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Range of Motion Spherical Grip Affected the Upper Extremity Muscle Strength in Post Stroke Patients



Lutfi Wahyuni¹, Siti Kotijah², Catur Prasastia Lukita Dewi³

^{1,2,3,4}Nursing Department, Universitas Bina Sehat PPNI Mojokerto, Indonesia

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Abstract

Stroke is a medical emergency. Post-stroke patients generally experience muscle weakness in the limbs, postural disturbances and muscle atrophy. The purpose of this study was to prove the effect of ROM Spherical Grip exercise on post-stroke patients. The type of the study was pre-experimental with one group pre-test-post-test design. The independent variable was Range Of Motion (ROM) Spherical Grip. The dependent variable was the degree of upper extremity muscle strength in post-stroke infarct patients who had hemiparesis. The sampling technique used a consecutive sampling technique. The sample was 33 respondents. The data were taken by measuring the muscle strength before and after being given the intervention. The instrument used an observation sheet for assessing muscle strength and manual muscle testing (MMT) physical examinations in post-stroke patients. The results of this study showed that most of the muscle strength before giving the Spherical Grip ROM exercise was Poor (there was movement but could not fight gravity) as many as 14 respondents (42.4%). After the intervention of the Spherical Grip ROM exercise, the muscle strength was mostly Fair (can move against gravity) as many as 19 respondents (57.6%). There is an increase in upper extremity muscle strength before and after being given ROM Spherical Grip exercise in post-stroke patients who experience hemiparesis. This showed that the Spherical Grip could improve the tone of those who experience weakness and if done continuously could increase muscle strength in post-stroke patients. It is hoped that with this research Spherical grip exercises can be used as one of the treatments for stroke patients who experience decreased upper extremity muscle strength and collaborate with physiotherapy also assisted by taking drugs according to doctor's advice.

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✉Correspondence Address:

Universitas Bina Sehat PPNI Mojokerto – East Java, Indonesia

Email : luf.hidayat@gmail.com

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INTRODUCTION

Stroke is a condition that occurs when the blood supply to the brain is reduced due to a blockage (ischemic stroke) or rupture of a blood vessel (hemorrhagic stroke). This makes the veins or blood flowing to all parts of the muscle not drained to all parts of the muscle not being drained. If the right side of the body cannot be moved, it means that the left muscle has a problem and vice versa (Anggraini, Septiyanti, & Dahrizal, 2018). Post-stroke patients generally experience muscle weakness in the limbs, postural disturbances and muscle atrophy. Muscle atrophy causes decreased activity in the joints so that the joints lose synovial fluid and cause joint stiffness (Anita, Pongantug, Ada, & Hingkam, 2018). With the high prevalence of stroke in Indonesia, rehabilitation is seen as important in treatment interventions for stroke patients. In non-hemorrhagic stroke patients after an attack that results in sensory and motor disturbances, including balance disorders, muscle weakness, and motor control disorders resulting in loss of coordination in the body (Nurtanti & Ningrum, 2018). According to WHO 2016 in 2015, as many as 6, 24 million people died from stroke. 53% had hemorrhagic stroke and the remaining 46% had ischemic stroke. The prevalence of stroke in Indonesia in 2018 was 10.9% and has increased by 3.9% in the last five years (Sultradewi Kesuma, Krismashogi Dharmawan, & Fatmawati, 2019).

Indonesia also has the second highest stroke burden after Mongolia, which is 3,382.2/100,000 people based on DALYs (disability-adjusted life-year). Approximately 15 million people suffer a first stroke each year, with a third of these cases or about 6.6 million resulting in death (3.5 million women and 3.1 million men). Stroke is a bigger problem in low-income countries than in high-income countries. More than 81% of deaths from stroke occur in low-income countries, the percentage of premature deaths due to stroke rises to 94% in people under the age of 70 years (World Health Organization, 2016).

Based on a preliminary study conducted in October 2021, it was found that 55 clients underwent exercise therapy in the Medical Rehab Poly Room at Prof Dr. Soekandar Mojokerto experienced the most paralysis in the upper extremities and underwent therapy for 3 months but had not yet recovered or had not shown

