

## Study on the Effect of Music Beat-Guided Ball Gripping Exercise in PICC-Catheterized Cancer Patients (Postprint)

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### Abstract

**Objective:** To investigate the effects of different exercise guidance methods on compliance with ball-squeezing exercise among cancer patients with peripherally inserted central catheter (PICC), and to provide a reference for exercise guidance in PICC catheterized patients in clinical practice.

**Methods:** A total of 100 PICC catheterized patients admitted to the hematology department of a tertiary grade-A hospital were enrolled and divided into an intervention group and a control group, with 50 patients in each group. The intervention group received music rhythm-guided ball-squeezing exercise instruction, while the control group received paper-based pictorial exercise instruction. The intervention lasted for 4 weeks. Both groups were assessed for ball-squeezing exercise compliance using the Ball-squeezing Exercise Compliance Scale before and after the intervention.

**Results:** Before the intervention, there was no statistically significant difference in ball-squeezing exercise compliance between the two groups ( $P>0.05$ ). After the intervention, the ball-squeezing exercise compliance of both groups was higher than before the intervention ( $P<0.01$ ), and the compliance of the intervention group was significantly higher than that of the control group ( $P<0.05$ ).

**Conclusion:** Music rhythm-guided ball-squeezing exercise can significantly improve exercise compliance among cancer patients with PICC catheterization, providing a reference for exercise guidance for PICC catheterized patients in clinical practice.

## Full Text

### Abstract

**Objective** To investigate the influence of different exercise guidance methods on compliance with hand grip ball exercise among cancer patients with peripherally inserted central catheters (PICC), and to provide reference for clinical exercise guidance for PICC patients. **Methods** Patients with PICC placement admitted to the hematology department of a tertiary Grade A hospital were selected as study subjects and divided into an intervention group and a control group, with participants in each group. The intervention group received metronome-guided hand grip ball exercise, while the control group received paper-based pictorial exercise guidance. The intervention lasted for weeks. Both groups were evaluated using the Hand Grip Ball Exercise Compliance Scale before and after intervention. **Results** Before intervention, there was no statistically significant difference in hand grip ball exercise compliance between the two groups ( $P > .$ ). After intervention, compliance in both groups was higher than before ( $P < .$ ), and the intervention group's compliance was significantly higher than the control group's ( $P < .$ ). **Conclusion** Metronome-guided hand grip ball exercise can significantly improve exercise compliance in cancer patients with PICC catheterization, providing reference for clinical exercise guidance.

**Keywords:** metronome; peripherally inserted central catheters; exercise; compliance

### Introduction

Peripherally inserted central catheters (PICC) are a reliable and relatively long-term central venous access [1]. Due to advantages such as simple operation, safety, convenient daily maintenance, and long indwelling time, they are widely used in clinical practice [2]. PICC placement can lead to complications such as infection and catheter-related thrombosis [3]. Catheter-related thrombosis (CRT) is one of its most serious complications, which can cause pulmonary embolism and endanger patients' lives [4]. Studies have shown that hand grip ball exercise can promote blood flow, improve vascular condition, and effectively prevent upper extremity venous thrombosis in cancer patients with PICC [5]. However, compliance with hand grip ball exercise among PICC patients in clinical practice is not ideal. Treatment response, disease coping attitude, and mastery of fist exercise knowledge are the main influencing factors [6]. Additionally, most cancer patients experience varying degrees of fatigue, pain, gastrointestinal symptoms related to chemotherapy, as well as psychological, family, and social pressures, which directly affect quality of life and treatment compliance [7]. Patients with long-term PICC placement find it difficult to persist with fist exercises. Some studies [8] have reported that music rhythm can effectively promote the brain into a highly relaxed state and can standardize rehabilitation treatment operations, promote timely and quantitative completion of rehabilitation training, improve patient treatment compliance and accuracy, and ensure

rehabilitation training effectiveness [9]. Therefore, this study primarily explored the effect of metronome guidance on hand grip ball exercise compliance in cancer patients with PICC, providing reference for exercise guidance in clinical PICC patients.

