

Effect of Mirror Therapy on Lower Limb Functions and Balance in Hemiparetic Patients

Rucha Choudhari¹, Simran Vohra², Trupti Siddapur^{1*}

¹Assistant Professor, Dr.D.Y.Patil College of Physiotherapy, Dr.D.Y.Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India

²Intern, Dr.D.Y.Patil college of Physiotherapy, Dr.D.Y.Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India

*Corresponding Author: Trupti Siddapur, Assistant Professor, Dr.D.Y.Patil College of Physiotherapy, Dr.D.Y.Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

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Abstract

Background: Leftover weakness of muscles leading to synergies and spasticity usually make stroke survivor to adapt an inactive way of living, which further restricts the individual's routine activities. These initial neurological deficits results in balance alteration leading to risk of fall and abnormal gait. Neurological disorders based on ideal motor control models and on motor learning theories help in regaining functional movements of the affected lower limb. Attempt to reduce the influence and enhance functional outcomes after a stroke thus, pose a major challenge for rehabilitation experts. Its been recommended that the mirror therapy is an easy, economical and patient governed treatment approach which enhances hand function.

Aim: To find out the effect of mirror therapy on lower limb functions and balance in patients with hemiparesis

Materials and methods: 30 subjects (<70 years) with one episode of stroke having 1-2 grade of spasticity according to modified Ashworth scale

were included in the study. Fugl Meyer Assessment for Lower Extremity and Berg Balance Scale were used to assess motor function and balance. Subjects were given conventional physiotherapy along with mirror therapy

Results: results of the study showed improvement in lower limb function and balance

Conclusion: from this study it can be concluded that mirror therapy can be used in conjunction with convention physiotherapy for stroke patients.

Keywords: Stroke; Mirror Therapy; Lower Limb Function, Balance

Abbreviations

MT: Mirror Therapy; BBS: Berg Balance Scale; FMA LE: Fugl Meyer Assessment Lower Extremity; PM: Psychoneuromuscular

Introduction

Hemiparesis, or unilateral paresis, in which weakness of one side of the body is seen [1]. It is a third major reason of death and

second important cause of disability [2]. Loss of motor Hemiparetic patients usually struggle to maintain balance because of limb weaknesses causing inability in shifting the body weight accurately. This hampers their Activities of daily living. The primary cause of hemiparesis and hemiplegia is stroke [1].

Stroke is defined as a clinical syndrome characterized by rapidly developing signs of focal or global disturbance of cerebral functions

that may lead to death. In adults it is one of the major causes of persistent disability. Leftover weakness of muscles leading to synergies and spasticity usually make stroke survivor to adapt a inactive way of living, which further restricts the individual's routine activities. These initial neurological deficits results in balance alteration leading to risk of fall and abnormal gait [3].

Neurological disorders based on ideal motor control models and on motor learning theories help in regaining functional movements of the affected lower limb. Trevisan, *et al.* have recommended a procedure on the basis of mirror therapy (MT). This approach targets improvement in the motor function, combining the sensory stimuli with motor responses, reorganizing the cortical connections and stimulating changes in areas with cortical representation [4].

Attempt to reduce the influence and enhance functional outcomes after a stroke thus, pose a major challenge for rehabilitation experts. Its been recommended that the mirror therapy is an easy, economical and patient governed treatment approach which enhances limb function. Integrating modified Mirror Therapy into the conventional program at the primary phases of rehabilitation and implementing it for a long period might be advantageous for enhancing limb function [5].

Mirror therapy in stroke demands performing the movements of the affected limb while observing its mirror reflection superimposed over the unseen paretic limb. Visual system mechanisms acts as an substitution for the missing feedback of proprioceptors of the paretic limb [6].

The principle of MT includes the strategies demanding "motor copy", which introduces the use of the affected limb by moving the unaffected limb which acts as an external feedback from mirror, and internal feedback is provided by means of mental practice of functional activities. Mirror therapy is an economic, harmless and helpful treatment approach. It is one of the recently used treatment approach for post stroke hemiparesis which intends to alleviate the sensorimotor deficits and to fasten up the functional rehabilitation of the paretic side [7].

Due to the importance of rehabilitation of stroke patients, this study was conducted to find out the effect of mirror therapy on the balance and functions of the lower limb in subjects with post-stroke hemiparesis.

