

**Effectiveness of a Mirror Therapy Intervention on Upper Extremity  
Functional Recovery in a 70-Year Old Sub-Acute Patient following Stroke.**

**PT659 Capstone Project**

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## **ABSTRACT**

**Background and Purpose:** Stroke is globally rated as the second most common cause of death and integral to engendering disability.<sup>1</sup> In the United states, it is considered a third most common disease with causality for death.<sup>2</sup> It is also deemed the leading cause of incurred adult impairment of functional activities of daily living in the developed economies.<sup>2</sup> Current research reinforces the impact of mirror therapy (MT) in acute, sub-acute and chronic phases of stroke with interventions lasting between 1-8 weeks recommended.<sup>3</sup> This case report aims to determine the effectiveness of a mirror therapy intervention on upper extremity functional recovery in a sub-acute patient following stroke.

**Case Description:** The patient is a 70-year old male who sustained an ischemic stroke and presented with left hemiplegia with other neurological deficits that impaired functional ability in completing ADL tasks. The patient received 21 days of intensive therapy in an inpatient rehabilitation facility (IRF). The patient was transferred to an inpatient rehabilitation facility for intensive rehabilitation following his acute hospital stay as he was functionally impaired and unable to return home. The patient demonstrated significant ADL impairment, hemiparesis, impaired mobility, and limited functional transfers and ambulation.

**Outcome Measures:** The Fugl Myer Assessment of Upper Extremity (FMA-UE) score improved by 23 points indicating considerable functional improvement. The GG section score improved to contact guard assistance (CGA) for self-care and other ADL tasks, along with supervision required for functional transfers and ambulation. Distance

ambulated also increased by 140 feet. Muscle strength improved to 3-/5 for the left upper extremity and 4+/5 for the left lower extremity.

**Discussion:** MT can have a have a significant impact on functional recovery in stroke rehabilitation.

## INTRODUCTION

Stroke is globally rated as the second most common cause of death and integral to engendering disability.<sup>1</sup> In the United States, it is considered the third most common disease with causality for death.<sup>2</sup> It is also deemed the leading cause of incurred adult impairment of functional activities of daily living in the developed economies.<sup>2</sup> The World Health Organisation (WHO) defines stroke as a “rapidly developing clinical signs of focal (or global) cerebral function with symptoms lasting 24 hours or longer or leading to death with no apparent cause other than that of vascular origin.”<sup>4</sup> Moreover, 85% of patients afflicted with stroke present with hemiplegia resulting in 69% presenting with upper extremity activity restrictions.<sup>4</sup> Patients with stroke are consequently transferred to inpatient rehabilitation facilities (IRF) to access intensive neurorehabilitation interventions to address their presenting neurological deficits to improve functional ability. Hemiplegia ranks among the prevailing sequelae of stroke, predisposing patients with stroke into a lifelong impairment of functional abilities.<sup>5</sup> It is paralysis of one side of the body as a consequence of a cerebral insult to the contralateral side of the cerebrum. Impairment of motor function caused by stroke consistently involves the face, arms, and legs of the contralateral cerebral hemisphere and this affects about 80% of persons with stroke.<sup>2</sup>

Successful performance of ADL (activities of daily living) tasks hugely depends on a functionally intact upper extremity. However, functional impairment of the upper extremity can be disabling and could predispose survivors into a physically inadequate and depressed state of mind.<sup>2</sup> ADL activities includes an individual's ability to perform bed mobility, toilet hygiene, bathing, showering, upper body and lower body dressing,

personal hygiene, eating, walking, stairs climbing and ultimately being able to navigate safely in an emergency situation.

