

The Effect of the Rubber Ball Grip and Range of Motion on Hand Muscle Strength in Patients with Hemiparesis Following a Stroke: A Case Study

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ABSTRACT

Background & Objective: Stroke is one of the leading causes of disability, often resulting in hemiparesis, which leads to decreased muscle strength, particularly in the upper extremities. One non-pharmacological intervention that nurses can provide to improve hand muscle strength is the rubber ball grip exercise. This study aimed to determine the application of rubber ball grip exercise in nursing care to improve hand muscle strength in stroke patients with hemiparesis. **Method:** This study employed a case series design with a nursing process approach, including assessment, nursing diagnosis, planning, implementation, and evaluation. The rubber ball grip exercise intervention was performed routinely according to standard procedures throughout the course of care. Muscle strength was measured using a muscle strength scale (Manual Muscle Testing/MMT) before and after the intervention. The study involved two patients in the An-Nisa 2 Ward: one patient receiving the rubber ball grip intervention and one control patient receiving standard care. **Result:** After the rubber ball grip exercise intervention, the patient showed improved hand muscle strength, indicated by an increase in MMT score from 3 to 4, better grip ability, and reduced tremor. In contrast, the control group patient who only received standard care without the rubber ball grip intervention showed no significant change in muscle strength, with MMT scores remaining at 2. **Conclusion:** The application of rubber ball grip exercises in nursing care is effective in improving hand muscle strength in stroke patients with hemiparesis. This intervention is easy to perform, safe, cost-effective, and can serve as a supportive therapy in stroke patient

rehabilitation. It is recommended that this intervention be routinely implemented as part of independent nursing care to improve hand muscle strength in stroke patients in healthcare settings.

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Introduction

Stroke is a functional disorder of the brain that occurs suddenly due to an interruption of blood flow to the brain in ischemic stroke or the rupture of cerebral blood vessels in hemorrhagic stroke, resulting in impaired oxygen and nutrient supply to cerebral tissue. The damage to cerebral tissue makes stroke one of the acute neurodegenerative diseases that is a leading cause of permanent physical disability and sudden death in patients. The most common clinical manifestations of damage include weakness or paralysis on one side of the body (hemiparesis), speech disorders (aphasia), decreased sensory function, and loss of fine motor coordination in the upper extremities, such as stiffness in the fingers (Syuhada & Kristinawati, 2026). Hemiparesis is a clinical condition characterized by weakness or decreased muscle strength occurring on one side of the body due to damage to the central nervous system. Hemiparesis begins with an obstruction of blood flow to the brain, which causes the death of nerve tissue in the motor area, resulting in the interruption of bioelectric signal transmission from the brain to the effector muscles in the extremities, causing the muscles to lose the stimulus to contract (Hinkle & Cheever, 2018).

In Indonesia, stroke is one of the major noncommunicable disease problems. Based on the latest national health research data from the Ministry of Health of the Republic of Indonesia, the prevalence of stroke in Indonesia is estimated to reach 10.9 per 1,000 population, making it one of the noncommunicable diseases with the highest mortality and morbidity rates in various central hospitals (Darmawati et al., 2024). At the local level, DKI Jakarta Province ranks among the regions with a significant prevalence of stroke cases in Indonesia, ranging from 12.5 to 14.3 per 1,000 population (SKI, 2023). Neurological complications in stroke patients in the form of a significant decrease in upper-extremity muscle strength, particularly in the fingers and wrists, occur in 35% to 57% of stroke patients and result in paralysis or functional weakness. The presence of extremity weakness and limitations in motor movement has a systemic impact on the drastic decline in patients' quality of life, considering that the hands are the primary instruments for fulfilling functional independence in daily activities (Activities of Daily Living/ADL), such as eating, drinking, bathing, and dressing (Zaffarsyah et al., 2024).

