



## Effect of Giving A Combination of ROM and Mirror Therapy to Increase The Muscle Strength of the Upper Limb

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### Abstract

**Background:** One of the problems in stroke patients is a decrease in muscle strength due to hemiparesis which affects the client's self-acceptance. The study aims is to determine the effectiveness of combination mirror therapy and ROM on upper limb muscle strength and self-acceptance stage in stroke clients with hemiparesis. **Materials and Methods:** Quasi experimental research with pre-post control group design was done on 36 respondents with consecutive sampling technique, for 3 months in the stroke room. Upper limb muscle strength was measured using a Medical Research Council scale, while the self-acceptance stage used a self-acceptance stage questionnaire based on the Kubler Ross adaptation stage. Data were analyzed using Wilcoxon and Mann-Witney test with p value <0,05. **Results:** Wilcoxon test known p value <0.05 for muscle strength and self-acceptance stage both in the treatment group and in the control group. The result of analysis of muscle strength difference between treatment group and control is known p value = 0.000, while for self-acceptance stage known p value <0,05 for denial, anger, bargaining and depression, At acceptance stage known p value 0,05. This analysis shows that there is a significant difference in muscle strength and self-acceptance at the denial, anger, bargaining and depression stages after being given a combination of mirror and ROM therapy with stroke clients given ROM therapy alone. **Conclusion:** Combination of mirror therapy with ROM can be used as nursing intervention in the hospital, especially on ischemic stroke clients with hemiparesis to increase muscle strength and self-acceptance of client

**Keyword:** Stroke, Mirror Therapy, Range of Motion, Stage of Self-Acceptance, Hemiparesis.

### Introduction

Stroke is a neurological deficit situation which occurs when brain cells are dying due to interruption of blood flow due to a blockage or rupture of blood vessels in the brain. Stroke an impact on all aspects of the life of a person suffering from both aspects of personal, social, physical and psychological. The most common impact is hemiparesis [1, 4]. According to Koyama *et al* [5] hemiparesis is a common complication after stroke. Found 70-80% of patients who suffered stroke, have hemiparesis and often lead to disability in the movement of the patient's extremities. Bienias *et al* [6].

In theirs study found that, 85% of stroke patients who experienced hemiparesis, as many as 55% -75% have limitations in the functioning of the upper limb Stroke also results in impaired cognitive function. Stroke clients who survived the death, 64% of whom had cognitive impairment with various levels

and a third will have dementia [7]. More Rohadirja *et al* [7]. Describe the physical changes cause the client is difficult to accept the conditions, so there is a feeling of sadness, anger, useless, hopeless and weak feel. According Schoenleber, College dan Gratz [8], loss of cognitive ability and physical function is a stressor that must be faced by the client stroke and if it is not in Arm with adaptability and adaptive coping, then the client can be impaired self-acceptance.

Self-acceptance is a state of individuals who had faith in the state of being, and are able and willing to live with the situation [9, 10]. Good self-acceptance only occurs when the individual is willing and able to understand the state of the self as it is, not as desired, therefore it is very important to improve the condition of the patient post-stroke to the previous state [9, 10].

Functional recovery pasca stroke can occur directly, but in general are rare and are not sufficient to restore normal function [11] Many studies that discuss the handling of hemiparesis with exercise movement substantially performed by nurses in different countries, one therapeutic technique developed to improve muscle strength and limb function in patients with stroke with hemiparesis, among other exercises ROM (Range of Motion).

ROM is often combined with a variety of neurorehabilitation therapies to improve mototric function, mirror therapy is one of them, but there is little research on mirror therapy in patients who have hemiparesis on muscle strength, whether performed by nurses or other professions [12, 13]. In this study ROM was combined with mirror therapy to improve cognitive and motor functional improvement in post-stroke clients. According to Caires [14] ROM therapy will improve muscle strength through stimulation of afferent nerve fibers.

The afferent nerves of the peripheral nervous system are responsible for conveying sensory information to the brain about the degree of muscle length and stretch to the central nervous system to assist in maintaining posture and joint position. Signals from the brain will be conveyed through the nerves of the efferent nerves to move the conscious and unconscious muscles. In the stroke client the feedback condition of the brain is not optimal because the brain has lesions. ROM will provide stimulation to the brain to improve brain function that is damaged [15, 16].