Mirror therapy, a mirror visual feedback, was invented by Ramachandra in 1995 originally for the treatment of phantom limb conditions. However, in 1999 the role of mirror therapy gained further traction as its role expanded into the treatment of hemiplegic upper extremity in facilitating motor recovery and function as pioneered by Ramachandra and Altschuler.<sup>1</sup> Several scholars have reported that the illusion created by mirror therapy of the affected upper extremity functionally tricks the brain, facilitates primary motor cortex excitability, and consequently results in cortical re-organisation and ultimately helps in the rehabilitation of patients with hemiplegic.<sup>6</sup> Mirror Therapy essentially involves the use of a mirror strategically placed in front of the patient such that the image of the moving intact upper extremity creates an illusion that depicts the impaired upper extremity as intact and functional. The use of mirror therapy is predicated on the mirror neuron system of the brain. Several researchers have established the effectiveness of mirror therapy as a modality in neurorehabilitation which facilitates functional recovery of the impaired upper extremity.<sup>1</sup> Conversely, others studies have reported no significant difference between patients receiving mirror therapy and those receiving other traditional neurorehabilitation techniques.<sup>4</sup>

Purpose: The purpose of this case report is to narrate the effectiveness of mirror therapy intervention on upper extremity functional recovery in a 70-year old sub-acute patient with stroke that was admitted to an inpatient rehabilitation facility (IRF).

## CASE DESCRIPTION

Following approval of the Director of Therapy Operations of the inpatient rehabilitation facility, a written and signed consent was obtained from the patient to participate in the case report and also to access and utilize the complete medical record for the purpose of this case report.

The patient is a 70-year old black male who was admitted into an inpatient rehabilitation facility following right hemispheric ischemic stroke as a result of right middle cerebral artery (MCA) involvement. The patient attended the ER with complaints of altered speech, left sided weakness, inability to stand accompanied by nausea and vomiting. The patient had a previous history of stroke with residual right sided weakness. In the emergency department, the patient was noted with left hemineglect, 3+/5 motor strength of the right-side extremities, flaccid paralysis on the left upper extremity and 3/5 motor strength on left lower extremity. Imaging: An MRI of the brain showed an acute ischemic infarct throughout the large MCA territory.

During the course of hospital admission, he was with fever and leucocytosis and completed a course of empiric IV Cefepime. The patient was also noted with dysphagia and had a nasogastric tube as a source for nutrition. The speech and language pathologist (SLP) re-evaluated patient shortly before transfer to IRF and diet was upgraded to regular. Past Medical History: Past medical history included high cholesterol, Hypertension, Diabetes type 2, anaemia, hemiparesis, leucocytosis and thrombocytopenia. No previous surgical history was noted. Current Medications: Current medications during the initial evaluation included: Amlodipine, Metformin, Lovastatin and Ferrous Sulphate. Social History and ICF Participation Factors: The

patient is a retired school bus driver who lives with his wife in a single level home with one step access to front door. Prior to his recent stroke and consequent hospital admission, he was fully independent with performing all aspects of his activities of daily living (ADL). Although with taxing effort, he ambulated indoors and outdoors using a straight cane and also went shopping for groceries with his wife. The patient's wife manages most of their finances including payment of bills. The patient enjoyed taking a walk with his wife in their local park daily after dinner. His goal was to return to home and walk in the park again with his wife.

#### **CLINICAL IMPRESSION #1:**

Given the patient's medical history of stroke and its associated neurological deficits and functional impairments, the patient was considered a good candidate for rehabilitation and this case report since the patient was not functioning at his previous baseline. Prior to his stroke he was independent with performing ADL tasks and was ambulating using a straight cane. The patient presented with considerable functional impairments in the context of bed mobility, functional transfers, ambulation, grooming tasks and other personal care tasks with increased fall risk. These presenting deficits underpin the patient's suitability for this case report.

#### **EXAMINATION AND EVALUATION:**

A review of the pre-screen admission chart revealed the patient received thirty minutes of physical therapy intervention daily as well as occupational and speech therapy while in the acute hospital. The discharge report also indicated patient required at least moderate assistance for bed mobility and functional transfers. Moderate

assistance was required for ambulating very short distances (less than 15 feet) using a hemi walker and the patient was unable to negotiate the stairs due to safety and fall concerns. All functional mobility tasks were performed with verbal and tactile cues for motor planning and general safety.

