Effects of Visual Imagery Techniques on Improving Motor Function of Upper Limb in Chronic Ischemic Stroke Patients: A Serial Case Report

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Keywords: Chronic Ischemic Stroke, Motor Function, Upper Limb, Visual Imagery.

Abstract: The aim of this study is to report our success in improving the motor function of the paresis hand of chronic stroke patients using visual imagery techniques. Three patients with chronic ischemic stroke were given visual imagery therapy carried out twice over three weeks, without stopped the occupational therapy. At the end of the treatment, an increase in hand function was found in all three cases, using the DASH questionnaire. In the first case, there was a significant increase in hand function in the activities of holding a motorcycle and car steering wheel, holding a shopping bag, and cleaning hair. In the second case, there was an increase in the function of opening and closing the jar, opening the lock, opening the door handle, attaching the object to the rack, cleaning the back, and holding the motor steering wheel. In the third case, improved hand function was found in carrying heavy objects, shopping bags, and wearing clothes. There was no decrease in hand function reported in all three cases after the administration of visual imagery therapy. This shows that visual imagery therapy as an adjunctive rehabilitation treatment to motor function in patients with chronic ischemic stroke gives good results.

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1 INTRODUCTION

Stroke is the second highest cause of death, and the third highest cause of disability in the world (Johnson, et al, 2016). The impact of disability will hamper daily activities and patient's readiness to return to their social environment. One of the disabilities due to stroke is impaired motor function of the upper limb. Rehabilitation of upper limb motor function becomes important because it supports the activities of daily living (ADL), such as eating and drinking, wearing clothes, bathing, combing hair, and so on (Venketasubramanian et al., 2017). Occupational therapy has been an option as a task-oriented training in rehabilitation of upper limb motor functions (Hatem et al., 2016). However, to achieve a fast recovery process requires continuous exercise every day, and this is often hampered by patient compliance. Then another alternative therapy is needed that can help speed up the recovery process of motor function of the upper limb. In recent years, many studies of visual imagery techniques in improving motor function after stroke. This technique is done by giving suggestions to the patient in a state of relaxation (Jones, 2014), and imagining the paresis limb to perform certain functional movements (Park et al., 2015). This technique is the most likely to be done routinely because without being affected by the motor strength of stroke patients. Aaron J. Manganiello in 2011 conducted a case study of visual imagery technique of a 57-year-old man with right hemiplegia. The result, within 5 weeks, there was an improvement in the function of the subjects, so that they were able to walk and move using the right extremities. Liu's RCT study, published in the 2009 Hongkong Med Journal, involved 17 subjects with visual imagery interventions, finding improved sensorimotor function in post-stroke patients compared with the conventional rehabilitation group, as measured by the Fugl-Meyer Assessment of Sensorymotor Recovery After Stroke. Holroyd et al from the University of California's Neurophysciatric Division gave suggestions to 66-year-old women with

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complete paralysis of the left arm due to carotid artery blockage. Obtained after 5 times of imagery interventions to do daily activities that are popular, there is a movement of the left arm that is much better than before therapy, and subjects are able to do daily activities even without help (Liu, 2009).

The main objective of this study is to report our success in improving the motor function of the paresis hand of chronic stroke patients using visual imagery techniques This study also explains how visual imagery can stimulate neuroplasticity in the brain and its clinical effect on the functioning of the paresis hand side.

2 METHOD

This study is a case series study of 3 people with chronic ischemic stroke, with weakness of the right arm and hand. Intervention of visual imagery techniques is given 2 times a week for 3 weeks to each subject, without stopping the occupational therapy that is being undertaken by the subject. The procedure of visual imagery is to relaxing the subject using direct suggestion, and guiding the patient to recall activities that can be carried out with the paresis side of the upper limb before the subject suffers from a stroke. The output is an assessment of hand function using the DASH questionnaire before and after the intervention.

3 CASE PRESENTATION

3.1 Case 1

Right-handed 50-year-old male, with long-standing infarction in internal capsule, thalamus and right putamen, right hemiparesis, motor strength score with Manual Muscle Testing (MMT) is 4, getting occupational therapy 2 times a week, and additional visual imagery therapy 6 sessions. Significant improvements were found in the activities of holding the steering wheel of a motorcycle and car, carrying shopping bags, and washing hair, with a score before getting intervention was 5, and after getting intervention was 2 (where the lower the score showed more improvement). Other activities such as sweeping the floor and holding a knife also improved with a score before the intervention was 4, and the score after the intervention was 2. Weaknesses in the arms, shoulders, or hands also experienced significant improvements. The subjects also rated the subject's confidence in the function of his arms, hands, or shoulders to increase.