an increase in muscle strength and a significant increase in range of motion, because the client was not regular or obedient to the prescribed therapy schedule. Based on an interview with the head of the Medical Rehab Polyclinic, it is known that every week there are 10 to 15 post-stroke patients visiting, each visit is 1x/week and 2x/week who undergo physiotherapy at the medical rehabilitation clinic. Factors that cause stroke include non-reversible factors such as gender and age, reversible factors such as hypertension, heart disease, high cholesterol, diabetes mellitus, polycythemia, emotional stress, and lifestyle factors, for example. smoking, drinking alcohol, illegal drugs, unhealthy activities (Nanda, 2013). Efforts to treat stroke patients start from acute phase management to rehabilitation. One of the rehabilitations that can be given to stroke patients is range of motion exercises or what is often called Range Of Motion (ROM) (Mustika Sari, Yuliano, & Perintis Padang, 2019). ROM is an exercise used to maintain or improve the level of perfection of the ability to move joints normally and completely to increase muscle mass and muscle tone. There are three types of Range Of Motion (ROM), namely active ROM, passive ROM and active-assistive ROM. Range Of Motion (ROM) has the benefit of maintaining or increasing muscle strength and muscle flexibility, maintaining cardio respiratory function, maintaining flexibility of each joint, and preventing contractures or stiffness in joints (Colik, 2018).

METHOD

The research design used is Pre-Experimental with One Group Pretest and Posttest Design. The population in this study were 33 people of all post-stroke patients who experienced paralysis of the left/right upper extremities at rehabilitation room RSUD Prof. Dr. Soekandar in 2021. In this study, the sampling technique used consecutive sampling with a sampling technique where data collection was limited by a certain period of time (Nursalam, 2013). The study was conducted for 4 weeks. The instrument in this study used an observation sheet about data collection procedures by measuring ROM / joint range of motion of stroke patients in the upper extremity joints. The muscle strength were manually measured by using a classic scale of 0, 1, 2,3, 4 and 5.

RESULT**Table 1:** Characteristics of Respondents Based on General Data post stroke patients in rehabilitation room RSUD Prof. Dr. Soekandar in October 2021

General data	Frequency	(%)
Gender		
Female	18	54.5
Male	15	45.5
Age		
25 years	0	0
26-30 years	0	0
31-45 years	10	30.3
>45 years	23	69.7
Total	33	100

Based on table 1, shows that the characteristics of respondents based on gender, most of the respondents were female as many as 18 respondents (54.5%) and male respondents as many as 15 respondents (45.5%). When viewed from the age characteristics of the respondents, namely 31-45 years as many as 10 respondents (30.3%). Age >45 years as many as 23 respondents (69.7%).

Table 2: Characteristics of respondents based on the respondent's muscle strength before and after giving ROM exercises using Spherical Grib in stroke patients in rehabilitation room RSUD Prof. Dr. Soekandar in October 2021

No	Criteria	Muscle Strength			
		Before		After	
		F	%	F	%
1	Zero	5	15.2	0	0
2	Trace	8	24.2	0	0
3	Poor	14	42.4	8	24.2
4	Fair	6	18.2	19	57.6
5	Good	0	0	6	18.2
Total		33	100	33	100

Based on table 2, the results obtained before giving the Spherical Grib ROM exercise as many as 5 respondents (15.2%) had zero muscle strength (no muscle movement at all), as many as 8 respondents (24.2%) had Trace muscle strength (there were contractions on palpation but no visible movement), as many as 14 respondents (42.4%) had poor muscle strength (there was movement but could not fight gravity), and 6 respondents (18.2%) had Fair muscle strength (can move against gravity) while after giving Spherical ROM exercises Grib as many as 8 respondents (24.2%) who have Poor muscle strength (can move and can fight light obstacles), 19 respondents (57.6%) have Fair muscle strength (can move against gravity), and 6 respondents (18.2%) who have good muscle strength (can move and can fight light obstacles). These data indicate that the intervention of giving Spherical Grib ROM exercise has been shown to have an effect on increasing muscle strength in post-stroke patients.

DISCUSSION**1. Respondents' muscle strength before being given Spherical Grib ROM exercises in post stroke infarction patients who experience hemiparese**

Based on table 2, it shows that the results of the study before giving ROM Spherical Grib exercises as many as 5 respondents (15.2%) had

zero muscle strength (no muscle movement at all), as many as 8 respondents (24.2%) had Trace muscle strength (there was contraction during palpation but no visible movement), as many as 14 respondents (42.4%) have poor muscle strength (there is movement but cannot fight gravity), and 6 respondents (18.2%) have fair muscle strength (can move against gravity).

Muscle strength is one of the most important elements as a foundation for heavier training preparations, when viewed physiologically muscle strength is the release of energy originating in the neuromuscular system through muscle contraction. The greater the voltage, the greater the power generated. Weaknesses in the body movement system in stroke patients will affect muscle contractions. Reduced muscle contractions are caused by reduced blood supply to the brain which causes reduced oxygen supply to the brain (Enny M, 2015).