The problem of hemiparesis is part of nursing care that must be identified immediately through accurate neuromotor physical assessment and subsequently addressed through early and continuous intervention to prevent secondary complications in the form of muscle atrophy and permanent joint stiffness. Nursing care provided focuses on improving adequate physical mobility, with one of the success indicators being evaluated using the Manual Muscle Testing (MMT) instrument. This intervention is designed to maximize the patient's remaining motor capacity, improve the intrinsic muscle tone of the hand, and facilitate optimal functional independence (Wulaningsih et al., 2025). Rubber Ball Grip exercise is one form of functional exercise or complementary therapy for the hand that uses an elastic

rubber ball to stimulate and train the strength of the intrinsic and extrinsic muscles of the fingers and palm (Jamaluddin & Ilham, 2025). The mechanism of this intervention is based on providing constant resistance when the patient squeezes the ball, which is physiologically effective in increasing local blood flow to cerebral tissue and stimulating motor neuron recovery through active contractility.

Various studies have demonstrated that rubber ball grip exercises are effective in improving upper-extremity muscle strength in stroke patients. A study by Febrywati et al. (2025) documented that rubber ball grip exercises resulted in a significant increase in finger flexor muscle strength, with a p-value of 0.001. The results of a study by Karim & Syamsuddin (2025) reported that the use of an elastic rubber ball increased the fine motor functional coordination ability of stroke patients by 35.4%, based on measurements using the Action Research Arm Test (ARAT). However, based on initial observations in the inpatient unit, nursing management for stroke patients with hemiparesis still focuses on collaborative interventions and standard mobilization without specific independent nursing interventions to improve hand muscle strength. Based on these conditions, a case study is necessary to describe the application of rubber ball grip exercises in clinical nursing practice and evaluate the patient's response to the intervention provided.

Objective

The purpose of this case study is to determine the application of rubber ball grip exercises in nursing care to improve hand muscle strength in stroke patients with hemiparesis.

Method

This study uses a case study design with a pre-post test approach involving two patients. The study aims to evaluate changes in hand muscle strength before and after the administration of rubber ball grip exercises in stroke patients with hemiparesis, as well as compare the results with a control patient who receives standard care only. The study subjects are 2 patients with a medical diagnosis of non-hemorrhagic stroke who experience hemiparesis and decreased hand muscle strength. The location and time of the study were at the An-Nisa 2 inpatient ward of Jakarta Pondok Kopi Islamic Hospital in July 2026. Data collection was carried out through direct observation, measurement of muscle strength using the MMT scale before and after the intervention, and documentation of measurement results on an observation sheet. Data analysis was performed descriptively and comparatively by comparing muscle strength values before and after the intervention, as well as comparing the results between the intervention and control groups, which were then presented in the form of tables, graphs, and narratives.

Inclusion Criteria

- 1) Patients diagnosed with non-hemorrhagic stroke with hemiparesis.
- 2) Experiencing decreased hand muscle strength (MMT score 2–3).
- 3) Cooperative and able to follow instructions.
- 4) Willing to participate as respondents (informed consent).

Research Variables

- 1) Independent variable: Rubber Ball Grip exercise.
- 2) Dependent variable: Hand muscle strength (MMT score).

Research Instruments

- 1) Elastic rubber ball (rubber ball grip).
- 2) Observation sheet for recording measurement results before and after the intervention.
- 3) Manual Muscle Testing (MMT) scale for measuring muscle strength.

Research Procedure

- 1) Measure hand muscle strength (pre-intervention) using the MMT scale.
- 2) Adjust the patient's position to be as comfortable as possible, either sitting or semi-sitting.
- 3) Place the elastic rubber ball in the palm of the patient's hand affected by hemiparesis.
- 4) Instruct the patient to squeeze the rubber ball as firmly as they can, then hold the squeeze for 3 to 5 seconds.
- 5) Instruct the patient to slowly release the squeeze and rest their hand for 2 seconds in a relaxed position.
- 6) Repeat the squeezing and releasing movements 10 to 15 times for one set of exercises.
- 7) Provide a rest period of 1 to 2 minutes to prevent the patient's muscles from experiencing extreme fatigue.
- 8) Perform this exercise routinely twice a day (morning and afternoon) during the intervention period (4 days).
- 9) Reassess hand muscle strength after the intervention (post-intervention).
- 10) Document the changes observed in the patient.