Meanwhile, ROM in combination with mirror therapy has an impact on visual stimuli in the brain. In this way the brain is stimulated to re-recognize the sensory stimuli resulting in motor recovery of limb who experience hemiparesis through visual illusion [17, 19]. Based on that ideas, it is important to further analyze the effectiveness of combination of mirror and ROM therapy on upper extremity muscle strength and self-acceptance stroke clients with hemiparesis.

## Methods

This research is a quasi experiment with control group pretest-post test design. The population in this study were post-stroke patients who had hemiparesis treated at Army Hospital, Dr. Ramelan Surabaya,

Indonesia, from February to April 2019. A total of 36 respondents with ischemic stroke first attack were selected by Consecutive sampling technique from 96 existing population, divided into 18 respondents of treatment group and 18 control group. The treatment group achieved a combination of mirror therapy with ROM while the control group received only ROM therapy alone.

The study used a Medical Research Council (MRC) measuring instrument with a range of 0-5 scale values to assess upper limb muscle strength while for measuring self-acceptance stages using a self-acceptance questionnaire based on Kubler Ross's adaptation stage. Data were analyzed using wilcoxon and Man-Witney test with p value <0,05.

The study protocol has been passed the ethical test of the Rumkital Health Research Ethics Commission, Ramelan Surabaya with number: 11 / EC / KERS / 2019 before the research. The data collected by the enumerator is a physiotherapist and nurse with a Ners educational qualification consisting of three stages: pre test, intervention and post test.

Prior to the data collection, respondents were informed about the research procedure. After obtaining clear information, if the client is willing to be the respondent then the client is asked to sign the approval sheet in the form of informed concent then done pre-test. Pre-test is performed to measure muscle strength and patient's self-acceptance stage, at the intervention stage of combination of mirror therapy and ROM given at dose 1 times daily for 2 weeks.

In 1 week the patient is treated for 6 days. Each therapy takes 5-7 minutes. In the control group only ROM was given with the same doses as in combination ROM therapy with mirror therapy in the treatment group. Post-test is given after the patient follows the 2-week therapy session, which is done on the twelfth day. Post-test measurements are performed using the same instrument.

## Results

Characteristics of patient demographic data presented consisted of age, gender and education level. Demographic data is the primary data obtained through questions on the instrument. Age data is presented in the form of mean calculations and standard

deviation, while the gender and education data are presented in terms of number and percentage.

The summary of the characteristics of patient demographic data can be seen in (Table 1).

**Table 1: Summary of demographic characteristics of 36 stroke patients with hemiparesis**

Characteristics		Combination mirror therapy with ROM Group (n=18)	ROM Group (n=18)
Age	Mean ± SD	50,11 ± 2,632	50,11 ± 2,632
	Min-maks	45-55	40-55
Gender	Male	10 (55,6 %)	10 (55,6 %)
	Female	8 (44,4 %)	8 (44,4 %)
Education Level	Primary School	3 (16,7 %)	4 (22,2 %)
	Junior/senior High School	13 (72,2 %)	12 (66,7 %)
	College/ above	2 (11,1 %)	2 (11,1 %)

Based on table 1 it is known that the mean age of respondents in the treatment and control group is 50.11 with a standard deviation of 2,632. The youngest age in the treatment group is 45 years old and the oldest is 55 years old, while in the control

group is 40 years old and the oldest is 55 years old. Respondents were more men than women in both groups (55.6% v / s 44.4%). The average respondent has a medium level of education which means being in the middle and upper secondary education.

**Table 2: Summary of Effect of Combination Mirror Therapy with ROM on Upper limb muscle strength of Stroke Client with Hemiparesis**

Groups	Muscle strength								Median (min-maks)
	1		2		3		4		
	f	%	f	%	f	%	f	%	
Pre tes Treatment (n=18)	9	50	9	50	0	0	0	0	1,50 (1-2)
Control (n=18)	10	55,6	8	44,4	0	0	0	0	1 (1-2)
Post test Treatment (n=18)	1	5,6	9	50	8	44,4	1	5,6	3(2-4)
Control(n=18)	10	55,6	8	44,4	0	0	10	55,6	2(2-3)

Based on table 2 above, it was found that muscle strength score in both groups experienced a previous increase of scale 1 and 2, to scale 3 and 4 in the treatment group, while in the control group increased the scale of muscle strength only up to scale 3 only. Wicoxon test was known p value <0,05 both in treatment group and in control group.

