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Effects of Mirror Therapy in Improving Motor Function After Stroke: A Literature Review

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ABSTRACT

Background: Stroke is a vascular disorder leading to focal cerebral dysfunction, often presenting as hemiplegia. Rehabilitation starts within 24 hours, focusing on motor recovery. Mirror therapy, a cost-effective treatment, enhances neuroplasticity by reflecting the unaffected limb's movements to stimulate the affected limb. This visual feedback improves motor function and reduces pain, particularly in patients with complex regional pain syndrome. Strategies include active, mental, and passive movements, with lasting improvements in motor function observed up to six months post-treatment.
Objectives: The objective of this literature review is to find the effects of mirror therapy in improving motor function after stroke.
Design: review of literature
Data synthesis: recent researches, meta-analysis, randomized control trials, observation studies
Methodology: various articles from following databases like Science Direct, PubMed and Cochrane were retrieved through a search by using keywords- Stroke, Upper Extremity; Recovery of Function; Rehabilitation; Meta-Analysis; Mirror Therapy, Exercise Therapy. Total 10 articles were included in the study and based on their findings a review was made.
Conclusion: This literature review concluded that mirror therapy reduced pain after ischemic stroke, but only in patients with a complex regional pain syndrome. Mirror therapy is significantly associated with immediately improved motor function of the upper extremity in patients with stroke.

Key words: Stroke, Mirror Therapy, Exercise Therapy, Motor function

INTRODUCTION

Stroke is a syndrome of rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin'. Stroke includes subarachnoid hemorrhage but excludes transient ischemic attack (TIA), subdural hematoma, and hemorrhage or infarction caused by infection or tumor. It also excludes silent cerebral infarcts.[1] Three main mechanisms contribute to cell death during stroke excitotoxicity and ionic imbalance, oxidative/nitrosative stress and apoptotic-like cell death.[2] Hemiplegia were the commonest presentation of stroke. Headache, vomiting, and vertigo were found. The incidence of stroke is defined as the

number of first in a life- time strokes occurring per unit time. It is a sensitive measure of the need for stroke services, but is difficult to estimate without considerable resource.

The incidence of all acute strokes (first and recurrent) is in the region of 20-30% higher than the first in a life-time.[1] Hemorrhage causes direct neuronal injury, and the pressure effect causes adjacent ischemia. Primary ischemia results from atherothrombotic occlusion or an embolism.[3] Ischemia causes direct injury from lack of oxygenation and nutritional support and sets up a cascade of neurochemical events that lead to spreading damage. The ischemia may be reversible if reperfusion is obtained quickly (now proved in clinical trials), and the chemical injury may be interrupted by various neuroprotective drugs (unproved in humans). Magnetic resonance imaging identifies stroke anatomy but can also assess blood flow and perfusion in the brain, detect whether lesions are new or old, and identify carotid artery stenosis. Complications have focused on individual problems in isolation, such as seizures, venous thromboembolism, or depression.[4] Stroke was clinically presented as sudden numbness or weakness in the face, arm, or leg, especially on one side of the body; sudden confusion, trouble speaking, or difficulty understanding speech. Sudden trouble seeing in one or both eyes; Sudden trouble walking, dizziness, loss of balance, or lack of coordination. Paralysis of the arm or leg is common after stroke and frequently causes problems with activities of daily living such as walking, dressing or eating.[5]

From 24 hours after a stroke, physiotherapists begin rehabilitation in short frequent spells, focused on getting out of bed, standing and walking. This repetitive task training helps people regain movement and relearn everyday activities. Physiotherapists use assistive equipment to enhance stroke rehabilitation. Beneficial treatment options for motor recovery of the arm include constraint-induced movement therapy and robotics.[6]

