

MIRROR THERAPY: A REVIEW OF EVIDENCES

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ABSTRACT

The aim of this review was to identify and summarize the existing evidences on mirror box therapy for the management of various musculoskeletal conditions. A systemic literature search was performed to identify studies concerning mirror therapy. The included journal articles were reviewed and assessed for its significance. Fifty one studies were identified and reviewed. Five different patient categories were studied: 24 studies focussed on mirror therapy after stroke, thirteen studies focussed on mirror therapy after an amputation, three studies focussed on mirror therapy with complex regional pain syndrome patients, two studies on mirror therapy for cerebral palsy and one study focussed on mirror therapy after a fracture. The articles reviewed showed a trend that mirror therapy is effective in stroke, phantom limb pain, complex regional pain syndrome, cerebral palsy and fracture rehabilitation.

KEY WORDS: Mirror Therapy, Stroke, Cerebral Palsy, Fracture Rehabilitation.

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INTRODUCTION

Mirror therapy was invented by Vilayanur S. Ramachandran to help alleviate the Phantom limb pain, in which patients feel they still have a pain in the limb even after having it amputated. Ramachandran and Rogers-Ramachandran [1] first devised the technique in an attempt to help those with phantom limb pain resolve what they termed a 'learned paralysis' of the painful phantom limb. The visual feedback, from viewing the reflection of the intact limb in place of the phantom limb, made it possible for the patient to perceive movement in the phantom limb. Their hypothesis was that every time the

patient attempted to move the paralyzed limb, they received sensory feedback (through vision and Proprioception) that the limb did not move. This feedback stamped itself into the brain circuitry through a process of Hebbian learning, so that, even when the limb was no longer present, the brain had learned that the limb (and subsequent phantom) was paralyzed.

The principle of mirror therapy (MT) is the use of a mirror to create a reflective illusion of an affected limb in order to trick the brain into thinking movement has occurred without pain. It involves placing the affected limb behind a mirror, which is sited so the reflection of the opposing limb appears in place of the hidden

limb [2]. A Mirror box is a device which allows the clinician to easily create this illusion. It is a box with one mirror in the centre where on each side of it, the hands are placed in a manner that the affected limb is kept covered always and the unaffected limb is kept on the other side whose reflection can be seen on the mirror. MT is a non-pharmacological and alternative treatment strategy that has been proposed as a means of managing phantom limb pain. It is a neuro-rehabilitation technique designed to remodulate cortical mechanisms. With this technique, patients perform movements using the unaffected limb whilst watching its mirror reflection superimposed over the (unseen) affected limb. This creates a visual illusion and provides positive feedback to the motor cortex that movement of the affected limb has occurred. The approach is thought to offer potential relief through the visual dominance upon motor and sensory processes [3].

Mirror therapy has been used in patients suffering from stroke, cerebral palsy, complex regional pain syndrome, phantom limb pain and fracture rehabilitation. Three particular conditions that have been studied the most are stroke, CRPS and phantom limb pain. During mirror therapy, a mirror is placed in the patient's mid sagittal plane, thus reflecting movements of the nonparetic side as if it were the affected side. This arrangement is suited to create a visual illusion whereby movement of or touch to the intact limb may be perceived as affecting the paretic or painful limb. The underlying mechanisms of the effects in these three patient groups have mainly been related to the activation of 'mirror neurones', which may also be activated when observing others perform movements and also during mental practice of motor tasks. Mirror neurons were found in areas of the ventral and inferior premotor cortex associated with observation and imitation of movements and in somatosensory cortices associated with observation of touch. These cortical areas are supposed to be activated by MT. Until now, direct evidence for the mirror-related recruitment of mirror neurons is lacking. Other potential mechanisms such as enhanced self-awareness and spatial attention by activation of the superior temporal gyrus,

precuneus and the posterior cingulate cortex have been proposed. The superior temporal gyrus is also thought to play an important role in recovery from neglect, and is activated by observation of biological motion.

METHODOLOGY & SEARCH CRITERIA

Independent search was carried out by researchers using a well defined search strategy in following databases; Medline, EBSCO, DOAJ, Science Direct and Google Scholar published from 1996 to 2013 using the key terms mirror box, mirror box therapy, mirror therapy and mirror visual feedback. All randomized controlled trials (RCTs), cohort, case controlled studies, single-case studies and case series were used in evaluating the clinical aspects of mirror therapy.

All age groups and both sexes were included for selection of reviews. Only physiotherapy intervention has been included, no medical or surgical intervention or comparison with any other alternative therapies. Visual analogue scale, range of motion, numerical pain rating scale, grip strength, wrist functionality measurements, timed performance tests, functional independence measure, modified Ashworth scale, functional ambulation categories, functional independent measure, wolf motor function test, motor activity log, Fugl-Meyer test, behavioral inattention test, test of attention performance, manual muscle testing, manual functional test, action research arm test, box and block test and 10-meter walk test were taken as an outcome measures

A total of 97 studies were potentially identified by the authors. Studies published in English language on effectiveness, efficacy, effects of mirror box therapy were included in the review. After checking for selection criteria and duplicates a total of 51 studies were considered for this review including 43 clinical trials and 8 systematic reviews. MT was used in conditions like stroke, cerebral palsy (CP), complex regional pain syndrome (CRPS), phantom limb pain (PL) and fracture rehabilitation. 23 out of 24 studies were supporting mirror box therapy for rehabilitation of stroke subjects. 12 out of 13 studies on phantom limb pain, three out of three for CRPS, one out of two for CP and one for fracture were showing statistically significant

improvement. Studies included were presented here with two titles, clinical trials and reviews.

