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## Using Mirror Therapy for Stroke Rehabilitation

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**NORTHERN ILLINOIS UNIVERSITY**

Using Mirror Therapy for Stroke Rehabilitation

**A Capstone Submitted to the**

**University Honors Program**

**In Partial Fulfillment of the**

**Requirements of the Baccalaureate Degree**

**With Honors**

**Department Of**

Nursing

**By**

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**DeKalb, Illinois**

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### Abstract

In the United States, strokes are known to kill over 140,000 people every year and effect mobility in more than 50 percent of stroke survivors (Centers for Disease Control and Prevention, 2020). It is a debilitating disease that befalls when blood vessels transporting nutrients to the brain are disrupted by a blood-clot or rupture of a vessel. While many rehabilitative therapies are available to those who have suffered from a stroke, there is one therapy that may benefit stroke survivors more than just conventional therapies. Mirror therapy (MT), a therapy that utilizes a mirror box to create an optical illusion, may be one way to help survivors to recover their lost motor functions. MT can aid rehabilitation by using a mirror to produce a reflection of a person's unaffected limb in place of the affected limb when performing tasks. When the unaffected extremity is shifted, the mirror image allows the brain to believe that the affected limb is moving. These optical illusions allow the patients to feel as if their two extremities are moving symmetrically. This literature review focuses on how mirror therapy is utilized in practice today and if it should be incorporated as a conventional therapy for stroke rehabilitation. Peer reviewed journal articles have been dissected from the databases CINAHL Complete and MEDLINE. Through the review process, it was revealed that while mirror therapy on its own did not show any significant changes in overall motor functionality, mirror therapy in combination with conventional therapy has the potential to have statistically significant results.

Keywords: *mirror therapy, stroke, rehabilitation, motor recovery, activities of daily living*

## Introduction

Movement is an essential facet of life. To some, being able to get out of bed and complete simple daily tasks such as brushing their hair or preparing a meal are essential in their daily routines. When the ability to control one's movement is taken, as in the event of a stroke, it can be extremely debilitating. According to the Centers for Disease Control and Prevention (2020), every 40 seconds, a stroke occurs in the United States and is the primary cause of long-standing disability. Once a stroke occurs and has left its mark, the focus of care is shifted towards rehabilitation. Rehabilitation, which works to re-teach an individual how to perform daily tasks in new modified ways, is a great way for stroke victims to work towards recovery. However, in the case of acquiring new routines, many times the focus of working towards regaining one's physical capabilities is overlooked. In this literature review, the current use of a newer therapy for stroke rehabilitation will be discussed along with its implications for future use.

To start, a stroke is an ailment that occurs when there is ischemia (a reduced supply of blood) or hemorrhage (bleeding from a ruptured vessel) in the brain that results in the death of brain cells (Lewis, Dirksen, Heitkemper, & Bucher, 2017, p. 1345). When brain cells perish, so does brain function ("About Stroke," n.d.). How one is affected by a stroke is dependent on the site, severity, and how soon it is resolved and treated. Functions such as movement, perception, thought, conversation and/or emotions that were once controlled by the affected area of the brain, may be lost or compromised (Lewis, Dirksen, Heitkemper, & Bucher, 2017, p. 1345).

After a stroke, many survivors struggle to deal with the hardships that come with their physical restrictions. Partaking in rehabilitation allows survivors of strokes to re-familiarize themselves with abilities that can be lost when parts of the brain are damaged. Rehabilitation

instills new means of executing tasks to try to counteract any lasting frailties. Individuals may need to acquire new techniques to complete their activities of daily living. This can include but is not limited to re-learning how to bathe and dress using one arm or how to balance themselves on their feet. Once a patient is stabilized post-stroke, rehabilitative therapy begins. Promoting independent movement is very important as many individuals are debilitated (National Institute of Neurological Disorders and Stroke, 2020).

