefits of maintaining this exercise routine.

In week twelve, an achievement-focused interview was conducted to reinforce the psychological benefits of accomplishment. Patients were encouraged to engage in activities they excelled in. Based on their recovery progress, personalized functional exercise plans and goals were established.

The intervention period lasted for three months.

2.4 Observation Indicators

Several indicators were used to evaluate the intervention outcomes:

Fall efficacy: The Fall Efficacy Scale (FES) was used to assess the fall efficacy of both groups at four time points: before discharge, and at 1, 2, and 3 months post-discharge.

Incidence of falls: The incidence of falls was recorded and compared between the two groups three months after discharge.

Self-care ability and subjective well-being: The Barthel Index (BI) was used to evaluate the self-care ability of both groups before discharge, and at 1, 2, and 3 months post-discharge. Additionally, the Subjective Well-being Index Scale (IWB) was used to assess the subjective well-being of the patients at the same time points.

Neurological function rating: The modified Rankin Scale (mRS) was employed to evaluate neurological function three months post-discharge. The scale ranges from 0 to 5, with higher scores indicating more severe neurological impairment.

Treatment compliance: The Stroke Functional Exercise Compliance Questionnaire was used to assess and record patient adherence to the prescribed rehabilitation program.

2.5 Statistical Methods

Statistical analysis was performed using SPSS 22.0 software. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables were presented as frequencies and percentages and analyzed using the chi-square (χ^2) test or Fisher's exact test, as appropriate. A P-value of less than 0.05 was considered statistically significant.

3 Results

3.1 Comparison of Fall Efficacy Scores Between the Two Groups Before and After Intervention

The fall efficacy scores of the two groups before intervention showed no significant difference ($P > 0.05$). However, after the intervention, the fall efficacy scores in the observation group were significantly higher than those in the control group at four time points: before discharge, and at 1, 2, and 3 months post-discharge ($P < 0.05$). See Table 2.

3.2 Comparison of the Incidence of Falls Between the Two Groups After Discharge

Three months after discharge, two patients in the control group experienced falls, resulting in an incidence rate of 7.14%. In contrast, no patients in the observation group experienced falls, yielding an incidence rate of 0.00%. The difference in fall incidence between the two groups was not statistically significant ($P > 0.05$).

Table 2 Comparison of fall efficacy scores between the two groups before and after intervention（$\bar{x} \pm s$,score）

Group	pre-intervention	Before discharge	1 month after discharge	2 months after discharge	3 months after discharge
Observation group(n=28)	5.38±1.02	6.42±1.35	7.31±0.91	7.98±1.15	8.46±0.77
Control group(n=28)	5.37±0.69	5.76±1.02	6.04±0.65	6.42±0.33	7.22±0.71
t	0.043	2.064	6.009	6.900	6.265
P	0.966	0.044	0.000	0.000	0.000

3.3 Comparison of BI Index and IWB Score Between the Two Groups Before and After Intervention

The BI index and IWB score were compared between the two groups before intervention, showing no significant difference ($P > 0.05$). However, after intervention, the BI index and IWB score in the observation group were significantly higher than those in the control group at four time points: before discharge, and at 1, 2, and 3 months post-discharge ($P < 0.05$). See Table 3.

Table 3 Comparison of BI index and IWB score between the two groups before and after intervention ($\bar{x} \pm s$, score)

Group	BI				
	pre-intervention	Before discharge	1 month after discharge	2 months after discharge	3 months after discharge
Observation group(n=28)	29.13±2.03	33.46±2.69	37.44±1.14	39.97±2.15	42.36±1.56
Control group(n=28)	29.41±1.98	31.14±1.83	33.85±0.97	35.02±1.50	37.02±1.13
t	0.522	3.773	12.691	9.991	14.669
P	0.603	0.000	0.000	0.000	0.000

IWB scoring				
pre-intervention	Before discharge	1 month after discharge	2 months after discharge	3 months after discharge
26.43±1.77	30.12±1.35	34.45±1.26	39.76±2.26	40.22±1.31
26.51±1.82	28.74±1.09	30.15±0.13	33.52±1.09	35.16±1.07
0.167	4.209	17.963	13.160	15.830
0.868	0.000	0.000	0.000	0.000

3.4 Comparison of Neurological Function Ratings Between the Two Groups Three Months After Discharge

Three months post-discharge, the distribution of patients with neurological function ratings of grade 3, grade 4, and grade 5 showed no significant difference between the two groups ($P > 0.05$). However, the number of patients with grade 0 and grade 1 neurological function ratings

in the observation group was higher than that in the control group, while the number of patients with a grade 2 neurological function rating was lower than that in the control group ($P < 0.05$). See Table 4.