Mirror Therapy is a rehabilitation therapy in which a mirror is placed between the arms or legs so that the image of the non-affected limb gives the illusion of normal movement in the affected limb. During mirror therapy (MT), a mirror is placed in the patient's mid-sagittal plane in such a way that the mirror image of the unaffected limb looks as if it were optically superimposed on the affected one.[7]The brain tends to recognize visual feedback before proprioceptive or somatic feedback.[8] Mirror therapy is based on the neuroplasticity suggested by this theory. The normal upper limb movement as seen in the mirror serves as the visual feedback necessary to stimulate the primary somatosensory cortex to induce movement of the paralyzed side. Mirror therapy is conventional, movement-oriented mirror therapy with addition of functional tasks. Mirror therapy is a simple, inexpensive, and patient-oriented treatment. Functional brain imaging studies conducted on healthy individuals have shown that the ipsilateral primary cortex excitability increases when observing the mirror image of the hand during unilateral hand movements. Mirror therapy involves the superimposition of the reflections of healthy extremity movements on the affected extremity for the patient to observe them as if their extremity is moving.[9] Mirror therapy is used to improve motor function after stroke and reduces pain, but only in patients with a complex regional pain syndrome. Movements were performed at the speed the patients desired. The patients in the conventional group performed the same exercises against the non-reflecting face of the mirror for an equal length of time. The same therapist delivered the mirror or sham therapy to the patients.[9]Three types of strategies used in Mirror Therapy in the first strategy, the participant watches the movements of the unaffected limb in the mirror and tries to imitate those movements with the affected limb actively, synchronizing it with the mirror reflection of the unaffected limb. In the second strategy, the participant is asked to mentally picture the affected limb moving as the desired

motor imagery without actively moving the affected limb when he/she looked into the mirror. Lastly, in the third strategy, a therapist will assist in the movements of the affected limb passively so as to synchronize it with the reflection of the movements of the unaffected limb in the mirror.[10] The beneficial effects on movement were maintained for six months.

OBJECTIVE

The objective of this literature review is to find the effects of mirror therapy in improving motor function after stroke.

METHODOLOGY

Search Strategies:

Keywords used:

Following are the keywords obtained using MeSH (medical subject heading): Stroke, Upper Extremity; Recovery of Function; Rehabilitation; Meta-Analysis; Mirror Therapy, Exercise Therapy

Criteria for selection: Inclusion Criteria:

1. All the articles selected are RCTs & systematic review
2. Articles published in English language
3. Articles were selected based on the age group above 50years
4. Articles from past 10 years (2013- till date) were selected

Exclusion Criteria:

1. Animals were excluded.
2. Articles published in other languages than English.
3. Articles having participants above the age group of 50 years
4. Studies recruited participants with other neurological diseases deficits.
5. Articles before the year 2013

Results:

Total 10 articles were taken and studied. The review study is described below. As describing below about author, nature, title and findings of studies.

REVIEW OF LITERATURE

A study on the mirror therapy is used to improve motor function after stroke and reduces pain, but only in patients with a complex regional pain syndrome. Movements were performed at the speed the patients desired. The patients in the conventional group performed the same exercises against the non-reflecting face of the mirror for an equal length of time. The same therapist delivered the mirror or sham therapy to the patients.[9]

Holm Thieme, et.al, investigated the effect of mirror therapy for improving motor function after stroke concluded that, mirror therapy is effective in improving activities of daily living. It seems to be an effective intervention, both for improving motor function and reducing pain. Mirror therapy seems not to influence pain in unselected stroke patients.[11]

A study conducted by, Sengkey et. al concluded that, mirror therapy in stroke rehabilitation an alternative therapeutic intervention that focuses on moving the unaffected limb to convey visual stimuli to the brain observation of the movements in the mirror.[12]

A study to investigate the effect of motor performance in the paretic upper limb after stroke by, Samuel Kamalesh Kumar et.al found that mirror therapy when combined with bilateral arm training and graded activities was effective in improving motor performance of the paretic upper limb after stroke compared with conventional therapy without mirror therapy.[13]

The effects of mirror therapy in stroke patients with complex regional pain syndrome type 1 concluded that, patients with stroke and simultaneous complex regional pain syndrome type 1, addition of mirror therapy to a conventional stroke rehabilitation program provides more improvement in motor functions of the upper limb and pain perception than conventional therapy without mirror therapy.[14]

A randomized control trial with the effect of mirror therapy with neuromuscular electrical stimulation for improving motor function of

stroke survivors showed that twenty-seven hemiplegic stroke survivors who were randomly assigned to either an experimental or a control group showed significant improvements in muscle strength. Mirror therapy combined with neuromuscular electrical stimulation may effectively improve muscle strength and balance in hemiplegic stroke survivors.[15]