This suggests that there is a significant effect of combination of mirror therapy with ROM on the muscle strength of the upper extremity of the srtoke client in the treatment group. Meanwhile, in the control group, ROM intervention also gave a significant effect on increasing limb muscle strength on stroke clients.

**Table 3: Summary of Effect of Combination Mirror Therapy with ROM on Self Acceptance of Stroke Client with Hemiparesis**

Groups	Measurements	Self Acceptance	Median	Min-Maks	(p Value)
Treatment (N= 18)	Pre test	Denial	13	11-15	0,000
	Post test	Denial	8	5-11	
	Pre test	Anger	12	11-15	0,000
	Post test	Anger	9	7-11	
	Pre test	Bargaining	14	12-15	0,000
	Post test	Bargaining	10	9-11	
	Pre test	Depresi	13	12-15	0,000
	Post test	Depresi	10	9-11	
Control (N= 18)	Pre test	Acceptance	13	11-15	0,000
	Post test	Acceptance	10.50	10-11	
	Pre test	Denial	14	11-15	0,000
	Post test	Denial	11.50	10-13	
	Pre test	Anger	12	10-15	0,001
	Post test	Anger	10	9-12	
	Pre test	Bargaining	10	9-11	0,001
	Post test	Bargaining	13	11-14	
Pre test	Depresi	10	9-11	0,000	
Post test	Depresi	12	11-15		
Pre test	Acceptance	11	10-11	0,000	
Post test	Acceptance	12	11-15		

Based on Table 3, it is known that there is influence of combination of mirror therapy with ROM on self-acceptance of stroke client with hemiparesis in treatment group, and in control group giving of ROM therapy influence to self-acceptance of stroke client with hemiparesis. It can be seen at p value <0,05, at each stage of self-acceptance both in the treatment group and in the control group.

Differences in the effect of combination mirror therapy and ROM with ROM on upper limb muscle strength and self-acceptance stroke client stage with hemiparesis were analyzed by Mann-Witney test analysis with  $\alpha = 0,05$ . A significant difference occurs if p value <0.05. summary of the research can be seen in (Table 4) for muscle strength and (Table 5) for self acceptance stage.

**Table 4: Summary of Differences in the effect Of Combination Mirror Therapy and ROM with ROM On Upper limb muscle strength of Stroke Clients with Hemiparesis**

Measurements	Groups	Median (Min-Maks)	(p Value)
Pre test	Treatment	1,50 (1-2)	0,742
	Control	1 (1-2)	
Post test	Treatment	3 (3-4)	0,000
	Control	2 (2-3)	

The result of muscle strength analysis at post test stage showed p value <0,05. this shows that there is a significant difference in muscle strength between the treatment group and the control group.

The results of this study prove that the combination of mirror therapy and ROM better in improving muscle strength of Upper limb client stroke with hemiparesis compared with ROM alone.

Measurements	Groups	Median (Min-Maks)	(p Value)
Pre Test Denial	Treatment	13 (11-15)	0,260
	Control	14 (11-15)	
Pre Test Anger	Treatment	12 (11-15)	0,272
	Control	12 (10-15)	
Pre Test Bargaining	Treatment	14 (12-15)	0,535
	Control	10 (9-11)	
Pre Test Depresi	Treatment	13 (12-15)	0,400
	Control	10 (9-11)	
Pre Test Acceptance	Treatment	13 (11-15)	0,742
	Control	11 (10-11)	
Post Test Denial	Treatment	8 (5-11)	0,000
	Control	11,50 (10-13)	
Post Test Anger	Treatment	9 (7-11)	0,003
	Control	10 (9-12)	
Post Test Bargaining	Treatment	10 (9-11)	0,004
	Control	13 (11-14)	
Post Test Depresi	Treatment	10 (9-11)	0,017
	Control	12 (11-15)	
Post Test Acceptance	Treatment	10,50 (10-11)	0,099
	Control	12 (11-15)	

## Discussion

### Differences in the Effect Of Combination Mirror Therapy and ROM with ROM on Upper limb muscle strength of Stroke Clients with Hemiparesis

The results showed that there was a significant difference in muscle strength score after being given a combination of mirror and ROM therapy with stroke clients given ROM therapy alone. The results of this study are in line with several related studies that combine mirror therapy with a variety of muscle stimulation exercises therapy in

stroke clients, including Kim et al [20]. Mirror therapy with electrical stimulation indicating there is upper limb motor repair in stroke clients with stroke of the first day of the four attacks carried out for 3 weeks. Research Lin et al [13].

