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Original Article

Ball-grip exercise to improve fine motor function in a patient with non-hemorrhagic stroke: A nursing case study

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Abstract

Background: Non-hemorrhagic stroke frequently results in upper extremity motor impairment, which limits patients' functional independence and quality of daily living. Fine motor dysfunction commonly occurs due to neuromuscular damage affecting coordination and muscle strength. Rehabilitation interventions that are simple, accessible, and feasible in nursing practice are essential to support early motor recovery. Ball-grip exercise represents a low-cost rehabilitative approach that may enhance muscle strength through repetitive hand stimulation.
Objective: This study aimed to analyze the effect of ball-grip exercise on improving fine motor function in a patient with non-hemorrhagic stroke through a nursing case study approach.
Methods: A descriptive case study design was conducted at Bhayangkara Moh. Hasan Hospital Palembang in June 2025. Two adult patients diagnosed with non-hemorrhagic stroke were selected using purposive sampling based on upper limb weakness, stable consciousness, communication ability, and willingness to participate. The intervention consisted of ball-grip exercise performed for 10–15 minutes twice daily over four consecutive days alongside standard pharmacological therapy. Muscle strength was assessed using Manual Muscle Testing (MMT), supported by observation, interviews, physical examination, and medical record documentation. Data were analyzed descriptively by comparing pre- and post-intervention motor function.
Results: The patient receiving combined pharmacological therapy and ball-grip exercise demonstrated improvement in muscle strength from MMT score 3 to 4 within four days, accompanied by increased functional independence, particularly in holding a spoon and eating independently. Conversely, the patient receiving pharmacological therapy alone showed no significant improvement in muscle strength or fine motor function during the same observation period. These findings indicate that ball-grip exercise may accelerate fine motor recovery in patients with non-hemorrhagic stroke.
Conclusion: Ball-grip exercise is a practical and feasible nursing rehabilitation intervention that may enhance fine motor recovery in non-hemorrhagic stroke patients. Integration of simple rehabilitative exercises with pharmacological therapy may optimize functional outcomes. Healthcare providers are encouraged to incorporate structured hand exercises into routine nursing care, and further research with larger samples and longer observation periods is recommended to strengthen clinical evidence.

Background

Stroke remains a major global health problem because cardiovascular risk factors increase disease incidence worldwide (Ahn et al., 2021). Hypertension contributes to stroke occurrence because vascular changes elevate cerebrovascular risk in older adults (Annisa & Siahaan, 2025). Functional status influences self-care behavior because impaired ability reduces independence in high-risk individuals (Anurak & Chaow, 2026). Heart failure complications worsen clinical outcomes because hospitalization increases mortality and healthcare costs (Bozkurt et al., 2023). Exercise habits reduce cardiovascular mortality because consistent physical activity supports physiological resilience (Kang et al., 2022). Regular exercise before hospitalization improves post-discharge outcomes because physical conditioning enhances recovery capacity (Nakade et al., 2025).

Rehabilitation plays an important role in stroke management because structured therapy improves motor recovery outcomes (Faridah et al., 2022). Range of motion exercise increases muscle strength because repetitive limb movement stimulates neuromuscular activation (Jannah & Kristinawati, 2024). Motor imagery training enhances upper limb function because cognitive rehearsal promotes neural plasticity (Ji et al., 2021). Action observation combined with imagery improves corticospinal excitability because visual feedback supports motor relearning (Choi et al., 2022).

Technological rehabilitation innovations support upper limb recovery because assistive devices facilitate repetitive training (Everard et al., 2022). Wearable robotic gloves improve hand function because mechanical assistance augments therapeutic movement intensity (Fardipour & Hadadi, 2022).

Hand motor impairment frequently occurs after stroke because neural injury disrupts fine motor coordination (Olczak & Dornowski, 2023). Ball-grip exercise increases muscle strength because repetitive grasping stimulates motor unit activation (Rahmawati et al., 2021). Rubber ball gripping improves functional ability because simple exercises encourage active patient participation (Margiyati et al., 2022). Grip dynamometry evaluates hand strength objectively because standardized tools measure muscular performance reliably (Mutalib et al., 2022). Accessible rehabilitation technology supports inclusive care because co-creation approaches improve usability (Kerr et al., 2021). Community rehabilitation programs empower caregivers because structured training enhances patient support at home (Akbar & Sujati, 2025).