Materials and Methods

A Pre-Post experimental study was conducted after approval from institutional ethical committee. 30 subjects, both males and females between 46-65, having one episode of stroke without any cognitive impairment, with the spasticity ranking between 1-2 on modified Ashworth scale and the subjects who can walk with or without walking aids were included in the study. Subjects with visual impairment, previous lesion in affected limb, any lesion in the non- affected limb and subjects with musculoskeletal condition affecting locomotion were excluded from the study.

Pre assessment of motor function was done using Fugl Meyr Assessment for Lower Extremity in which reflex activity, flexors and extensors synergy, coordination, balance and motion were included [8] and the balance was assessed using Berg Balance Scale [9].

Subjects were initially given conventional physiotherapy which included Icing, active and passive ROM exercises, stretching, kneeling, strengthening, weight shifts, balance training on wobble board, etc. was supervised by 30 mins of Mirror therapy In this condition, the unaffected lower limb of the patient was kept under the visual field and the involved lower limb was kept behind the reflecting part of the mirror. Patients were asked to notice the unaffected limb in the mirror and to carry out the same activities with the affected limb. Evaluation was done again after 10 treatment sessions and the data was collected and the collected analyzed using paire 't' test. Following activities were given to the patients either in sitting or in long sitting positions.

Ankle movements [1,2]

- **Patients position:** Sitting position.
- **Mirror placement:** A rectangular mirror was positioned with respect to the patient's sagittal line in sitting. In this scenario, the unaffected low er limb was kept in area of patient's visual field while the involved lower limb was kept behind the reflecting surface of mirror.
- **Movements performed:** Subject was asked to perform Ankle Dorsiflexion and Plantarflexion as much as possible with his unaffected limb while looking in the mirror and try to perform the same movement with the affected limb which was covered.

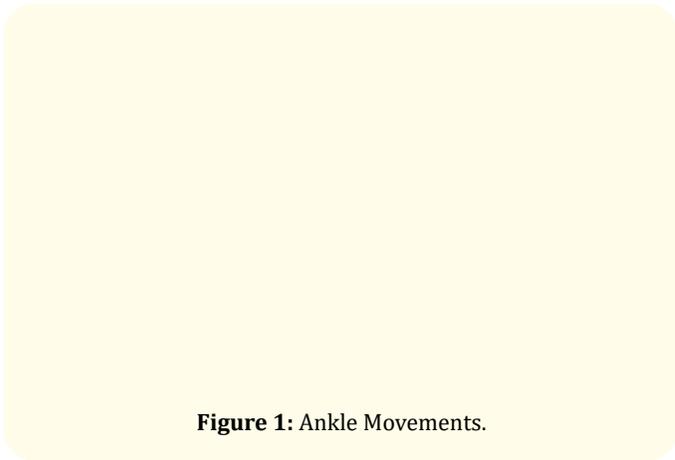


Figure 1: Ankle Movements.

Knee movements [3]

- **Patients position:** Sitting position.
- **Mirror placement:** A rectangular mirror was positioned with respect to the patient’s sagittal line in sitting. Here, the sound lower limb was in the area of patient’s visual field while affected lower limb was kept behind the mirror.
- **Movements performed:** Subject was asked to perform knee flexion and extension as much as possible with his unaffected limb while looking in the mirror and try to perform the same movement with the affected limb which was covered.

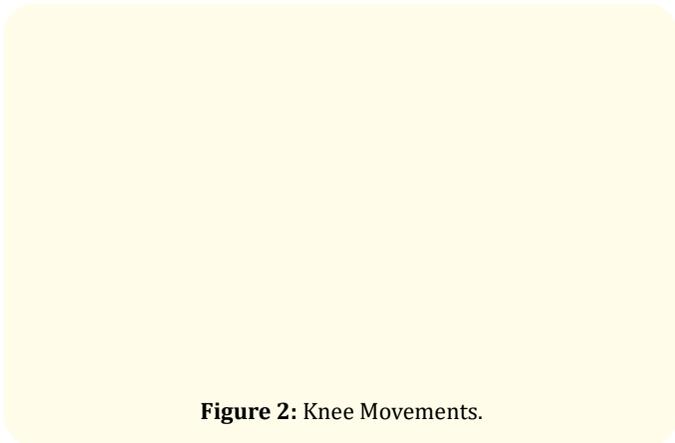


Figure 2: Knee Movements.