## Methods

### Study Design and Participants

This study selected PICC patients admitted to the hematology department of the First Affiliated Hospital of Guangxi Medical University as research subjects. Inclusion criteria were: clinically diagnosed with hematological malignancies; PICC indwelling time exceeding hours; no communication barriers; no limb movement disorders; owned and could use smart devices; informed consent to participate. Exclusion criteria were: severe dysfunction of vital organs (heart, lung, liver, kidney); mental illness; exercise contraindications. Dropout criteria were: voluntary withdrawal from hand grip ball exercise intervention; death during observation period. This project was approved by the Ethics Committee of the First Affiliated Hospital of Guangxi Medical University [ (KY-E- )]. A total of patients were enrolled as observation objects, including males and females, with an average age of years in the control group and years in the intervention group. Educational levels ranged from primary school and below to junior high school to high school and above in both groups. There were no statistically significant differences in gender, age, or other general data between the two groups ( $P >$ ), indicating comparability.

### Questionnaire Design

Referencing Weng Guizhen's [10] investigation on exercise prescription compliance in gastric cancer patients with cancer-related fatigue, we designed a hand grip ball exercise compliance evaluation scale consisting of three parts. The first part collected general patient information: age, gender, hospitalization number, and education level. The second part assessed patient compliance with fist exercise, including: whether patients could remember the basic requirements of hand grip ball exercise; whether they could follow the exercise regimen formulated by medical staff, including performing exercises on time and in the prescribed amount according to guidance at catheter placement, and using correct methods daily for hand grip ball exercise. It also assessed self-monitoring ability, including whether patients could self-supervise and record exercise diaries daily, and observe the puncture site condition after each exercise. Additionally, it evaluated whether patients could accept supervision from others and actively seek advice, including accepting supervision from family, friends, or medical staff during exercise; actively communicating with medical staff when encountering problems and accepting their recommendations; communicating with other patients requiring hand grip ball exercise; and actively seeking alternative exercise plans when perceiving ineffective exercise or monotonous methods. The scale

also included self-assessment of fatigue level after exercise. The third part examined reasons for failing to perform hand grip ball exercise on time and in the prescribed amount. After a pilot survey of patients, the scale's reliability was calculated: internal consistency Cronbach's  $\alpha$  was and content validity I-CVI was .

### **Intervention**

Based on the research group's evidence-based study results, we constructed a PICC patient hand grip ball exercise protocol: "Begin hand grip ball exercise with the catheterized limb hours after catheter placement, at least daily, preferably in the morning, afternoon, and evening. Each standardized exercise consists of groups of consecutive grips, trying to compress the ball to its full volume for seconds before relaxing for seconds." According to this protocol, we developed metronome-guided exercise audio and pictorial educational materials. Before exercise guidance, on-site questionnaires were administered to understand patients' baseline exercise compliance levels.

After group assignment, the control group received catheter maintenance and self-management health education after catheter placement, along with paper-based pictorial hand grip ball exercise guidance including illustrated instructions and diagrams explaining the importance and necessity of fist exercise. The intervention group, based on the control group's education, received exercise guidance audio (metronome-guided) instead of pictorial guidance, was informed of hand grip ball exercise methods, and performed each exercise under the guidance of the audio. After weeks of hand grip ball exercise, telephone follow-up surveys were conducted to assess exercise compliance.

### **Data Collection**

The principal investigator was responsible for distributing exercise materials and providing on-site guidance, promptly answering questions from participants. Follow-up data collection was conducted via telephone to gather patient hand grip ball exercise compliance information. The second part of the Hand Grip Ball Exercise Compliance Evaluation Scale comprised items for patient subjective fatigue level and items for hand grip ball exercise compliance. Each item used a 4-point scoring method corresponding to four levels: "completely unable to do," "occasionally able to do," "basically able to do," and "completely able to do." Compliance scoring: total score was the sum of all item scores, with higher scores indicating better compliance. Compliance rate calculation: (actual compliance score/theoretical maximum compliance score  $\times$  %). Hand grip ball exercise compliance rates were categorized as low, medium, and high, corresponding to different levels.