The muscle strength of the respondents in this study showed that before being given ROM Spherical Grip exercises, 5 respondents had zero muscle strength (no muscle movement at all), disease so that they receive less attention related to the condition of the respondent. In trace muscle strength (there is a contraction when palpated but no visible movement) by 8 respondents, this occurs because of the lack of mobilization of the respondents and lack of physical exercise, especially in the upper extremities so that the muscles become stiff and difficult to move. In poor muscle strength as many as 14 respondents and fair muscle strength as many as 6 respondents, this happened due to lack of activity in approximately one month after the stroke which is one of the causes of decreased ability of stroke patients and lack of family support to train respondents so they can perform a wide range of motion.

2. Respondents' muscle strength After being given Spherical Grip ROM exercises in stroke infarction patients who experience hemiparesis

Based on table 2, it shows that the results of the study after giving ROM Spherical Grip exercises were as many as 8 respondents (24.2%) who had poor muscle strength (can move and can fight light obstacles), as many as 19 respondents (57.6%) who had muscle strength Fair (can move against gravity), and 6 respondents (18.2%) who have good muscle strength (can move and can fight light obstacles). These data show that the intervention of giving ROM Spherical Grip exercises increased muscle strength. Changes in increased muscle strength occur because it has been given exercise.

Exercises can be done using ROM (Range of Motion) exercises or known as range of motion. Range of motion is a joint motion exercise that

allows active muscle contraction and movement. The form of the ROM (Range of Motion) exercise is functional hand exercises (power grip), power grip consists of Spherical Grip. Spherical Grip is a functional hand exercise by gripping a round object (Cholik, 2018). This exercise is carried out in 3 stages, namely opening the hand, closing the fingers to grip the object and adjusting the grip strength and the muscles that are influential in this case are the abductors and adductors of the fingers, in addition to the flexors of the fingers. Based on the reviews above, to help recover the upper arm and upper extremity, techniques are needed to stimulate the hands, such as spherical grip exercises (Ira, 2021). The results of this study are in line with research conducted by The results of the study (Purqoti, 2020) showed that the majority of respondents were >60 years old (60%), were male (50%) and female (50%), and all of them had suffered a stroke non hemorrhagic. Prior to ROM therapy, the patient's degree of muscle strength was in the category of degrees 0 to degree 2, and after ROM therapy, the patient's degree of muscle strength was included in the category of degrees 2 to degree 4. There was a difference (increase) in the degree of patient's muscle strength before and after ROM therapy with p value = $0.000 < 0.05$. ROM therapy is stated to be effective in increasing the limb muscle strength of stroke patients. The increase in muscle strength is influenced by several factors, while the factors that affect muscle strength are gender and age (Purqoti, 2020).

Regarding the gender factor, it was found that the majority of respondents were female, as many as 18 respondents (54.5%). Gender is one of the factors that affect muscle strength. Women have a stronger relationship with increasing muscle strength than men. According to Laubach (1976) in (Utomo, 2010). The results of the comparison of male and female muscle strength in the extremities of female muscle strength averaged 71.9% of male muscle strength. Male muscle strength after puberty is influenced by the hormone testosterone which has an anabolic effect, one of which is important in maintaining muscle mass. Based on the research above, the increase in muscle strength in women also greatly affects joint flexibility. Women's joints are more flexible than men's because their bones are smaller and they also have fewer muscles than men. In the next factor, namely age, it was found that the

majority of respondents were >45 years old, as many as 23 respondents (69.7%). As you get older, muscle strength will gradually decrease. After the age of 30 years, humans will lose approximately 3-5% of total muscle tissue per decade. A decrease in muscle function and strength will result in a decrease in the ability to maintain body balance, resistance to movement and changes in body posture (Susanti, 2019).

Based on the results of the study that there were 8 out of 33 respondents, some of whom had experienced a decrease in muscle strength, making it difficult to do ROM exercises. This happened because he had suffered a stroke for years and had never even done any ROM exercises so that he experienced stiffness. It's actually normal for a decrease in muscle strength. This happens because with increasing age a person will also be followed by a decrease in body tissues which causes a decrease in the ability of muscles and other organ functions. Decreased ability to perform activities caused by the gradual shrinkage of body tissue. At the age of > 45 years with increasing age, degeneration that occurs scientifically can also cause a decrease in muscle strength. The duration of training can affect the results obtained. The duration of the exercise depends on the patient's condition. Good exercise therapy is exercise that doesn't melt, the duration is not too long but with as many repetitions as possible. Exercise repeatedly with as much quality as possible. Repetitive, focused movements can establish new connections between motor systems and activate spinal motor neurons is the basis of recovery in stroke patients. If this movement is done regularly, there will be an increase in muscle strength (Andarwati, 2013).

The results of this study indicate that ROM (Range Of Motion) exercises using Spherical Grip really help balance the use of muscles that still have normal function, help maintain, build strength and help maintain ROM in affecting the limbs in preventing muscle contractures and disability. Doing Spherical Grip exercise (Range Of Motion) regularly 2 times a day in the morning and evening with 10 minutes given for 3 days, can increase independence in stroke patients. This is because almost all of them move the fingers in a flexed position so that they can grip an object. When gripped the metacarpophalangeal and interphalangeal joints move freely. So that the many joints and muscles that work can increase muscle strength.