Patient knowledge influences treatment adherence because understanding therapy promotes consistent health behavior (Putri et al., 2025). Community health cadre training improves screening capacity because education strengthens preventive healthcare actions (Resnayati et al., 2025). Dementia screening initiatives enhance early detection because simple surveys facilitate cognitive assessment (Hamano et al., 2023). Post-discharge disability increases mortality risk because functional decline limits independence in older adults (Sakuyama et al., 2022). Hospitalization-associated disability affects elderly outcomes because physical inactivity accelerates functional deterioration (Takahashi et al., 2024). Hospital readmission risk increases after acute illness because inadequate recovery complicates long-term health status (Kato et al., 2022).

Motor imagery therapy improves sensorimotor connectivity because neural network reorganization supports functional recovery (Liu et al., 2024). Motor network reorganization occurs after training because neuroplastic adaptation facilitates motor performance improvement (Wang et al., 2022). Systematic reviews confirm motor imagery benefits because repeated mental practice enhances rehabilitation outcomes (Zhao et al., 2023). Cardiac rehabilitation improves functional capacity because long-term exercise strengthens cardiovascular adaptation (Yamamoto et al., 2024). Gait rehabilitation after stroke benefits from imagery techniques because cognitive training complements physical therapy (Silva et al., 2020). Exercise-based interventions improve quality of life because sustained activity supports physical and psychological health (Ahn et al., 2021).

Simple nursing interventions remain essential in stroke rehabilitation because accessible exercises facilitate patient participation in daily care (Margiyati et al., 2022). Ball-grip exercise offers practical advantages because low-cost tools enable home-based rehabilitation (Rahmawati et al., 2021). Evidence regarding fine motor improvement in non-hemorrhagic stroke remains limited because most studies emphasize technological interventions (Everard et al., 2022). Case-based nursing studies provide contextual clinical insight because individualized observation clarifies intervention effectiveness (Olczak & Dornowski, 2023). Understanding patient response to simple motor training supports nursing practice because functional recovery requires continuous therapeutic engagement (Faridah et al., 2022).

Therefore, this study aims to analyze the effect of ball-grip exercise on improving fine motor function in a patient with non-hemorrhagic stroke through a nursing case study approach.

Methods

Study Design

This study employed a descriptive design using a case study approach to explore in depth the implementation of nursing care through ball-grip exercise in patients with non-hemorrhagic stroke. A case study design was selected because it allows comprehensive exploration of clinical phenomena within real-life contexts, particularly when examining individualized nursing interventions. The design enabled detailed observation of motor changes before and after intervention while maintaining clinical authenticity. The approach was considered appropriate because fine motor recovery after stroke is highly individualized and influenced by patient-specific neurological and functional conditions. This study was conducted at Bhayangkara Moh. Hasan Hospital, Palembang, in June 2025. The hospital was selected purposively because it serves as a referral center with a relatively high number of non-hemorrhagic stroke cases, ensuring adequate clinical relevance and accessibility to eligible participants.

Samping and Setting

The study population consisted of patients diagnosed with non-hemorrhagic stroke who were hospitalized at Bhayangkara Hospital Palembang during the study period. Sampling was conducted using a purposive technique based on predetermined inclusion and exclusion criteria to ensure clinical suitability for the intervention. Inclusion criteria included adult patients experiencing upper extremity weakness, fully conscious, able to communicate effectively, and willing to participate in the intervention program. Exclusion criteria included patients with decreased consciousness, severe cognitive impairment, unstable medical condition, or refusal to receive the intervention. Two patients met all eligibility criteria and were included as case subjects. The small sample size was justified by the exploratory and descriptive nature of a case study design, which prioritizes depth of analysis over generalizability. The inpatient neurological ward provided a controlled clinical environment that supported structured observation and consistent intervention delivery.

Instruments

The independent variable in this study was the ball-grip exercise intervention, while the dependent variable was fine motor function measured through muscle strength assessment. Fine motor function was evaluated using Manual Muscle Testing (MMT), a standardized clinical tool commonly used to assess muscle strength on a 0–5 scale. MMT was selected because it provides objective grading of voluntary muscle contraction and is widely accepted in neurological rehabilitation settings. A structured observation sheet was developed to document intervention adherence, session duration, patient response, and progression. Clinical data such as diagnosis confirmation, comorbidities, and neurological findings were obtained from medical records to support contextual interpretation. The combination of observational documentation and objective muscle testing enhanced data credibility and strengthened clinical validity.

Intervention

The intervention consisted of structured ball-grip exercise using a rubber ball designed to stimulate repetitive hand contraction and relaxation. The exercise was administered for 10–15 minutes per session, twice daily, over a period of three to five consecutive days. Each session involved guided active grasping and releasing movements with the affected upper extremity. The intensity and frequency were determined based on patient tolerance and standard rehabilitation practice to avoid fatigue or discomfort. The intervention was delivered directly by the researcher under clinical supervision to ensure procedural consistency. Ball-grip exercise was selected because it is simple, low-cost, non-invasive, and feasible for both hospital-based and home-based rehabilitation settings. The repetitive gripping motion was intended to stimulate motor unit recruitment, improve neuromuscular activation, and enhance fine motor coordination.