Is known that combination of mirror therapy with somatosensory stimulation give positive effect in post stroke client's motor healing process including muscle strength, manual grasping task, and improve the ability of move for 3 weeks. Cacchio et al. [21]. Found an effect of mirror therapy with ROM in which a combination of both treatments reduced pain

and improved upper limb motor function in stroke clients with complex regional pain syndrome type 1 (CRPSt1) given for 2 weeks. The existence of this result difference is actually due to a combination of mirror therapy and ROM has a different effect on the motor function of the client.

This is in accordance with opinion [22] & [23] who say therapeutic exercise is a form of rehabilitation or exercise that relies on and trains the imagery or imagination of motorcycles of clients inducing the activation of motor sensory cortical nerves, whereby the mirror will provide visual stimulation to the brain (cerebral motor nerves are ipsilateral or contralateral for the movement of limbs that hemiparesis) through observation of body movements that will tend to be imitated as in the mirror by the body parts that are impaired. This condition does not occur in ROM therapy. The strength of ROM relies solely on muscle movement where the muscles that perceive hemiparsis are stimulated by range of motion exercises either actively or passively.

Wirawan, [24] revealed that ROM exercise is an exercise performed to maintain or improve the level of perfection ability to move the joints normally and completely to increase muscle mass and muscle tone. Stimulation of muscles with hemiparesis will stimulate the peripheral nervous system responsible for delivering commands to muscles and glands for a particular movement. Stimulation of this signal to clients who have a stroke does not always get to the brain. In this case, signals from afferent fibers do not reach the brain, but produce reflexive movements by direct connection with the efferent nerves in the spine.

Brain lesions are not given stimulation, making ROM therapy different from a combination of mirror therapy and ROM [25, 16]. Researchers suggest that ROM training in stroke clients with hemiparesis improves brain function through stimulation of afferent nerve fibers alone that can activate neuromuscular and muscular chemicals, increase metabolism in mitochondria, stimulate parasympathetic nerves and increase ATP production, and more increasing the stimulation of acetylcholine production that can trigger contractions upper limb muscles. On Combination of ROM with mirror therapy, motor function other

than stimulated through afferent nerve stimulation that exists in ROM exercises is also stimulated through visual stimulation existing in the mirror therapy that is able to induce the motor sensory cortical nerve activation, and further stimulate the parietal cortex and cerebellum that trigger contraction muscle. visual stimuli that exist in the mirror therapy will stimulate the visual cortex of the brain that activates neuron cells and stimulates motor activation as well as the coordination of limb movements.

This condition causes the restoration of motor function in the client given combination of ROM with mirror therapy to have a better recovery. This researcher's view is in line with opinion Schaechter [26], which revealed that post-stroke clients with hemiparesis can be manipulated with sensorimotor input. Combination of mirror therapy with ROM is of one sensorimotor input to the motor cortex that plays an important role in the process of re-learning motor skills in clients post-stroke. Increased cortex response to somatosensory stimulation contributes to the improvement or recovery of motor skills.

The cortex area in the brain can be modified by somatosensory input, experience and learning and response to injury [27] In this study the combination of ROM with mirror therapy is done by the client set the body sitting position and put a mirror between the arms and then move the healthy arm together with look to the mirror and imagine or feel as if that arms have weakness also move [28]. The goal is to provide sensory input in the cerebral cortex motor area. Sensory input will affect the activity (excitation) of neurons in the brain that will increase BDNF (brain-derived neurotrophic factor) transcription in post synap through Ca<sup>2+</sup> dependent transcription factors [29].