The patient completed all aspects personal care including grooming tasks with maximal assistance and verbal cues for sequencing. The patient was received sitting in a lightweight wheelchair with a foam cushion, bilateral leg rest, and a left hemi-tray attached to the wheelchair for left upper extremity support. Mental Status: He was alert and well orientated to time, place, person and situation. He also demonstrated the ability to obey multiple step commands, though demonstrated some word finding difficulty and mild dysarthria. Pain: The patient reported dull achy constant left shoulder pain rated 5/10 using the numerical pain rating scale (NPRS). Sensation: Sensory assessment revealed altered sensation in the left upper and lower extremity for light touch, but remained intact for deep touch. The patient also demonstrated deficits with two-point discrimination in the upper extremity. The patient denied any previous falls before his recent stroke. Systems Review: A systems review was performed and included the cardiovascular, pulmonary, musculoskeletal, neuromuscular and integumentary systems. The patient's BP was 142/82mmHg, Pulse 77 beats per minute, Oxygen saturation was 96% and respiratory rate was 18 per minute. No edema was detected in the bilateral upper and lower extremities. Manual muscle testing was performed using the Oxford muscle grading technique.<sup>5</sup> This revealed right extremity gross muscle strength 3+/5 with full active range of motion (AROM). However, his left extremities revealed 1+/5 muscle strength in the upper extremity and 3+/5 strength in

the lower extremity. Impaired AROM in left upper extremity due to dense weakness and decreased tone was noted but PROM was full except for pain onset during left shoulder movement. Full PROM was noted in the left lower extremity. Sensation was intact except in the left upper extremity where patient reported mild numbness and proprioceptive dysfunction. Motor Control: Initial assessment of the sensorimotor function of the left upper extremity was performed using the Fugl Myer Assessment of Upper Extremity function (FMA-UE).<sup>6</sup> This entails assessing the upper extremity, wrist, hand, and coordination/speed. However, the patient's overall functional ability including ADL (activities of daily living) and mobility function and were assessed using the GG section tool.

The Fugl Myer assessment (FMA-UE) has been used extensively with patients with stroke to measure stroke-related impairments. The scale was designed to detect impairment of reflex activity, motor control and strength among stroke survivors with upper extremity paralysis or paresis.<sup>7</sup> The FMA-UE scale is a 33-item upper extremity specific outcome measure with each segment having an ordinal scale of 0-2; moreover, a score of 0 indicates the inability to perform the required tasks, a score of 1 indicates partial ability to perform required tasks, while a score of 2 indicates full ability to perform tasks. A maximal score of 66 can be achieved which indicates full upper extremity function. Researchers suggest that a score of less than 31 may indicate poor upper extremity functional ability, with 32-47 suggesting finite upper extremity functional capacity, 48-52 indicating considerable functional ability and 53-66 indicating full upper extremity functional ability.<sup>6</sup> Upper extremity functions assessed includes reflex activity, volitional movement within synergies, volitional movement mixing with synergies,

volitional movement with little or no synergy, and coordination in the entire upper extremity. The FMA-UE has been rated by scholars and clinicians as demonstrating excellent validity and having a reliable test-retest and inter-rater ability.<sup>8</sup> The FMA-UE has also been reported to have acceptable concurrent validity and internal consistency ( $\alpha = 0.94-0.98$ ), intra-rater (ICC 0.99, 95% CI) and inter-rater (ICC 0.96, CI 95%) reliability. Minimally clinically detectable change for patients with sub-acute stroke was estimated to be 9-10 points.<sup>8</sup> On the initial evaluation, the patient scored a total of 25 indicating poor upper extremity functional ability.

Functional Mobility: Considering the patient's functional limitation in the context of self-care and mobility, the section GG was used to assess functional ability. The Section GG (Figure 1) is a generally accepted standard assessment measure of post-acute care patients' functional ability.<sup>9</sup> The outcome measure facilitates transfer of care, communication of functional abilities and comparison of patient categories, outcomes and healthcare cost across post-acute healthcare facilities within the United States.<sup>9</sup> Section GG was used to evaluate the patient's functional ability (Mobility and self-care elements coded as GG0130-GG0170) at the initial stage (admission into IRF) and discharge.<sup>9</sup> The tool is a 6-level functional performance instrument with level 1 indicating dependency for all functional tasks and 6 representing complete independence. Fig.1 shows detailed GG section for self-care and mobility.<sup>9</sup> The patient was determined to be at a maximal assistance (GG score 2) level for all self-care tasks, and moderate assistance (GG score 3) level for bed mobility, functional transfers and ambulation. He was deemed unsafe to be able to safely negotiate the stairs at the initial stage.