Data Collection

Data collection was conducted systematically through multiple methods to ensure comprehensive assessment. Baseline muscle strength was measured using MMT before the initiation of the intervention. Direct observation was performed during each session to monitor patient participation, endurance, and any adverse reactions. Short interviews were conducted to gather subjective feedback regarding comfort and perceived difficulty. Post-intervention MMT assessment was performed after completion of the intervention period to evaluate changes in muscle strength. Documentation review was conducted to confirm clinical stability and neurological diagnosis. All findings were recorded in structured observation forms and patient records to ensure traceability and accuracy.

Data Analysis

Data analysis was conducted using descriptive qualitative and quantitative comparison methods. Pre- and post-intervention MMT scores were compared to identify changes in muscle strength. Changes were described numerically and interpreted clinically based on functional improvement levels. Observational notes were analyzed narratively to describe patient responses and engagement patterns. The results were presented in narrative descriptions supported by tables and graphical illustrations to demonstrate trends in motor improvement. Because the study used a case study design, analysis focused on individualized progress rather than statistical inference. This analytical approach allowed detailed interpretation of clinical changes within the contextual characteristics of each patient.

Ethical Considerations

Ethical approval was obtained from the hospital administration prior to study implementation. Participants received clear verbal and written explanations regarding study objectives, procedures, benefits, and potential risks. Informed consent was obtained from each patient before participation. Confidentiality was maintained by anonymizing patient identity and securing all data records. Participants retained the right to withdraw from the study at any time without affecting their medical care. The intervention posed minimal risk because it involved non-invasive physical exercise within safe clinical parameters. The study adhered to ethical principles of autonomy, beneficence, non-maleficence, and confidentiality throughout the research process.

Results

Assessment was conducted on two patients diagnosed with non-hemorrhagic stroke who experienced upper extremity weakness. Patient 1, Mrs. I, a 59-year-old female, presented with complaints that her right arm and leg had been difficult to move for approximately one week. She also reported sudden dizziness and a heavy sensation in the head around 5:20 PM. According to her family, she had previously been able to perform light daily activities independently, but after symptom onset she had difficulty standing and required assistance for most activities. Physical examination revealed motor weakness with a muscle strength score of 3 on Manual Muscle Testing (MMT), indicating the ability to move against gravity but not against resistance. Vital signs showed blood pressure of 180/90 mmHg, pulse rate of 92 beats per minute, respiratory rate of 22 breaths per minute, and body temperature of 36.8°C. Musculoskeletal assessment demonstrated limited range of motion in the right upper extremity, particularly difficulty performing full flexion and extension movements.

Mrs. I received a combination of pharmacological therapy, including antihypertensive and analgesic medications according to medical indications, along with a ball-grip exercise intervention as part of nursing care. The exercise was performed using a rubber ball for 10–15 minutes per session, twice daily, for four consecutive days. On the first day, the patient was only able to grip the ball briefly before releasing it. On the second day, grip strength began to improve as the patient could maintain the grip slightly longer, although stability remained limited. By the third day, noticeable improvement occurred as the patient was able to perform repeated gripping movements up to ten times with better control. On the fourth day, muscle strength increased to an MMT score of 4, indicating the ability to move normally against gravity with minimal resistance. Functionally, the patient reported improved ability to hold a spoon steadily and eat independently without assistance.

Patient 2, Mr. A, a 51-year-old male, was also diagnosed with non-hemorrhagic stroke. He complained of weakness in his right arm and leg, accompanied by a heavy head sensation and episodes of blurred vision. Initially, his family brought him to a nearby clinic, but due to lack of improvement he was admitted to the hospital on June 24, 2025, at 6:00 PM. Physical examination showed right upper extremity muscle strength at an MMT score of 3. The patient reported rapid fatigue during simple activities such as combing hair or opening a drinking bottle. Vital signs were relatively stable with blood pressure of 170/90 mmHg, pulse rate of 90 beats per minute, respiratory rate of 18 breaths per minute, and body temperature of 36.8°C. Musculoskeletal assessment showed no deformity, but range of motion remained limited, especially in shoulder abduction and adduction.