3.2 Case 2

67-year-old, right-handed male with multiple infarcts in the right subcortical lobe, right-left lateral periventricle, right basal ganglia, and right-sided pons, right hemiparesis, motor limb strength scores over MMT 4, get therapeutic intervention by technique 6 sessions of visual imagery, as additional therapy. Subjects received occupational therapy twice a week in the hospital. Significant improvements occurred in the opening and closing of the jar, opening the door handle, and holding the steering wheel of the motorcycle, with a score of 5 before getting visual imagery intervention, and a score of 1 after getting visual imagery intervention. Other activities such as turning a door lock, putting an object on a shelf, and cleaning your back also improved, with a score of 5 before the intervention and a score of 2 after getting the intervention. Weakness of arms, shoulders, or hands also experienced significant improvement. Subjects were also more confident with the development of hand functions experienced by the subjects during the study.

3.3 Case 3

A 38-year-old, right-handed woman with right periventricular frontal lobe infarction, left hemiparesis, with an upper limb muscle strength score of MMT 4, received 6-session therapeutic intervention with visual imagery techniques, as additional therapy. Subjects received occupational therapy once a week. Qualitatively, there was a significant increase in hand function in the activity of carrying shopping bags, lifting heavy objects, and wearing clothes, with a score before the intervention was 4, and after the intervention was 1. Weakness in the arms, shoulders, or hands did not experience significant improvement. Subjects still felt inadequate and lacked confidence in the function of the arms, shoulders, or hands after the study.

Table 1: DASH Questionnaire Score.

	Score					
	Subject 1		Subject 2		Subject 3	
	Pre	Post	Pre	Post	Pre	Post
Open a tight or new jar	3	1	5	1	5	4
Write	5	5	4	3	1	1
Turn a key	4	3	4	1	4	3
Prepare a meal	-	-	-	-	2	2
Push open a heavy door	4	2	5	1	3	2
Place an object on a shelf above · your head	4	4	5	2	5	4
Do heavy household chores (eg · wash walls, wash floors)	3	2	4	4	4	4
Garden or do yard work	4	2	2	2	4	3
Make a bed	2	2	2	2	2	2
Carry a shopping bag or briefcase	5	2	3	2	4	1
Carry a heavy object (over 10 lbs)	3	3	2	2	4	1
Change a lightbulb overhead	5	5	5	3	-	-
Wash or blow dry your hair	5	2	5	2	2	2
Wash your back	3	3	5	2	4	3
Put on a pullover sweater	3	2	4	2	4	1
Use a knife to cut food	4	2	4	2	-	-
Recreational activities which require little effort (eg card playing, knitting, etc)	2	2	2	2	4	3
Recreational activities in which you take some force or impact through your arm, shoulder or hand (eg golf, hammering, tennis, etc)	-	-	-	-	5	5
Recreational activities in which you move your arm freely (eg playing frisbee, badminton, etc)	3	2	3	2	5	4
Hold the steering wheel of a motorcycle or car	5	2	5	1	4	2
Sexual activities	-	-	-	-	-	-
During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups	5	4	4	3	4	3
During the past week, were you limited in your work or other regular · daily activities as a result of your arm, shoulder or hand problem?	4	3	3	2	3	3
Arm, shoulder or hand pain	5	4	1	1	5	4
Arm, shoulder or hand pain when you performed any specific activity	4	3	2	1	5	4
Tingling (pins and needles) in your · arm, shoulder or hand	1	1	1	1	1	1
Weakness in your arm, shoulder or hand	4	2	3	1	4	3
Stiffness in your arm, shoulder or hand	4	3	3	2	3	3
During the past week, how much 29 difficulty have you had sleeping · because of the pain in your arm, shoulder or hand?	5	4	1	1	1	1
I feel less capable, less confident or 30. less useful because of my arm, shoulder or hand problem	4	1	4	1	4	3

4 DISCUSSION

One of the goals of the rehabilitation program in patients with chronic ischemic stroke is to restore the function of limbs affected as optimal as possible. The process of recovering neuronal damage after ischemic stroke can occur spontaneously, and or stimulated by rehabilitation interventions, to stimulate brain neuroplasticity through the mediation of Brain Derived Neurotrophic Factor (BDNF) (Pascotini et al., 2018). Most BDNF is produced in synapses in the hippocampus after ischemic-induced brain injury, including stroke.(Lu et al., 2014) The hippocampus is a center of learning and long-term memory. By imagining and recalling memory regarding certain activities with the side of the paresis arm, the hippocampus will be activated to recall that memory. Activation of the hippocampus is thought to stimulate BDNF secretion which triggers the process of neuroplasticity (Vertes, et al, 2001).