Results

A female patient, Mrs. M, aged 66 years, with a history of non-hemorrhagic stroke since 3 years ago, as well as comorbid hypertension, diabetes mellitus, and chronic kidney disease (CKD) undergoing routine hemodialysis, was admitted to the hospital with complaints of fever, dizziness, generalized weakness, and a brief loss of consciousness. The patient had a history of hypertension and diabetes mellitus for 6 years. During the assessment, the patient complained that her right hand felt weak, trembled, and had reduced gripping strength, while her left hand trembled slightly when forced to grip. The patient also experienced dysarthria (slurred speech).

The results of Mrs. M's physical examination showed a moderately ill general condition, compos mentis consciousness with a GCS score of 15 (E4M6V5). Vital signs: BP 142/82 mmHg, pulse 100 beats/minute, RR 21 breaths/minute, temperature 36.7°C, and SpO₂ 96% with a nasal cannula at 5 Lpm. Neurological examination revealed impairment of cranial nerve XII (hypoglossal nerve), characterized by dysarthria, and a positive Babinski reflex (+) in the right extremity. Examination of the upper extremities showed weakness on the right side, with an MMT score of 2 in the fingers of the right hand. The fingers appeared weak, exhibited visible tremors during movement, and had very weak grip strength. In the left extremity, muscle strength was measured at MMT grade 4. The lower extremities demonstrated clinically functional muscle strength, namely 2/2/4/4. Laboratory examination showed Hb 10.30 g/dL, leukocytes $10.3 \times 10^3/\mu\text{L}$, hematocrit 23%, platelets $198 \times 10^3/\mu\text{L}$, and random blood glucose 341 mg/dL. The brain CT scan showed findings of multiple lacunar infarcts and atherosclerosis. The established nursing diagnoses were: (1) Impaired physical mobility related to decreased muscle strength and limited range of

motion due to cerebral lesions, and (2) Self-care deficit related to neuromuscular impairment/muscle weakness.

The intervention focused on mobility support to improve hand muscle strength, with the application of an innovative intervention in the form of functional rubber ball gripping exercises (rubber ball grip). This exercise was selected as a nonpharmacological intervention aimed at stimulating the mechanism of neuroplasticity in the brain, strengthening grip strength, and improving finger motor coordination. The therapy was administered for four consecutive days, twice daily, with a duration of 10 minutes per session and 10–15 repetitions per session. The family (the patient's husband) was also involved in providing support and helping remind the patient during the intervention.

In addition, there was one control patient (Mrs. M, 69 years old) with a medical diagnosis of non-hemorrhagic stroke since 5 years ago who received only standard nursing care in the form of ROM exercises without the rubber ball grip intervention.

The intervention in this case study focused on improving hand muscle strength. Based on the results of the intervention conducted over 4×24 hours, the patient demonstrated an improvement in condition. Hand muscle strength increased from an initial MMT score of 3 to 4 on the fourth day. This improvement was also demonstrated by improved motor function, with stronger grip strength, reduced tremors, and the patient's ability to hold a glass independently. In contrast, in the control group, muscle strength remained stationary at an MMT score of 2 throughout the 4 days of observation, without significant improvement.

TABLE 1. Development of Muscle Strength During Observation (Intervention Group)

Date	Pre- and Post-test	Skor MMT Score	Interpretation
1.	Pre-test	2	Weak muscle tone, loose grip strength
	Post-test	2	Weak muscle tone, loose grip strength
2.	Pre-test	3	Improved muscle tone, adequate/moderate grip strength, easily fatigued, able to resist gravity for 2 seconds.
	Post-test	3	Improved muscle tone, grip strength is fairly stable, able to resist gravity for 2–3 seconds
3.	Pre-test	3	Improved muscle tone, grip strength is fairly strong, able to resist gravity for 3–4 seconds
	Post-test	3	Improved muscle tone, grip strength is beginning to reach optimal levels, able to resist gravity for 3–4 seconds
4.	Pre-test	3	Strong muscle tone, increased grip strength, able to withstand light resistance and gravity for 4 seconds
	Post-test	4	Strong muscle tone, increased grip strength, able to withstand light resistance and gravity for 5 seconds