Something that can aid in a patient's recovery from a stroke is the use of mirror therapy. Mirror therapy (MT) is a type of therapy that is built on ophthalmic stimulation. With the utilization of a mirror, a barrier is created on an individual's midsagittal plane. With this, the client is able to construct an image of his/her unaffected extremity in place of the affected limb when fulfilling tasks. When the unaffected extremity is shifted, the mirror image allows the brain to believe that the affected limb is moving, simulating the two extremities moving synchronously ("Mirror therapy for stroke rehabilitation: Tricking the brain into believing what it sees," 2019). This review focuses on how this rehabilitative treatment is used in therapy and if it should be integrated with traditional therapies for stroke rehabilitation.

### **Methods**

For this literature review, only peer reviewed journal articles were examined. Articles were chosen through the use of online databases through NIU's Founders Library. Databases utilized included CINAHL Complete and MEDLINE. Search criteria included the terms "mirror therapy", "stroke rehabilitation", and "motor recovery." The selected peer reviewed journals were published within the last ten years. Of the 122 journals found within these two databases,

10 articles fit the criteria of being an academic journal, written within the last 10 years, and written in the English language.

## **Literature Review**

### **MT in Upper Extremities**

Upper extremity passivity, a usual occurrence following a stroke, is one of the most restricting complications for survivors. A study published in 2016 by Gurbuz, Afsar, Ayas, and Cosar found that when mirror therapy was merged with traditional rehabilitation (i.e. mobility training using an assistive device or range of motion exercises) upper extremity movement increased. This study required patients from both groups (traditional therapy and MT) to undergo one-to-two hours of upper extremity rehab, five times a week for four weeks (Gurbuz, Afsar, Ayas, & Cosar, 2016). The researchers believed that activities completed in front of the mirror activated neuronal networks in the motor cortex. The use of functional magnetic resonance images (fMRI) backed this theory. However, when the results of the MT group were compared with those of the control group (who underwent traditional therapy only), Brunnstrom stages (which gauge motor improvement in the hemiplegic patients) and FMA scores (used to assess motor fragility) of the upper extremities were not significantly different between the groups at baseline ( $p>0.05$ ; Gurbuz, Afsar, Ayas, & Cosar, 2016). This illustrates that while neuronal connections were being made, they did not translate in motor functionality.

Another study observing the efficacy of MT in concurrence with established therapy in subacute stroke patients was found to have positive results in motor performance and control. The intervention was conducted within a four-week conventional stroke rehabilitation program for the upper limb, consisting of five one-hour sessions a week (Invernizzi, Negrini, Carda,

Lanzotti, Cisari, & Baricich, 2013). The experimental group then received an additional 30 minutes of therapy the first two weeks, and received one hour of additional therapy the last two-weeks. After one month of treatment, patients from both groups displayed statistically significant progress; however, patients who received MT exhibited greater advances in the Action Research Arm Tests, the method chosen to assess limb function (Invernizzi et. al, 2013).

Researchers Colomer, Noe, and Llorens (2016) conducted 24 sessions of mirror therapy, each session lasting 45 minutes, three days-a-week. When assessed on the ability subscale, a three percent difference was noted in favor of the MT group; however, significant changes in the Wolf Motor Test were shown. This is important because those who took part in this study were chronic stroke survivors who suffered from severe paresthesia of the upper limb. This indicates that mirror therapy, even at chronic stages, can improve motor function (Colomer, Noe, & Llorens, 2016).

### **MT in Lower Extremities**

When looking at the success of MT on lower extremities, outlining the results on stability and mobility are crucial. In a study performed in 2013 by Mohan, Babu, Kumar, Suresh, Misri, & Chakrapani the researchers found that there was noteworthy improvement in participants who were in the experimental group. The regaining of motor function, balance and agility were concepts that were examined. The mirror group revealed more progress in ambulation than the control group, while no significant data was shown in motor recovery and steadiness between the two therapy groups. In this study, sham therapy (placebo therapy) was utilized for the control group. Therapy sessions lasting 90 minutes were run per day (including 30 minutes of MT for the experimental group and sham therapy for the control group), six days a week, for a two week intervals to both groups (Mohan et al., 2013).