Table 4 Neurological function ratings of the two groups 3 months after discharge [n(%)]

Group	Lv 0	Lv 1	Lv 2	Lv 3	Lv 4	Lv 5
Observation group(n=28)	8（28.57）	10（35.71）	5（17.86）	3（10.71）	1（3.57）	1（3.57）
Control group(n=28)	2（7.14）	3（10.71）	12（42.86）	5（17.86）	4（14.29）	2（7.14）
χ^2	4.383	4.909	4.139	0.583	1.976	0.352
P	0.036	0.027	0.042	0.445	0.160	0.553

3.5 Comparison of Treatment Compliance Scores Between the Two Groups

Treatment compliance scores were compared between the two groups before intervention, before discharge, and one month post-discharge, with no significant difference observed ($P > 0.05$). However, the compliance score in the observation group was significantly higher at 2 and 3 months post-discharge compared to the control group ($P < 0.05$). See Table 5.

Table 5 Comparison of treatment compliance scores between the two groups ($\bar{x} \pm s$, score)

Group	pre-intervention	Before discharge	1 month after discharge	2 months after discharge	3 months after discharge
Observation group(n=28)	15.37±0.14	16.34±1.17	19.54±1.31	23.15±0.21	32.01±0.06
Control group(n=28)	15.26±0.26	16.20±0.88	19.30±1.29	21.34±0.44	28.40±0.12
t	1.971	0.506	0.691	19.645	142.380
P	0.054	0.615	0.493	0.000	0.000

4 Discussion

Stroke has become the leading cause of death among Chinese residents, and in recent years, its incidence has shown a significant upward trend, posing a serious threat to public health[7,8]. Following the onset of stroke, patients often present with symptoms such as facial asymmetry, limb numbness and weakness, blurred or lost vision, and consciousness disorders. These symptoms not only have a significant impact on patients' physical health but also cause considerable psychological distress. Therefore, in the clinical management of stroke patients, it is crucial to provide comprehensive health training while also addressing mental health and stabilizing emotional well-being[9,10].

In this study, fall efficacy scores were compared between the two groups before intervention, showing no significant difference ($P > 0.05$). However, after intervention, the fall efficacy scores in the observation group were significantly higher than those in the control group at four time points: before discharge, and at 1, 2, and 3 months post-discharge ($P < 0.05$). Three months post-discharge, two patients in the control group experienced falls, resulting in an incidence rate of 7.14%, whereas no patients in the observation group experienced falls (0.00%). The difference in fall incidence between the two groups was not statistically significant ($P > 0.05$).

The BI index and IWB score were also compared between the two groups before intervention, showing no significant difference ($P > 0.05$). After intervention, both scores were significantly higher in the observation group compared to the control group at all measured time points: before discharge, and at 1, 2, and 3 months post-discharge ($P < 0.05$). Similarly, neurological function ratings for grades 3, 4, and 5 showed no significant difference between the two groups three months post-discharge ($P > 0.05$). However, the number of patients with grade 0 and grade 1 neurological function ratings was higher in the observation group, while the number of patients with a grade 2 rating was lower compared to the control group ($P < 0.05$).

Treatment compliance scores were compared before intervention, before discharge, and one month post-discharge, showing no significant difference ($P > 0.05$). However, compliance scores in the observation group were significantly higher at 2 and 3 months post-discharge compared to the control group ($P < 0.05$). These findings suggest that PERMA combined with Otago exercise training is an effective clinical intervention for stroke patients.

In summary, the application of PERMA combined with Otago exercise training has demonstrated significant clinical benefits for stroke patients. This combined intervention effectively reduces fall risk, improves neurological function, enhances daily living abilities, and increases subjective well-being and overall intervention satisfaction.

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