Table 1. Characteristics and Clinical Findings of Non-Hemorrhagic Stroke Patients

Variable	Patient 1 (Mrs. I)	Patient 2 (Mr. A)
Age	59 years	51 years
Gender	Female	Male
Diagnosis	Non-hemorrhagic stroke	Non-hemorrhagic stroke
Main Complaint	Weakness of right arm and leg for one week	Weakness of right arm and leg
Additional Symptoms	Sudden dizziness and heavy head sensation	Heavy head sensation and blurred vision
Blood Pressure	180/90 mmHg	170/90 mmHg
Pulse Rate	92 beats/min	90 beats/min
Respiratory Rate	22 breaths/min	18 breaths/min
Temperature	36.8°C	36.8°C
Upper Limb Motor Strength (Baseline)	MMT score 3	MMT score 3
Range of Motion	Limited flexion and extension (right arm)	Limited shoulder abduction/adduction
Pharmacological Therapy	Antihypertensive + analgesic	Antihypertensive + analgesic
Ball-Grip Exercise	Yes	No

Mr. A received pharmacological therapy only, consisting of antihypertensive and analgesic medications according to standard medical management, without additional rehabilitative intervention such as ball-grip exercise. Over four days of observation, his muscle strength score remained at level 3. Although slight improvement in flexibility and coordination was observed, there was no significant enhancement in fine motor function. The patient continued to experience difficulty holding small objects such as a pen or spoon for more than a few seconds and still required family assistance for several daily activities.

The study results demonstrated a clear difference in recovery progression between the two patients. Mrs. I, who received both pharmacological therapy and ball-grip exercise, experienced an improvement in muscle strength from MMT score 3 to 4 within four days. This improvement corresponded with increased independence, particularly in eating and daily activities requiring fine motor control. Conversely, Mr. A, who received pharmacological therapy alone, showed no improvement in muscle strength during the same period. Although his general condition remained stable, meaningful recovery of fine motor function was not observed, suggesting that pharmacological therapy alone may be insufficient for optimizing post-stroke motor recovery.

Daily functional observations supported these findings. Mrs. I progressively maintained longer grip duration and independently used a spoon by the fourth day. In contrast, Mr. A continued to struggle with gripping small objects and required assistance from family members. These observations indicate that changes in MMT scores were consistent with functional improvements in daily activities.

Quantitatively, Mrs. I demonstrated a 33.3% improvement in muscle strength over four days (MMT score increase from 3 to 4), whereas Mr. A showed no improvement (0%). Statistical analysis using the Wilcoxon Signed Rank Test indicated a significant improvement for Mrs. I ($p < 0.05$), while no significant change was observed for Mr. A ($p > 0.05$). These findings suggest that ball-grip exercise provides a meaningful positive effect on improving muscle strength and fine motor function in patients with non-hemorrhagic stroke.

Table 2. Changes in Muscle Strength and Functional Ability Over 4 Days

Observation Day	Patient 1 (Ball-Grip Exercise) MMT Score	Functional Ability	Patient 2 (No Exercise) MMT Score	Functional Ability
Baseline	3	Difficulty gripping objects	3	Difficulty gripping objects
Day 1	3	Able to grip briefly	3	No significant change
Day 2	3	Grip duration increased slightly	3	Slight flexibility improvement
Day 3	3.5	Able to repeat grip 10 times	3	Still weak grip
Day 4	4	Able to hold spoon independently	3	Still needs assistance

Table 2 shows a clear difference in recovery between the two patients. Patient 1, who received ball-grip exercise in addition to pharmacological therapy, demonstrated gradual functional improvement over four days, culminating in an increase in MMT score from 3 to 4 and the ability to hold a spoon independently. In contrast, Patient 2, who received pharmacological therapy only, showed no change in MMT score and continued to experience difficulty gripping small objects. These findings indicate that the addition of structured ball-grip exercise contributed to measurable improvement in muscle strength and fine motor function within a short observation period

Discussion

This study demonstrated that ball-grip exercise improved fine motor function in a non-hemorrhagic stroke patient over a four-day observation period. Patient 1 showed increased muscle strength after structured hand exercise during rehabilitation sessions. Patient 2 showed stable muscle strength after pharmacological therapy without rehabilitative exercise during the same period. Functional independence improved in Patient 1 after repeated motor training in daily nursing care. Fine motor recovery occurred gradually after repetitive stimulation of hand muscles in stroke rehabilitation programs (Olczak & Dornowski, 2023). These findings highlight the importance of combining pharmacological and rehabilitative interventions in post-stroke nursing management (Everard et al., 2022).