Hip abduction, adduction [4,5]

- **Patients position:** Long Sitting position.
- **Mirror placement:** A rectangular mirror was placed with the reference to the sagittal subject’s line in sitting position, the sound lower limb was in the area of patient’s visual field while affected lower limb was kept behind the mirror.

- **Movements performed:** Subject was asked to perform hip abduction and adduction as much as possible for 20-50 repetitions with his unaffected limb while looking in the mirror and try to perform the same movement with the affected limb which was covered.

Ball rolling, ball kicking [6-8]

- **Patients position:** Long Sitting position.
- **Mirror placement:** A rectangular mirror was positioned with respect to the patient’s sagittal line in sitting position. The sound lower limb was in the area of patient’s visual field while affected lower limb was kept behind the mirror
- **Movements Performed:** Ball rolling and ball kicking.

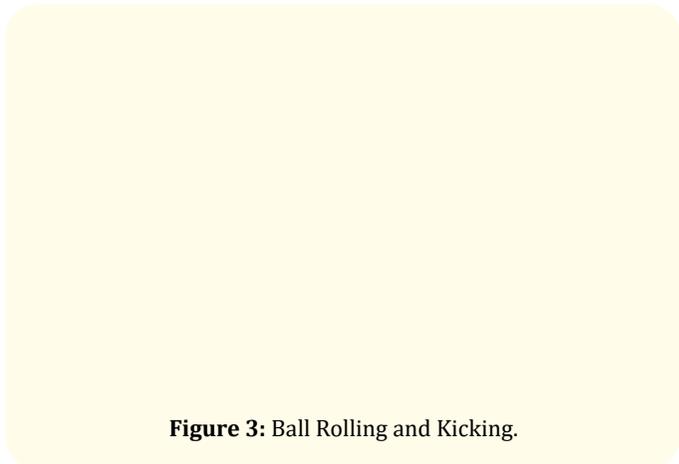


Figure 3: Ball Rolling and Kicking.

Result and Discussion

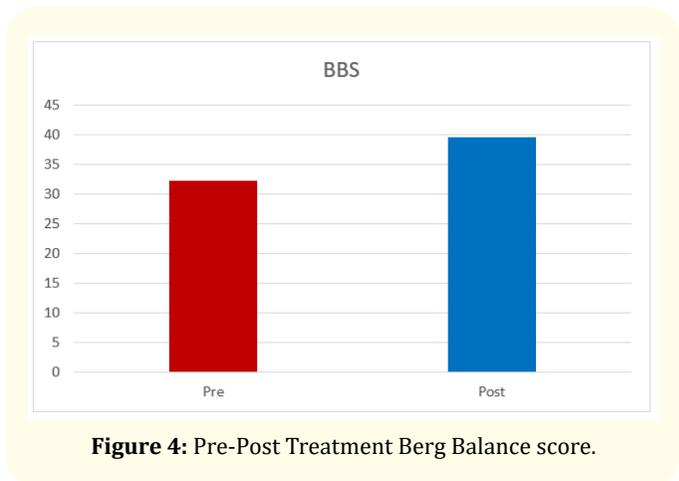


Figure 4: Pre-Post Treatment Berg Balance score.

Interpretation

Figure 4 shows that there is increase in the BBS score suggesting that there is significant improvement in the balance

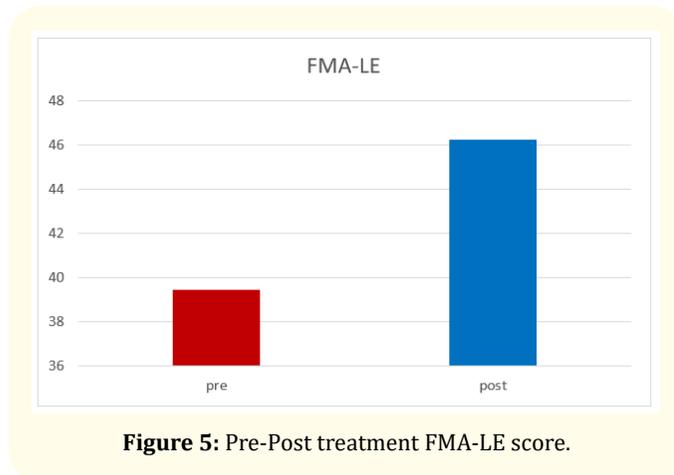


Figure 5: Pre-Post treatment FMA-LE score.

Interpretation

Figure 5 shows that there is increase in the post treatment values of the Fugl Meyer assessment scale for lower limb, suggesting that there is significant improvement in the lower limb function.