### **MT and Activities of Daily Living**

Hemiparesis (partial paralysis on one side) is one of the ailments triggered by stroke, which restricts basic activities of daily living. Elderly stroke victims are more prone to losing their autonomy due to injury and fragility and in a study conducted in 2017 by Radajewska, Opara, Biliński, Kaczorowska, Nawrat-Szoltysik, Kucińska, & Lepsy, participant ages and injury sides were analyzed for their effects on MT. The program lasted for 21 days, with therapy taking place 5 days-a-week, with the MT group receiving two sessions a day (one session of conventional therapy and one session of MT). What was discovered was that there were substantial changes in the patients' performance of ADL between groups in relation to the affected side. The examination presented a "higher level of mean (mean = 13.750) score reflected in the significance level ( $p = .037$ ) of older adults in the MT group" (Radajewska et al., 2017). When scrutinizing the data associated to age, no substantial findings were found considering the usefulness of mirror therapy rehabilitation.

Paralleling movement has been shown to activate parts of the hemisphere opposite to the side of the observed limb, increasing motor cortex and muscular excitability (Thieme, Morkisch, Mehrholz, Pohl, Behrens, Borgetto, & Dohle, 2018). This literature review compared peer reviewed journals on the use of MT for improving motor function in patients who have suffered from a stroke. What was reiterated was that the optical image of the paralyzed limb was observed as a moving appendage, and "reversed learned non-use of the paretic limb in patients" (Thieme et al., 2018). While in another study, MT was joined with exercise tasks and orthodox therapy. It was found that through one 30-minute exercise session per day, five days-a-week, for four weeks, limb function improved along with ADL performance. These findings correlate with Thieme et al., showcasing consistent results (Kim, Lee, Kim, Lee, & Kim, 2016).

Mirror Therapy has also been evaluated in conjunction with cross education. Cross-education is the contralateral strength gain following one-sided training of the unaffected limb, which alone has shown improvement in the neural pathways of the affected limb. The control group and experimental group both practiced exercising their lesser-affected ankle dorsiflexors three times a week, for four weeks (Simpson, Ehrensberger, Horgan, Blake, Roberts, Broderick & Monaghan, 2019). Once this study was concluded, it was found that cross-education when combined with mirror therapy, has the potential to refine motor function after a stroke. When combined with each other, there were twice as many benefits such as increased walking speed and improved scores on the London Handicap Scale Assessment. This study demonstrated the possibility of a blended treatment being utilized and the need for future studies (Simpson et al., 2019).

### **Cost Effectiveness of MT**

Mirror therapy is a low-cost therapy technique for stroke victims and can be effortlessly merged into a domestic setting. This is beneficial as stroke survivors suffer hefty expenses accompanied with their strokes in the first year. Rehabilitation costs can range anywhere between \$5,000 and \$15,000 (Godwin, Wasserman, & Ostwald, 2011). By utilizing mirror therapy, patients can practice rehabilitative activities set by their therapists from the comfort of their homes, without incurring such debilitating charges and fees. This version of mirror therapy is largely self-administered and personalized to tackle individual patient apprehensions, in a household environment (Waghavkar & Ganvir, 2015).

### **Summary of Findings**

After reviewing the ten selected peer reviewed journals, the findings stayed fairly consistent. Mirror therapy works by using a mirror to create a reflection of one's unaltered extremity in place of the affected limb when carrying out tasks. When the unaffected limb is stirred, the mirror image lets the brain imagine that the affected limb is moving. While some studies have seen mirror therapy trigger neuronal links in the motor cortex, there have not been enough clinical results that indicate this treatment is more beneficial than conventional therapy. When utilized in combination with established therapies and cross-education, mirror therapy was shown to have its most beneficial effects. It is in this manner that MT should be incorporated within normal therapy systems and be utilized more often. However, there needs to be more research on identifying an optimal duration of therapy. Potential studies should further explore combinations of mirror therapy with cross-education to assess long-term effects along with prolonged duration of mirror therapy. In addition future studies should focus on defining a set duration of mirror therapy session (time of each session, weeks of therapy, etc.).

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