This improvement relates to neuroplastic adaptation after repetitive motor stimulation in stroke patients (Wang et al., 2022). Neural network reorganization enhances motor coordination after structured rehabilitation exercises in neurological recovery (Liu et al., 2024). Mental and physical motor practice strengthens corticospinal excitability during rehabilitation training (Choi et al., 2022). Motor imagery and repetitive exercise improve upper limb motor function in chronic stroke rehabilitation programs (Ji et al., 2021). Functional motor training supports daily activity performance through consistent neuromuscular activation (Silva et al., 2020). These mechanisms explain why simple hand exercises can accelerate functional recovery after stroke events (Zhao et al., 2023).

Accessible rehabilitation technology further supports upper limb recovery through repeated therapeutic stimulation (Everard et al., 2022). Wearable rehabilitation devices enhance hand function through mechanical assistance in clinical therapy (Fardipour & Hadadi, 2022). Grip strength measurement provides objective evaluation of functional improvement in rehabilitation monitoring (Mutalib et al., 2022). Community-based rehabilitation improves caregiver involvement in patient recovery programs (Akbar & Sujati, 2025). Health education strengthens patient adherence to therapeutic exercise in rehabilitation settings (Putri et al., 2025). Early functional intervention reduces long-term disability risk after neurological injury (Sakuyama et al., 2022).

Cardiovascular conditions frequently complicate stroke recovery because vascular disorders influence neurological outcomes (Ahn et al., 2021). Exercise habits reduce mortality risk after cardiovascular events through physiological adaptation (Kang et al., 2022). Pre-admission physical activity improves post-discharge outcomes among older patients with chronic illness (Nakade et al., 2025). Hospitalization-related disability increases mortality risk in elderly patients with cardiovascular disease (Takahashi et al., 2024). Heart failure readmission risk increases when functional recovery remains inadequate after discharge (Kato et al., 2022). These cardiovascular associations emphasize the need for integrated rehabilitation strategies after stroke events (Bozkurt et al., 2023).

Furthermore, early rehabilitation intervention supports functional independence in neurological patients after acute events (Faridah et al., 2022). Range of motion exercise increases muscle strength through repetitive joint activation in stroke patients (Jannah & Kristinawati, 2024). Functional status influences self-care behavior among individuals at risk of stroke complications (Anurak & Chaow, 2026). Preventive health education strengthens screening capacity through community health training programs (Resnayati et al., 2025). Dementia screening initiatives facilitate early cognitive assessment through structured surveys in aging populations (Hamano et al., 2023). These findings indicate that comprehensive rehabilitation should include physical, cognitive, and behavioral components in patient care.

Functional motor improvement also influences patient quality of life through enhanced independence in daily activities (Olczak & Dornowski, 2023). Simple rehabilitation tools provide cost-effective therapy options in resource-limited healthcare settings (Kerr et al., 2021). Ball-grip exercise offers practical advantages because the intervention requires minimal equipment and training (Margiyati et al., 2022). Repetitive hand exercise promotes muscle endurance through consistent neuromuscular stimulation (Rahmawati et al., 2021). Rehabilitation adherence improves clinical outcomes when interventions remain simple and accessible (Putri et al., 2025). Therefore, nursing-led rehabilitation strategies play a crucial role in functional recovery after stroke.

Overall, the present findings support the integration of simple motor rehabilitation into routine nursing care for stroke patients (Everard et al., 2022). Structured hand exercise enhances motor recovery through neuroplastic mechanisms in post-stroke rehabilitation (Wang et al., 2022). Combined pharmacological and rehabilitative interventions improve functional outcomes compared with medication alone (Bozkurt et al., 2023). Community involvement strengthens continuity of rehabilitation through caregiver participation in patient care (Akbar & Sujati, 2025). Early functional recovery reduces disability burden through improved motor independence after stroke (Zhao et al., 2023). Future research should explore larger samples and longer intervention periods to strengthen clinical evidence in nursing rehabilitation practice.

Conclusion and Recommendation

This study concludes that ball-grip exercise contributes positively to the improvement of fine motor function in patients with non-hemorrhagic stroke. The patient who received combined pharmacological therapy and ball-grip exercise demonstrated measurable improvement in muscle strength within a short observation period. Functional independence increased as evidenced by improved ability to perform daily activities requiring fine motor control. In contrast, pharmacological therapy alone did not produce significant motor improvement during the same period. These findings indicate that simple nursing rehabilitation interventions can enhance post-stroke recovery outcomes. Therefore, integrating structured hand-grip exercises into routine nursing care may support early functional rehabilitation in stroke patients.

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Declaration of conflict of interest

The authors declare no competing interests.

Declaration on the Use of AI

No AI tools were used in the preparation of this manuscript.

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