## **CLINICAL IMPRESSION #2**

Following the initial evaluation, it was noted that based on the FMA-UE and section GG outcome measures the patient presents with significant neurological deficits which impairs his functional ability in the context of activities of daily living (ADL) and ambulation. This further validates the patient's appropriateness for a mirror therapy intervention given upper extremity motor and coordination deficits and the need for functional transfers and gait training. Occupational & speech therapy will be included in addition to the mirror therapy intervention. It is proposed that the FMA-UE and GG section score will exceed the minimal clinically important difference (MCID) to demonstrate the effectiveness of the mirror therapy intervention.

## **INTERVENTION**

Mirror therapy (MT) over the years has become an integral intervention used in the management of stroke. Its impact extends beyond improving motor function, but it has been reported to have an effect on sensation, visuospatial neglect, and pain post-stroke.<sup>3</sup> A systematic review established the impact of MT in acute, sub-acute and chronic phases of stroke with interventions lasting between one to eight weeks recommended.<sup>3</sup> The patient undertook three hours of therapy daily consisting physical, occupational and speech therapy five days a week for 21 days in the inpatient rehabilitation facility. The multispecialty intervention is targeted at facilitating functional improvement in all areas of deficits. Sixty minutes were allocated to physical therapy,

with 30 minutes dedicated to MT and the remaining the time focused on improving bed mobility, functional transfers using the hemi walker, graded strength training, gait training using the hemi walker, standing balance/posture and cardiorespiratory endurance. The patient was provided with visual, verbal and tactile cues as needed throughout the sessions. However, the level of assistance required diminished as the patient progressed. During MT, the patient was asked to perform flexion/extension, supination/pronation, elbow flexion/extension and digital movements in all planes as much as possible with the uninvolved right upper extremity. This reflected in the mirror as though the involved left upper extremity is making the demonstrated movement. This exercise is performed for 30 minutes daily and facilitates neuroexcitability required for recovery of the involved left upper extremity.

Functional Training and Therapeutic Exercise: The last 30 minutes of the session focused on performing graded strengthening exercises to the bilateral lower extremities and core from 5-15 repetitions each for four sets with short rest breaks. Resistance training against gravity was progressed with the addition of free weights; in addition, interventions included functional transfers (from 5-15 repetitions x 4 sets with short rest breaks initiating with moderate assistance from elevated surfaces to task independence from lower surfaces (sit to stand, bed to wheelchair/chair, toilet and car transfers), and static and dynamic standing balance training. Gait training using the hemi walker on even/uneven surfaces was performed while progressively increasing distances from 15 feet to greater than 155 feet. Community ambulation and stairs negotiation were also attempted toward the last eight days of the patient's stay in the facility. These functional tasks were alternately performed daily due to time constraints and to prevent monotony.

Motor Learning Practice Schedule: All functional activities were initiated with random practice to facilitate retention and generalizability in a varying environment.<sup>10</sup>

Interprofessional Activities: The patient's functional status, barriers and progress were discussed in a weekly interdisciplinary meeting. The patient was discharged home on the 21<sup>st</sup> day in the facility with the wife's support and outpatient physical, occupational and speech therapy consults were recommended to the interdisciplinary team during the last team conference. Discharge Plan: A comprehensive family training was undertaken a week before discharge focusing on fall recovery techniques, community ambulation/safety navigation of curbs, ramps, thresholds, and use of the gait belt initially for confidence and safety. The family was also trained on how to safely supervise the patient while performing functional tasks and administering home exercises program twice during the final days of his stay at the facility. Equipment: A quad cane and a transport wheelchair (for community long distances) were prescribed and ordered at discharge.