Mirror therapy in stroke: Lin KC et al evaluated afferent stimulation and mirror therapy for rehabilitating motor function, motor control, ambulation, and daily functions after stroke. Forty-three chronic stroke patients with mild to moderate upper extremity received MT + MG, MT, or CT for 1.5 hours/day, 5 days/week for 4 weeks. Results shows MT + MG and MG with reduced motor impairment and synergistic shoulder abduction more than CT [4].

Mirror therapy in phantom limb pain: Jack W. Tsao et al. evaluated mirror therapy in phantom limb pain. Twenty-two patients were assigned to one of three groups: one that viewed a reflective image of themselves in a mirror (mirror group); one that viewed a covered mirror; and one that was trained in mental visualization. The study found that mirror therapy reduced phantom limb pain in patients who had undergone amputation of the lower limbs. Such pain was not reduced by either covered mirror or mental visualization treatments. These results suggest that mirror therapy may be helpful in alleviating phantom pain in lower limbs [5].

Mirror therapy in cerebral palsy: Max G. Feltham et al. evaluated the effect of visual information on bimanual coordination in children with spastic hemiparetic cerebral palsy. The study incorporated two additional visual feedback conditions by placing a glass or opaque screen between the arms. During bilateral symmetric circular arm movements mirror visual feedback induced lower neuromuscular intensities in the shoulder muscles of the less impaired arm of children with SHCP compared to the other visual conditions. In addition, the mirror lead to shorter relative durations of eccentric and concentric activity in the elbow muscles of the more impaired arm, whereas no effects of visual feedback were found in a matched control group. These results suggest that replacing veridical visual information of the more impaired arm with a mirror reflection of the less impaired arm improves the motor control of children with SHCP during inter limb coupling [6].

Mirror therapy in CRPS: G.L Moseley et al has

done a randomized controlled trial on effectiveness for long-standing complex regional pain syndrome. Thirteen chronic CRPS1 patients were randomly allocated to a motor imagery program (MIP) or to ongoing management. The MIP consisted of two weeks each of a hand laterality recognition task, imagined hand movements and mirror therapy. After 12 weeks, the control group was crossed-over to MIP. The results uphold the hypothesis that a MIP initially not involving limb movement is effective for CRPS and support the involvement of cortical abnormalities in the development of this disorder [7].

Mirror therapy in fracture: Altschuler E. et al examined mirror therapy in a patient with a fractured wrist and no active wrist extension. Patient was trained by moving both hands while watching the reflection of the present or good hand in a parasagittal mirror. Mirror therapy found extremely useful after a fractured wrist [8].

Clinical Interpretation

This literature review has given an account of the reasons for the widespread use of mirror therapy. Some of the potential limitations of this review were the lack of meta-analysis and quality scoring of the included studies.

Kelly Lamont et al., 2009 summarize the current evidence supporting use of Mirror Box Therapy and its successor, Immersive Virtual Reality. They showed, in recent years the Phantom Limb Pain (PLP) and to some degree Complex Regional Pain Syndrome (CRPS) may prove to be an exception [9].

Oujamaa L et al., 2011 reviewed 66 studies. The main therapeutic strategies they found activation of the ipsilesional motor cortex, inhibition of the contralesional motor cortex and modulation of the sensory afferents. This pathophysiological mechanism could explain the positive impact of constraint-induced movement therapy (CI therapy) in an environmental setting for chronic stroke patients. This literature review shows that exercising the hemiparetic hand and wrist is essential in all stages of a stroke rehabilitation program. New data stemming from neurosciences suggest that ipsilesional corticospinal excitability should be a priority [10].

Mirror therapy has shown positive effects in the treatment of stroke rehabilitation and complex regional pain syndrome. It also shows positive effects on hand and foot rehabilitation following an injury or surgery [9,11].

Rothgangel AS et al., reviewed clinical aspects of mirror therapy in rehabilitation. They found little is known about which patients are likely to benefit most from MT, and how MT should preferably be applied. Future studies with clear descriptions of intervention protocols should focus on standardized outcome measures and systematically register adverse effects [12]. More research is needed to determine the optimal dose of therapy, optimal time to start this intervention, and the right target group. Accordingly, no firm conclusions can now be drawn on the effectiveness of MT until more evidence is present [13].

DISCUSSION

This review was a clinically and scientifically applicable for use both by clinicians and researchers involved with patients of unilateral limb involvement like stroke, cerebral palsy, phantom limb and CRPS. Some of the potential limitations of this review were the lack of meta-analysis and quality scoring of the included studies. This review included studies of all designs leading to heterogeneity not only in interventions, outcome assessment and follow-up, but also in analysis and effect size. Only studies in English were reviewed and this might have missed some other important studies.

The increased variability regarding different physiotherapy modalities, comparison interventions, follow-up, and outcome measures also made it very difficult to compare results across studies and draw relevant conclusions. Further good quality controlled clinical trials on comparison between the physiotherapy modalities and lifestyle modification are necessary to derive valid conclusions.

CONCLUSION

The articles reviewed showed a trend that mirror therapy is effective in stroke, phantom limb pain, complex regional pain syndrome, cerebral palsy and fracture rehabilitation. This study would facilitate clinicians and research-

ers to understand the use of MT, its feasibility and applicability in the management of patients' with neuro musculoskeletal conditions affecting unilateral limb.

Conflicts of interest: None

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