In addition, studies show that when a person performs visual imagery, it appears that the distribution of blood flow occurs in the occipital, parietal, prefrontal, and anterior cingulate cortex using Positron Emission Tomography (PET) (Jensen et al., 2015). Activation of these areas turns out to be the same as when a person gets sensory input and performs certain motor movements significantly in response to external stimuli. This shows that performing visual imagery will have the effect of increasing the firing rate of neurons in the same way as doing real movements. Research by Ishai et al found several studies of imagery that can evoke response responses in the cortex that are visually associated, namely occipitotemporal and occipitoparietal (Ishai, Ungerleider and Haxby, 2000). Although there is no voluntary movement that occurs during visual imagery, various studies show that brain neuroplasticity occurs when visual imagery is carried out, which is characterized by improved function.

The post-stroke visual imagery technique is done by giving the patient suggestions in a state of relaxation, to imagine the body part that the paresis is moving for a particular purpose. It has been investigated that visual imagery when the brain is in theta waves will increase firing and stimulate neurons to make impulse pathways to the cortical area, stored as memory, as if the imagery were actually done and were happening at that time (Faymonville, Boly and Laureys, 2006).

In this study, the three subjects were right-handed, namely the dominance of the right hand to carry out daily activities. Subjects 1 and 2 had right hemiparesis, and were undergoing occupational therapy 2 times a week. Whereas subject 3 was left hemiparesis, and was undergoing occupational therapy once a week. Improved hand function in certain activities which is qualitatively significant is seen to be more common in subjects 1 and 2 than in subject 3. Similarly, weakness in the arms, shoulders, or hands improved significantly in subjects 1 and 2. These results are consistent with Harris et al in a study concluded that functional disorders that occur on the dominant side will be lighter than if the affected side is non-dominant.3 In addition, a randomized controlled trial (RCT) study by Liu et al published in the Hong Kong Medical Journal indicates that patients who received additional visual imagery interventions for 3 weeks, doing daily activities better than the group that only received occupational therapy (Liu et al., 2004). Likewise, a study by Park et al who divided the two groups of subjects with stroke. Each group received occupational therapy 20 minutes a day for five sessions a week for two weeks. In the intervention group visual therapy was added as many as five sessions a week for two weeks. The results obtained in the intervention group, there was an increase in upper limb function and Activity Daily Living (ADL) significantly compared to the control group (Park et al., 2015).

In all three cases, there was an increase in the motor function of the subject's hands on the paresis side in certain activities, as measured by the DASH questionnaire. Hand function activities that have improved significantly are related to specific activities that are carried out repetitively as subjects' daily lives. Studies by Israely et al mention that specific hand function exercises such as reaching, grasping and object manipulation, which are carried out 4-5 sets with each set of 8-15 reps, will improve hand function as measured by the Fugl Meyer score score (Israely, Leisman and Carmeli, 2017). Literature review from Oujamaa et al showed that exercise on the wrist and hand side of the paresis is very important in all phases of the stroke rehabilitation program. Recent neuroscience data suggest that ipsilesional corticospinal stimulation should be a priority. To get optimal functional outcomes, stroke rehabilitation programs must be based on specific activities and are repetitive (Oujamaa et al., 2009).

In this study, psychologically it appears that feelings of inadequacy, less useful, and lack of confidence in the function of the arms, shoulders, or hands of subjects 1 and 2 have improved. This is

because there is a significant increase in many activities undertaken by subjects 1 and 2. While the increase in activities that are still limited to subject 3 has not been able to increase the subject's confidence. This is consistent with the study by Dogu et al. That there is a relationship between impaired hand function and psychological effects on sufferers of brain injury, where a person's stress level or depression will improve along with the improvement in hand function experienced (Dogu et al., 2014).

Visual imagery technique is an effective and safe technique. No side effects were reported in this study. A meta-analysis states that the visual imagery technique is a safe therapy for various procedures. Suggestions given by doctors to patients become an important component in establishing doctor-patient communication in daily clinical practice (Häuser et al., 2016).

The limitation of this study is the absence of a control group, so it cannot be concluded clearly whether the intervention of visual imagery therapy significantly improves hand function. In addition, the occupational therapy that was undertaken by the patient during the study was not standardized, so that it could cause bias in the results of the study. Factors such as a person's ability to imagine, residual sensorimotor capabilities, ability to follow commands, attention, and motivation may be crucial components not considered in these patients (Butler and Page, 2006). Further studies are needed with a larger sample size, taking into account these aspects to increase internal validity in research.

In conclusion, therapy with visual imagery techniques can be considered an additional therapy in patients with chronic ischemic stroke, because it is proven to stimulate brain neuroplasticity, so as to improve the function of the hands on the paresis side.

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