Abbreviation: MMT (Manual Muscle Testing)

TABLE 2. Development of Muscle Strength During Observation (Control Group)

Date	Pre- and Post-test	MMT Score	Interpretation
1.	Pre-test	2	Weak muscle tone, weak and loose hand grip
	Post-test	2	Weak muscle tone, weak hand grip with no change
2.	Pre-test	2	Passive movement is limited to the bed; the patient is not yet able to resist gravity
	Post-test	2	No improvement in motor strength; constant passive lateral movement

3.	Pre-test	2	No improvement in muscle tone of the fingers or right palm
	Post-test	2	Muscle tone remains stable at an MMT score of 2; tone and grip strength remain unchanged
4.	Pre-test	2	The right hand is only able to grasp slightly
	Post-test	2	The final evaluation shows that muscle strength remains stable at an MMT score of 2.

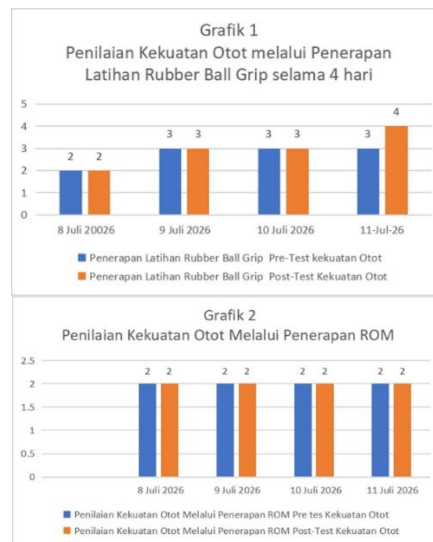


FIGURE 1. Graph Comparing the Development of Muscle Strength (MMT) Between the Intervention and Control Groups.

(A bar/line graph showing a comparison of MMT scores between the two groups over 4 days of observation)

The analysis of the results showed that muscle strength in the intervention group tended to improve after the rubber ball grip intervention. On the fourth day, the post-test score increased from 3 to 4, while the pre-test score remained at 3. These results indicate that the effects of the exercise began to appear after the intervention was performed consistently for several days. Meanwhile, in the control group, there was no difference between the pre-test and post-test scores during the four-day observation period. Muscle strength remained at a score of 2, indicating that no improvement in muscle strength was observed during the observation period. These findings suggest that rubber ball grip exercises may have a positive impact on improving hand muscle strength, while standard ROM exercises without additional intervention have not demonstrated a significant effect.

Discussion

The first patient, Mrs. M (66 years old), had a history of non-hemorrhagic stroke for 3 years, with comorbid hypertension, diabetes mellitus, and CKD requiring routine hemodialysis. The second patient, Mrs. M (69 years old), also had a history of non-hemorrhagic stroke for 5 years, with comorbid hypertension and diabetes mellitus. Both patients were elderly women and had significant risk factors for stroke. This is consistent with research stating that the majority of stroke patients are elderly and that stroke is closely associated with a history of hypertension and diabetes mellitus (Darmawati et al., 2024). Physiologically, the aging process causes decreased blood vessel elasticity, increased blood pressure, and metabolic changes that accelerate the occurrence of cerebrovascular disorders, particularly when accompanied by uncontrolled risk factors.

During the assessment, Mrs. M (66 years old) complained that her right hand felt weak, trembled, and had reduced gripping strength. Objective data indicated weakness on the right side, with an MMT score of 2 in the fingers of the right hand. The fingers appeared weak, exhibited visible tremors during movement, and had very weak grip strength. The patient also experienced dysarthria (slurred speech). The brain CT scan showed findings of multiple lacunar infarcts and atherosclerosis. This is consistent with the research by Gold (2025) and Hinkle & Cheever (2018), which states that hemiparesis is one of the most common clinical manifestations in stroke patients and affects more than 80% of patients with acute stroke. Damage to the corticospinal tract results in the loss of voluntary control over peripheral motor units, which clinically varies from a flaccid phase to the development of a spastic phase.