## Statistical Analysis

SPSS software was used. Measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), with comparisons between groups using t-tests. Count data were expressed as percentages (%) using  $\chi^2$  tests. Ranked data used rank-sum tests. The significance level was  $\alpha = 0.05$ , with  $P < 0.05$  considered statistically significant.

## Results

### Patient Characteristics and Baseline Compliance

Before intervention, there was no statistically significant difference in hand grip ball exercise compliance between the two groups ( $P > 0.05$ ). After audio and pictorial intervention, compliance in both groups was higher than before intervention, with statistically significant differences ( $P < 0.05$ ). After intervention, the intervention group's compliance was significantly higher than the control group's, with statistically significant differences ( $P < 0.05$ ).

Comparison of Patient Compliance Between Two Groups Before and After Intervention [n(%)]

### Factors Affecting Compliance

The third part consisted of open-ended questions about factors affecting timely and adequate hand grip ball exercise. A total of patients were surveyed, of whom did not answer this question, leaving valid responses with an effective response rate of . As shown in [Figure 1: see original paper], the main factors affecting timely and adequate hand grip ball exercise in PICC patients were lack of professional guidance, fear of exercise-induced injury, lack of free time, and chemotherapy drug side effects.

[Figure 1: see original paper] Main Factors Affecting Exercise Compliance in PICC Patients (n = )

## Discussion

PICC placement can reduce the pain of frequent venipuncture for patients, avoid vascular damage from irritating drugs and chemotherapy extravasation, control medical risks, and improve patient comfort and satisfaction [11]. Currently, hand grip exercise is the main method used domestically to prevent thrombosis after PICC placement, with preventive effects primarily depending on patient compliance [12]. However, hand grip exercise is mechanical and lacks interest for patients, making it difficult to persist [13]. Additionally, due to concerns about catheter dislodgement and pain, patients often avoid moving the catheterized limb, resulting in relatively low exercise compliance [14]. This study found that the main factors affecting hand grip ball exercise compliance in cancer patients with PICC were fear of exercise-induced injury and lack of professional guidance.

This study demonstrates that metronome-guided hand grip ball exercise can significantly improve exercise compliance levels in cancer patients with PICC. Research by Xie Fangmei et al. [15] and Guo Shan [16] showed that music grip training exercises can effectively improve patient grip training compliance. Metronome-guided training using audio assistance helps patients easily accept and master training essentials. Moreover, metronome-guided hand grip ball exercise can reduce the boredom of conventional training, increase exercise interest, and thereby improve compliance [17]. Wang Xiaomin et al. [18] found that music grip training can help patients focus their attention on grip training, reducing discomfort caused by catheterization and improving compliance.

Metronome guidance provides scientific hand grip ball exercise instruction. This study found that most patients could not complete exercises on time and in the prescribed amount due to lack of professional guidance. The metronome, with its stability, regularity, and periodicity [19], is an ideal clinical practice method for guiding hand grip exercises. By constructing exercise prescriptions and creating corresponding audio files for clinical application in cancer patients, this study guided patients through auditory cues, scientifically quantified hand grip exercises, and standardized patient operations. This made exercise prescriptions clearer and more understandable, enabling patients to complete them on time and in the prescribed amount to achieve optimal therapeutic effects [20]. After catheterization, patients often lack knowledge about post-catheterization hand grip exercise and fear incorrect exercise methods may injure the catheterized limb, resulting in low compliance. Health education for catheterized patients can enhance health knowledge and awareness, help patients correctly understand their disease, maintain a positive attitude, improve risk awareness, and increase exercise compliance [21]. Meanwhile, metronome guidance can help patients better master resistance exercise knowledge, standardize rehabilitation operations, promote timely and quantitative completion of exercises, improve compliance and accuracy, and ensure training effectiveness [22].

In summary, using metronome guidance can accurately direct cancer patients with PICC to perform standardized hand grip ball exercises, improve exercise compliance, and provide reference for clinical exercise guidance in cancer patients with PICC.

**Conflict of Interest Statement:** The authors declare no conflict of interest in this article.

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