

Mirror Therapy in Stroke Rehabilitation

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Abstract: *This paper discusses about one of the upcoming therapies i.e. Mirror Therapy in rehabilitation of Stroke. Many researches have been conducted so far in acute, sub-acute or chronic stage but it is still unclear as to which one is benefitted the most. The methodology and the mechanism by which mirror therapy works have been discussed. Most of the evidence for mirror therapy is from studies with weak methodological quality. The present review showed a trend that mirror therapy is effective in treatment of stroke patients whereas the effectiveness in other patient groups has yet to be determined.*

Keywords: Stroke, Mirror Therapy, Mirror Visual Feedback (MVF), Hemiparesis, Mirror Neurons

1. Introduction

Stroke or cerebral vascular accident, is the sudden death of brain cell due to inadequate blood flow. The WHO clinically defines stroke as the rapid development of clinical signs and symptoms of focal neurological disturbance lasting more than 24 hours, or leading to death with no apparent cause other than of vascular origin.^[1] The paretic upper limb is a common and undesirable consequence of stroke that increases activity limitation.^[2] A number of interventions have been published evaluating the effect of various rehabilitation methods in improving upper extremity control and functioning.

Mirror therapy is a relatively new therapeutic intervention which is simple, inexpensive and most importantly patient directed treatment that focuses on moving the unimpaired limb. It was first introduced by Ramachandran and Roger Ramachandran to treat phantom limb pain after amputation.

In stroke patients, this technique involves performing movements of unimpaired limb while watching its mirror reflection superimposed over the (unseen) impaired limb, thus creating a visual illusion of enhanced movement capability of the impaired limb.^[3]

It is thought that Mirror therapy uses mirror visual feedback which increases neural activity in areas involved with allocation of attention and cognitive control (dorsolateral prefrontal cortex, post cingulate cortex, S1 & S2 precuneus).

There is little evidence that mirror visual feedback activates the mirror neuron system. Mirror visual feedback increases the excitability of the ipsilateral primary motor cortex that projects to the untrained hand/ arm. There is also evidence for ipsilateral projections from the contra lateral M1 to the untrained/ affected hand as a consequence of training with mirror visual feedback. It has been shown that functional organization of the motor system, including the primary motor cortex, can be modulated by both ipsilateral limb movement and passive observation of movement of movement of the contra lateral limb. Various studies have been done over years to test the efficacy of mirror therapy in

rehabilitation of stroke in all the three stages but to no conclusive idea about which stage i.e. acute, subacute or chronic is benefitted the most.

2. Procedure

Mirror therapy is generally given for thirty minutes, five days a week for four weeks along with a thirty minutes session of conventional therapy. Mirror therapy consists of variety of movements like wrist and finger flexion and extension, hand opening and closing, forearm pronation and supination, grasp lift and release, wrist rotation while being seated close to the table on which mirror box is placed and performing the activities with the non involved hand in front of the mirror while the involved hand is kept behind the mirror (non reflective side). The patients perform the movements while looking into the mirror, watching the image of their non involved hand, thus seeing the reflection of the hand movement projected over the involved hand.

3. Studies

Uthra Mohan et al (2013) did a study to evaluate the effectiveness of mirror therapy in lower extremity motor recovery, balance and mobility in patients with acute stroke. Patients with first time onset of stroke with mean post stroke duration of 6.41 days, able to respond to verbal instructions, and brunnstorm recovery stage 2 and above were enrolled. Mirror therapy group performed 30 minutes of functional synergy movements of non- paretic lower extremity, whereas control group underwent sham therapy with similar duration. In addition, both groups were administered with conventional stroke rehabilitation regime. Altogether 90 minutes therapy session per day, six days a week, for two weeks duration was administered to both groups. Lower extremity motor subscale of fugl Meyer Assessment (FMA), Brunel balance assessment (BBA), and functional ambulation categories (FAC) were the outcome measures. The study concluded that administration of mirror therapy early after stroke is not superior to conventional treatment in improving lower limb motor recovery and balance, except for improvement in mobility.^[4]