Several studies have shown that BDNF is a growth regulator that plays an important role in neuronal survival, differentiation, neuronal growth, synapses development and plasticity through activity [30]. Post-stroke nerve damage causes a disturbance of sensorimotor information that has been stored in the brain. The formation of sensorimotor information is performed by re-learning through sensorimotor manipulation of the affected limb thus triggering the

reorganization of cortical activity [31]. One that can be done to achieve this goal is through the provision of combination ROM with mirror therapy. In addition, the client's full attention to the movement undertaken can influence the occurrence of higher motor skills [32]. This is because the control of a motor ability (movement) to be efficient requires the attention or awareness of the client to visual information, vestibular and somatosensory [5].

Various descriptions and findings of the research above can be said that to achieve good motor function in clients post-stroke need to involve cognitive processes and behavioral science and psychology. It is based on the workings of a combination of mirror and ROM therapy, in which motor learning is initiated by the cognitive phase and subsequently evolves into an automatic. The cognitive phase emphasizes the importance of the client's awareness to be aware of the affected parts of the body and seeks to know the movements that are trained on the affected extremity.

The effort will increase the sensory input and simultaneously feedback to the brain, which forms the basis of motor control or conscious learning. Thus, the acceptance or attempts to realize instruction or exercise of motion in post-stroke clients with hemiparesis become very important in motor learning. The combination exercise of mirror and ROM therapy emphasizes how the movement is generated and how the movements are learned, so the active participation of the client to perform a conscious movement is necessary in determining its functional performance.

### **Differences in the Effect of Combination Mirror Therapy and ROM with ROM on Self-Acceptance of Stroke Clients with Hemiparesis**

The results showed that there was a significant difference in the client's self-acceptance stage at denial, anger, bargaining and depression after being given combination of mirror therapy and ROM with stroke clients given ROM therapy alone. Provision of mirror therapy and ROM did not show a significant difference in the acceptance stage by giving ROM therapy to stroke clients. The results of this study indicate that self-acceptance in post-stroke clients requires a process in which each

individual has a different response. According to Tomb [33] the attitude of self-acceptance occurs when a person is able to face reality rather than surrender or has no hope. Loss of body roles and functions will be responded differently by everyone.

Emotional reactions on the client stroke occurs because, having less energy to maintain life activities which previously could be performed (number, level and activity) and changes in general appearance can lead to feelings of depression and even self-loathing [34]. Their motivation from family and medical or nursing team, will have an impact on the mental clients in achieving more positive feelings and self-acceptance as a response to many physical and social transition they might experience later [35].

In line with this idea, post-stroke clients with hemiparesis treated for 2 weeks with the first stroke were given a combination intervention of the mirror therapy and ROM showed a more significant change in self-acceptance, which at the beginning of the diagnosis was at the denial stage and the members after treatment were largely transformed into bargaining and depression and there are some that acceptance.

The difference in muscle strength between the treatment group and the control group became an important thing that researchers found as the basic of the client's self-acceptance. This condition can be associated with the client's self-image. Stroke client with hemiparesis describes the shape and size of his body, perceiving and judging what he thinks and feels about the size and shape of their body, and on the judgment of others against them.

Unfortunate events in this case hemiparesis and cognitive impaired cognitive function can be accepted by the client with all the deficiencies possessed without causing anger, hostility, low self-esteem, embarrassment, and insecurity. The researcher's assumption is in line with Rohadirja et al [7] research on stroke clients with hemiparesis found that client's negative judgment of himself, including feeling unloved by others and unable to accept his circumstances will affect the client's self-concept. These feelings make the client feel stressed and disturbed that ultimately can aggravate the pain. Stuart [36] argues that most ways of behaving that

individuals take are in harmony with self-concept, then in line with that the right way to change the behavior and perception of clients are to change the self-concept that can be done with good self-management and also change the concept or the client's view of herself, so that in the end the client can accept their self

## Conclusion

Researchers can conclude that the combination of mirror therapy with ROM is

more effective in improving upper limb muscle strength and self-acceptance of stroke clients with hemiparesis than stroke clients given ROM therapy alone. Recommendation of this research is this therapy can be made as one of the fixed procedure in giving nursing intervention in Hospital especially in patient with ischemic stroke that has hemiparesis to increase muscle strength of upper limb and increase client self-acceptance stage.

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