Nigar Gurbuz, et.al evaluated the, effect of mirror therapy on upper extremity motor function in stroke patients found that, mirror therapy in addition to a conventional rehabilitation program was found to provide additional benefit in motor recovery of the upper extremity in stroke patients.[16]

A study conducted to investigate the effect of, mirror therapy for improving lower limb motor function and mobility after stroke, concluded that, mirror therapy is effective in improving motor function, muscle tone, balance characteristics, functional ambulation, walking velocity, passive range of motion for ankle dorsiflexion and gait characteristics for patients after stroke.[17]

A randomized control trial on the efficacy of lower extremity mirror therapy for improving balance, gait, and motor function post-stroke found a large beneficial effect following mirror therapy training. Lower extremity mirror therapy also had a positive effect on mobility. Mirror therapy for the lower extremity, as well as mirror therapy supplemented with stimulation, has positive outcomes for improving gait speed.[18]

A randomized control trial was conducted to investigate the effect of, mirror therapy for improving upper limb motor functions in stroke patients showed that, there were significant differences between pre-treatment and post-treatment mean scores of upper arm functions, hand function and advance hand activities between two groups. Mirror therapy was found to be effective in improving upper limb motor functions of stroke patients.[19]

DISCUSSION

Various hypotheses have been postulated on the neurophysiological basis of MT. The first hypothesis suggests the presence of a mirror neuron system (MNS) in the frontotemporal region and superior temporal gyrus (STG), which discharges with a goal-oriented hand action or through observation of a similar action by another person.[7] This action-observation facilitates the corticospinal pathway; in turn improving motor function by eliciting mental imagery and inducing motor learning. Observation of biological motion also is thought to aid in recovery from neglect by activation of the STG. The second hypothesis suggests potential mechanisms like increased self-awareness and spatial attention by activation of the STG, precuneus, and posterior cingulate cortex (PCC). MT increases activity in primary and secondary visual and somatosensory areas, thus enhancing attention, conscious awareness of sensory feedback, and avoidance of learned non-use of the affected limb. The third hypothesis describes the role of MT in activation and recruitment of the otherwise dormant, ipsilateral motor pathways originating in the unaffected hemisphere and projecting ipsilaterally to the paretic side of the body.[7] The role of MT in promoting normalization of balance within the hemispheres post stroke by modulating the excitability of the primary motor cortex (M1) has also been hypothesized.[7] During MT, both the affected limb movement and the passive observation of movement of the unaffected limb as reflected in the mirror influence M1 excitability. Bhasin et al observed an increase in the activation of primary motor area Brodmann area 4 post MT (restitution principle of neuroplasticity).[10]

Our review has reported effects of MT in rehabilitation post stroke. More than half of the studies intervened and recorded improvements in the acute phase of stroke. This can potentially change clinical practice as MT can intervene for a completely flaccid limb, unlike other rehabilitation approaches (Constraint Induced Movement Therapy (CIMT), therapy with computer games, virtual reality, etc.) where a minimal amount of voluntary movement is a pre-requisite for

initiating therapy.

Few studies have previously reported that MT, when combined with bilateral arm training, increases the visual or mental imagery feedback, which in turn facilitates upper limb motor function. Our review supports this finding and additionally reports that bilateral arm training shows positive results in both sub-acute and chronic motor impairments of the upper limb and for hemineglect.[6]

A future scope for MT would be to identify its relation to the differing presentations of stroke among men and women. The differing risk factors, stroke severity, and neurological outcomes between men and women may demand a modified application of MT for rehabilitation in individual genders. Research is also needed into the effect of MT in different subtypes of stroke, be it pure motor strokes or those with sensory and other components. The role of MT in rehabilitating acute and chronic lacunar strokes (which show better functional prognosis), its long-term effects, and associated improvement in quality of life can be investigated to set the stage.[20]

CONCLUSION

This literature review concluded that mirror therapy reduced pain after ischemic stroke, but only in patients with a complex regional pain syndrome. Mirror therapy is significantly associated with immediately improved motor function of the upper extremity in patients with stroke.

Declaration by Authors

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