Based on these conditions, the nursing diagnosis of impaired physical mobility related to decreased muscle strength and limited range of motion due to cerebral lesions was established. This diagnosis differs from several stroke studies that emphasize impaired cerebral tissue perfusion or the risk of injury, as the primary focus in this case is persistent motor weakness that affects the patient's daily activities.

Nursing interventions serve as a benchmark for providing safe, ethical, and effective nursing care (Wardani et al., 2023). The intervention focused on mobility support. The novelty of this case lies in the application of rubber ball grip exercises as part of mobility support for stroke patients with hemiparesis. This exercise was selected because it aims to stimulate the mechanism of neuroplasticity in the brain, strengthen grip strength, and improve finger motor coordination. The exercise was administered over 4×24 hours, twice daily, for 10 minutes per session. This is consistent with the research by Hangkiho & Lumingkewas (2026), which showed that this exercise was conducted in a structured manner for 4 consecutive days, twice daily (morning and afternoon), for 10–15 minutes per session, and was shown to provide adequate functional stimulation to trigger early neuromotor adaptation.

After rubber ball grip exercises were performed for 4×24 hours, an improvement in motor function was observed, characterized by an increase in muscle strength from an MMT score of 3 to 4, stronger grip strength, reduced tremors, and the patient's ability to hold a glass independently. This is consistent with the research by Febrywati et al. (2025), which demonstrated that rubber ball grip exercises significantly improved upper-extremity muscle strength in post-stroke patients (p -value = 0.001), as well as the research by Syuhada & Kristinawati (2026), which reported that the effectiveness of this fine motor exercise resulted in a significant increase in upper-extremity muscle tone and strength in patients, measured using the MMT method, from a score of 7 to 8, with an average increase of 1.42 points ($p < 0.01$).

In the control group, which received only standard care in the form of ROM exercises without rubber ball grip exercises, the results showed that muscle strength remained stationary at an MMT score of 2 throughout the 4-day observation period, without significant improvement. The patient remained dependent on family assistance in performing ADLs and demonstrated psychosocial risks (boredom) due to the lack of active interventions. This reinforces the evidence that rubber ball grip exercises provide an important additional stimulus for fine motor recovery compared with standard ROM exercises alone. These results are also supported by the research of Khusnul Nadhiroh Neilin Nikmah (2023), which stated that passive-active ROM interventions performed twice daily for 20 minutes were effective in improving muscle strength in non-hemorrhagic stroke patients, with results after 3 days of

intervention showing an increase in the MMT scale from 1 to 2. However, in this case, standard ROM exercises without gripping exercises had not demonstrated optimal results during the 4-day observation period.

This case study demonstrates that the application of rubber ball grip exercises as a nonpharmacological intervention provides clinical improvement in stroke patients with hemiparesis, characterized by increased muscle strength, improved grip strength, and reduced tremors. The findings of this study emphasize that interventions focusing on specific functional exercises targeting the distal area may be an appropriate approach for stroke patients with hemiparesis. This case study has limitations, as it involved only two patients; therefore, the results obtained cannot be generalized to all stroke patients with hemiparesis. Further research with a larger number of respondents and a stronger research design (such as a randomized controlled trial) is needed to strengthen the scientific evidence regarding the effectiveness of rubber ball grip exercises in stroke patients with hemiparesis.

Conclusion

The assessment of both stroke patients in the An-Nisa 2 Ward revealed hemiparesis, which contributed to the primary nursing problem of Impaired Physical Mobility, characterized by decreased hand muscle strength (low MMT scores).

The rubber ball grip intervention was successfully implemented according to the procedure, being performed regularly twice a day for 10–15 minutes without causing excessive fatigue or secondary injuries in the patients.

The application of evidence-based nursing care through rubber ball grip exercises was proven effective in improving hand muscle strength in stroke patients with hemiparesis, as demonstrated by increased MMT scores and clinical improvement in gripping ability.

Recommendations

It is expected that the results of this KIAN can serve as an academic reference for the development of medical-surgical nursing knowledge, particularly neurorestoration. Future researchers are recommended to conduct studies with larger sample sizes and longer intervention durations to examine the long-term effects on patients' ADL independence.

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