The aim of the study was to evaluate the efficacy of mirror therapy on balance, and function of lower limb in hemiparetic patients. A remarkable betterment for FMA_LE and balance was found post assessment. The principle of mirror therapy (MT) is the use of a mirror to create a reflective illusion of an involved extremity for making the brain to think that movement has occurred at the involved limb [3]. It included placing the involved limb behind a mirror, which is kept in such a way that the reflection of the healthy limb appears to be in the place of the hidden limb. A Mirror box is a device which permits the rehabilitation professionals to easily generate this illusion. It is a box with one mirror in the center where on each side of it, the limbs are kept in such a way that the involved limb is kept covered always and the uninvolved limb is placed on the other side whose reflection can be seen in the mirror.

The results of this current study shows positive effects of mirror therapy on balance and function of lower limb. Significant improvements were seen in the scores of daily living activities and functional capacity of the lower limb after the treatment. It is proposed that the functional improvement owed to the visual

stimuli with the mirror that are able to improve the neural plasticity to repair functions that were damaged by the stroke. Movement activated the proprioceptors located in the muscles and tendons, hereby ameliorating damaged functions that improves anteroposterior stability that improves balance [3].

Mirror neurons come under the category of bimodal visuomotor neurons which get activated during action observation, mental stimulation (imagery), and action execution. For example, it has been observed that only observation of an action increases M1 excitability of the muscles that are used for a particular action. Mirror neurons are responsible for learning of new skills by visual observation of the skill [5].

The mirror reflection of sound limbs looks like the involved extremity moving correctly and “replaces “ for the reduced proprioceptive signals. Mirror therapy may be helpful to reverse learned disuse of the involved extremity at neurological as well as psychological levels. Mirror neurons come under the category of bimodal visuomotor neurons which get activated during action observation, mental stimulation (imagery), and action execution. There are various researches found stating the use of mirror therapy for the betterment of functioning of affected limb with the help of visual feedback contributing to the recovery of the proprioceptors by reactivating the damaged area and making migration of brain function balance to their original area and producing functional reorganization of usage dependency of structure of brain which afterwards reduces the learned non use giving rise to the recovery of motor function [6].

Psychoneuromuscular (PM) theory: the central nervous system stores a pattern of motion patterns that act as a motor program; Despite the presence of physical disability, the “motor pattern” yet endure intact or present partially in patients with stroke, these synergy patterns if used in functional activity training helps for improving and strengthening the motor imagery of the paretic limb. Particularly, the motor imagery of the mirror therapy would frequently built up the near normal patterns of movements from brain to muscle groups in the same way the same way as seen in actual activities in order to stimulate targeted muscle groups, betterment of controlled movement along with coordination, which improves the motor skills and gear up the process of motor learning; The “visual feedback mechanism acts as visual feedback

provided by mirror therapy enhances the neural recruitment and reorganization of function in premotor area, primary motor cortex along with sensorimotor cortex. It helps in the establishment of the

link between visual input and movement [2,4]. It accelerates the recovery of motor functions.

Sr no.	Activity	Target Movement	Dosage
1	Ankle movements	Ankle dorsi-plantar flexion	20-50 repetitions*3 sets
2	Ankle movements	Ankle inversion-eversion	20-50 repetitions*3sets
3	Knee movements	knee flexion, extension	20-50 repetitions*3sets
4	Hip abduction	Hip abduction	20-50 repetitions*3 sets
5	Hip adduction	Hip adduction	20-50 repetitions*3 sets
6	Ball rolling	Knee flexion- extension	20-50 repetitions*3 sets
7	Ball rolling	Hip internal-external rotation	20-50 repetitions*3 sets
8	Ball kicking	Knee extension	20-50 repetitions*3 sets

Table 1: Activities performed in front of the mirror.

BBS	Mean	SD	p value
Pre	32.2	10.89	0.0001
Post	39.53	9.63	

Table 2: Pre and Post treatment Values of BBS.

FMA-LE	Mean	SD	P value
Pre	41.53	4.32	0.0001
Post	49.03	4.59	

Table 3: Pre and post values of FMA-LE.

Conclusion

The result of this study shows that Mirror therapy has an added effect on balance and function of lower limb. Hence we conclude that mirror therapy can be introduced along with conventional therapy.

Acknowledgements

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Conflict of Interest

We declare there is no conflict of interest.

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