Holm Thieme et al (2012) did a randomized control trial to evaluate the effects individual or group mirror therapy on sensorimotor function, activities of daily living, quality of life and visuospatial neglect in patients with severe arm paresis after stroke. 60 patients within three months of stroke were included in the study & were divided into three groups: (1). Individual mirror therapy, (2) group mirror therapy, (3) control intervention with restricted view on the affected arm. Fugl- Mayer test, Action Research arm test, Barthel index, stroke impact scale and star collection test were used as the outcome measures. The study showed no effect on sensorimotor function of arm, activities of daily living, and quality of life of mirror therapy compared to control intervention after stroke. However, a positive effect on visuospatial neglect was neglected.^[5]

Lee MM et al (2012) did a study to evaluate the effects of mirror therapy program on upper limb motor recovery and motor function in twenty six acute stroke patients. The subjects were assigned to either experimental or control group. Both the group members participated in a standard rehabilitation program, but only the experimental group received mirror therapy program for 25 minutes twice a day, 5 times a week for 4 weeks. The Fugl Meyer assessment, Brunnstrom motor recovery stage and Manual function test were used to assess the changes in upper limb motor recovery and motor function post intervention. It was concluded that mirror therapy program is an effective intervention for upper limb motor recovery and motor function improvement in acute stroke patients.^[6]

Yosuke Wada et al (2011) investigated the improvement in dorsiflexion of severely affected ankle joints of acute stroke patients after mirror therapy. Nine with first ever episode of stroke patients participated in the study. A mirror was placed to reflect the non-paralyzed lower limb. A set of 50 dorsiflexion movements of the ankle joint was performed 4 times a day for 7 days. Foot functions of the Stroke Impairment Assessment Set (SIAS-F) and the foot floor angle at active dorsiflexion were measured every 7 days from 14 days before initiation of the mirror therapy training to 7 days after, for a total of 5 times. Significant improvement in dorsiflexion of the ankle joint, as measured by SIAS-F, was achieved with mirror therapy.^[7]

Christian Dohle et al (2009) evaluated the effects of a therapy that includes use of a mirror to stimulate the affected upper extremity with the unaffected extremity upper extremity early after stroke. 36 patients with severe hemiparesis because of first ever ischemic stroke in the territory of middle cerebral artery were enrolled. They completed a protocol of 6 weeks of additional therapy (30 minutes a day, 5 days a week) with random assignment to either mirror therapy (MT) or an equivalent control therapy (CT). The main outcome measure was Fugl- Meyer assessment for upper extremity. Mirror therapy patients regained more distal function than control patients. Furthermore across all patients, MT improved recovery of surface sensibility. Neither of these effects depended on the side of lesioned hemisphere. MT stimulated recovery from hemineglect. The study concluded that mirror therapy early after stroke is a promising method to improve sensory and

attentional deficits and to support motor recovery in a distal plegic limb.^[8]

A. Sciusco et al (2008) did a study on mirror therapy combined with conventional therapy, which has been compared to conventional therapy alone in the motor recovery of upper limbs. A total of 14 patients in the sub-acute or chronic phase of stroke participated in the trial, divided into two equal groups. Before and after the rehabilitation program, each patient underwent examination and complete psychiatric evaluation (Mini Mental state examination), Functional independence measure, Fugl Meyer Assessment, Modified ashworth scale. After 4 weeks, the subjects treated with the mirror therapy combination showed a slightly lower grade of spasticity, an improvement in the motor ability of arms. The study concluded that as compared with traditional rehabilitation techniques, mirror therapy may offer an additional effective strategy.^[9]

M. Invernizzi et al (2013) did a study on 36 subacute stroke patients to find out if adding mirror therapy to conventional therapy could improve motor recovery of upper limb. Patients were randomly allotted to the mirror therapy or the control group. Both followed a comprehensive rehabilitative treatment. In addition, mirror therapy group had received 30 minutes of Mirror therapy while the control had undergone 30 minutes of sham therapy. After one month of treatment, patients of both the groups showed significant improvement in action research arm test, motoricity index and functional independence measure. However mirror therapy group patients performed better than the control ones in all the variables measured. It was concluded that mirror therapy is a promising and easy method to improve motor recovery of upper limb in subacute stroke patients.^[10]

Gunes Yavuner et al (2008) did a randomized control trial to evaluate the effects of mirror therapy on upper extremity motor recovery, spasticity and hand related functioning of patients with subacute stroke. A total of 40 patients with stroke all within 12 months post stroke were included. The patients underwent 30 minutes of mirror therapy a day consisting of wrist finger flexion- extension movements or sham therapy in addition to conventional stroke rehabilitation program, 5 days a week, 2 to 5 hours a day, for 4 weeks. The brunnstrom stages of motor recovery, modified ashworth scale and self-care items of FIM instrument were the outcome measures. The study concluded that hand functioning improved more after mirror therapy in addition to conventional rehabilitation program compared with a control treatment immediately after 4 weeks of treatment and at 6 month follow up, whereas mirror therapy did not affect spasticity.^[2]