3. Analysis of the Effect of Muscle Strength Before and After Given Spherical Grip ROM (Range Of Motion) Exercise in Stroke Infarction Patients Who Have Hemiparesis

The results of the analysis showed that after giving Spherical Grip ROM (Range Of Motion) exercises there was an increase in muscle strength in stroke patients. This can be shown through the results of statistical tests using the Wilcoxon Signed Rank Test. The results of the Wilcoxon Signed Rank Test show data that $p = 0.000$ and $\alpha = 0.05$ so that $p < \alpha$ then H_0 is rejected and H_1 is accepted, so there is an effect of Spherical Grip ROM (Range of Motion) exercise on increasing muscle strength in post stroke infarction patients who experience hemiparesis in the rehabilitation poly of Prof. Hospital. Dr Soekandar Mojosari. The above opinion is supported by Soeparman (2004, in (Ira, 2021). which states that movement exercises, especially range of motion using Spherical Grip for post stroke sufferers can increase patient independence. This is because with motion exercises the muscles will mobilize. Muscle mobilization can prevent muscle stiffness, improve blood circulation, and increase muscle mass. If this is done regularly, the muscle tolerance for movement will increase. Strength can be described as the ability of the muscles to withstand weight both external and internal loads. Muscle strength is closely related to the neuromuscular system, namely how much the nervous system is able to activate the muscles to contract. So that the more muscle fibers that are activated, the greater the strength generated by these muscles. This involves muscle function, especially that of the flexor digitorum profundus. The sublimis flexor digitorum and interosseous muscles are helpful when greater muscle strength is required. The interosseous muscles are important for providing metacarpophalangeal flexion as well as traction and rotation of the phalanges to conform to objects. The flexor pollicis longus will be equally active, then there will be contractions of these muscles and increase muscle strength.

ROM exercises can stimulate neuromuscular and muscular chemical activity. Stimulation via neuromuscular will increase the stimulation of the nerve fibers of the limb muscles, especially the parasympathetic nerves, which stimulate the muscles, especially the smooth muscles of the limb, to increase. Smooth muscle of the extremities contains active filaments and interacts with one

another. The interaction process is activated by calcium ions and adeno diphosphate (ATP), then broken down into adeno diphosphate (ADP) to provide energy for muscle contraction in the extremities (Lesmana, 2012). Spherical grip exercise is a form of exercise by gripping a round object such as a ball in the palm of the hand which aims to support the recovery of movement abilities and hand function. Doing this program regularly will help the process of hand motor development. In addition to increasing muscle strength in stroke patients, they also stated that there was no stiffness in the muscles after ROM (Range Of Mation) Spherical grip exercises (Ira et al., 2021). Increasing muscle strength using Spherical grip exercises is very influential because almost all of them move their fingers in a flexion position so that they can grip an object. When gripped the metacarpalangeal and interpalangeal joints move freely.

The number of joints and muscles that work is one of the factors in increasing muscle strength. In addition to the many joints and muscles that work, the increase in muscle strength in the Spherical grip also has an effect due to the force or load used to contract, so that when the muscles contract and generate tension, it requires power or strength. When doing Spherical grip exercises that use more joints or muscles, the energy required will be greater, the contractions that occur are more maximal and can increase muscle strength.

CONCLUSION

The results showed that there was an effect of Spherical Grip ROM (Range Of Mation) exercises on increasing muscle strength in post-infarction stroke patients who experienced hemiparesis at the Rehabilitation Polyclinic at Prof. Hospital. Dr. Soekandar Mojosari. Movement exercises, especially range of motion using Spherical Grip for post stroke patients can increase muscle strength. this is because almost all of them move the fingers in a flexed position so that they can grip an object. The number of joints and muscles that work is one factor in increasing muscle strength.

SUGGESTION

1. For Respondents

It is hoped that after being given Spherical grip ROM exercises, respondents are asked to continue

ROM exercises themselves at home to increase muscle strength in post-stroke patients.

2. For Health Workers

It is hoped that this research can be used as additional knowledge about muscle strength training in stroke patients who experience decreased muscle strength, especially in the upper extremities

3. For Further Researchers

It is hoped that future researchers can use other types of range of motion to increase muscle strength in post-stroke patients.

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CONFLICT OF INTEREST

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AUTHORS CONTRIBUTION

In this study the first author as a correspondence author who is responsible for the research process to publication by writing articles that have been adjusted to journal guidelines. The second author assisted in the research process and data analysis. The third author helps research in the data collection process.

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