Serap Sutbeyaz et al (2007) did a randomized control trial to evaluate the effects of mirror therapy on the lower extremity motor recovery and motor functioning of patients with sub-acute stroke. A total of 40 patients with stroke, all within 12 months post stroke were included in the study. The intervention included 30 minutes per day of mirror therapy in addition to conventional stroke rehabilitation program, 5 days a week, 2 to 5 hours a day for 4 weeks. The brunnstrom stages of motor recovery, modified ashworth scale (MAS), functional ambulation categories (FAC), & motor items of

FIM instrument were the main outcome measures. The mean score of Brunnstrom stages as well as FIM showed significantly more improvement at follow up in the mirror group compared with control group. Neither MAS nor FAC showed a significant difference between the groups. The study concluded that mirror therapy combined with conventional stroke rehabilitation program enhances lower-extremity motor recovery and motor functioning in subacute stroke patients.^[3]

NidhiKathuria et al (2013) did a study to compare the effect of knowledge of performance and knowledge of results when given with mirror box therapy in improving hand function in stroke patients. Thirty stroke patients, all within one year after stroke, were randomly divided into Group A (knowledge of performance) & Group B (knowledge of result). The subjects underwent 30 minutes of mirror therapy program a day in addition to fifty minutes of conventional stroke rehabilitation program, 5 days a week for 4 weeks. The assessments were done pre and post intervention using Fugl Meyer Test and Jebsen test of hand function. The results of the study showed that knowledge of performance proved to be more effective than knowledge of results in Fugl Meyer assessment scores.^[11]

ChingYi et al (2013) did a randomized control trial to compare the effects of mirror therapy versus control treatment on movement performance, motor control, and sensory recovery and performance of activities of daily living in people with chronic stroke. Thirty three participants were included in the study. The mirror therapy group received upper extremity illusion of the unaffected limb's movements from the mirror. The control treatment group received task oriented upper extremity training. Treatment intensity for both groups was 1.5 hours per day, 5 days a week for 4 weeks. The Fugl-Meyer assessment, kinematic variables, the Revised Nottingham sensory assessment, the motor activity log, and the ABILHAND questionnaire were the outcome measures. The results of the study concluded that the application of mirror therapy after stroke might result in beneficial effects on movement performance, motor control and temperature sense but may not translate into daily functions in the population with chronic stroke.^[12]

Matthys K et al (2009) did a study in which it was found that there are 2 areas which are uniquely associated with the mirror-induced visual illusion of hand movements: the right superior temporal gyrus and the right superior occipital gyrus. Eighteen healthy subjects were taken and neural activation was compared in a no-mirror experiment and a mirror experiment by a functional magnetic resonance imaging (fMRI) study of mirror-induced visual illusion of hand movements. Both experiments consisted of blocks of finger tapping of right hand versus rest. It was seen that in the mirror experiment, movement of left hand was simulated by mirror reflection of right hand movement.^[13]

4. Discussion

As we have gone through so many studies which have been cited above and the results indicate that many patients show substantial recovery of function using Mirror Therapy (MVF). But the variability suggests that the procedure may

help some patients more than others like it is still unclear as to which stage would be benefitted the most acute, subacute or chronic. This variability may depend in part on the exact location of the lesion and duration of paralysis following stroke. Once these variables have been understood, it might be possible to administer MVF to those patients who are likely to benefit most. (Although, given the simplicity of the procedure, there is no reason why it should not be implemented routinely as adjuvant therapy.) Also the dosage and the movements needed to perform have to be documented well.

5. Conclusion

Although it has been seen that Mirror Therapy helps recovering function in hemiparesis but still it is unclear that to which stage is benefitted the most post stroke. Many other researches have to be conducted in order to streamline the feasibility, dosage, patient population who would be benefitted the most. Also the follow ups and the carryover should be studied well.

6. Future Scope

Future researches can be conducted to find out which stage is benefitted the most post stroke. Also documentation of the dosage needs to be done.

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