## **OUTCOME**

At the end of 21 days of inpatient intensive rehabilitation program, the patient was discharged home with a quad cane and a transport chair for long distances. It was hoped that patient would not need the transport chair for a long time as he progressed further in his strength and cardiorespiratory endurance. The patient made measurable progress given functional ability documented at evaluation and at discharge using the FMA-UE and the section GG scores. On the evaluation, the patient scored a total of 25 on the FMA-UE which indicated poor upper extremity function. The patient also

required maximal assistance for all self-care tasks, moderate assistance for bed mobility, functional transfers and ambulation. He was also deemed to be unsafe to negotiate the stairs as indicated by the GG section score. Discharge Status: However, at discharge, the patient scored a total of 48 on the FMA-UE indicating considerable functional ability in the left upper extremity and a diminished level of assistance completing ADL tasks. He progressed from an initial maximal assistance required for ADL's and moderate assistance for ambulation to contact guard assistance(GG score 4) and supervision(GG score 4) respectively. The patient was able to ambulate over 155 feet on even and uneven surfaces using a quad cane with supervision (GG score 4). The patient was also able to negotiate at least six steps on 4-inch steps with contact guard (GG score) and occasional verbal cues for step sequence and general safety. The patient generally demonstrated improved cardiorespiratory endurance as evident by his ability to tolerate over 20 minutes of continuous aerobic activity with no shortness of breath on exertion, fatigue or having to stop abruptly.

## **DISCUSSION**

Cerebrovascular accident (stroke) can be regarded as one of the most disabling conditions in recent times. Its ability to cause temporary or permanent impairment of functional ability including ADL's and ambulation in survivors from stroke is particularly overwhelming. MT is considered a simpler , cost effective and patient-oriented neurorehabilitation modality for effective recovery of an impaired upper extremity.<sup>11</sup> Studies have revealed the efficacy of MT in facilitating recovery of impaired upper

extremity function over other conventional therapies. MT in fact is reported to have improved the upper extremity function more significantly.<sup>1</sup>

Holme Theime et al. in a systematic review reported reasonable impact of MT when correlated with other interventions in facilitation of motor recovery and activities of daily living. However, the review suggested weak evidence exists to support the validity of MT in managing pain and no effect was reported on visuospatial neglect.<sup>12</sup> MT is an effective treatment approach for upper extremity hemiplegia and has also been established to be even more effective when used in combination with other traditional approaches.<sup>13</sup>

The neural activation capability of MT has also been evaluated and reported in a study using functional magnetic resonance imaging technique( fMRI) to investigate neural activation during MT. MT was noted to activate the mirror neuron system (MNS) of the nervous system thereby facilitating neuroplasticity and causing recovery of functional impairment in the affected limb.<sup>14</sup> MT has proven to be a potential innovative alternative treatment modality given its effortless application, cost effectiveness, and patient –directed and goal oriented focus.<sup>14</sup>

The patient's stated goal on admission was to be able to return home and walk the local park with his wife. This ICF participation goal was taken into consideration and formed the basis of his plan of care. MT and other adjunct therapy were incorporated to facilitate the attainment of the patient's goal. The patient demonstrated functional gain as measured using the FMA-UE and section GG score. These outcome measures were meticulously assessed initially, midway, and at the discharge. The FMA-UE and GG

section scores improved and exceeded the minimal clinically important difference (MCID) to demonstrate the effectiveness of mirror therapy as an adjunct intervention.

## **LIMITATIONS**

The impact of other interventions in the form of speech, occupational therapy and other physical therapy techniques that may have also influenced patient's functional recovery in a positive fashion. Based upon these integrated interventions, it may be difficult to be able to delineate the effectiveness of the individual MT intervention.

## **CONCLUSION**

It is important for physical therapists to continue to incorporate all appropriate and effective evidence- based neurorehabilitation interventions in managing their patients with stroke to facilitate maximal functional recovery and positive patient experiences.

Further clinical research is indicated to continue to evaluate the exclusive effectiveness of MT in the impaired upper extremity post-stroke.

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**Fig 1:<sup>9</sup> (Centre for Medicare and Medicaid GG section Tool).<sup>9</sup>**

GG code	Explanation and guidance.
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06	<b>Independent</b> – Patient/resident safely completes the activity by him/herself with no assistance from a helper.
05	<b>Setup or clean-up assistance</b> - Helper sets up or cleans up; patient/resident completes activity. Helper assists only prior to or following the activity
04	<b>Supervision or touching assistance</b> - Helper provides verbal cues and/or touching/steadying and/or contact guard assistance as patient/resident completes activity. Assistance may be provided throughout the activity or intermittently.
03	<b>Partial/moderate assistance</b> - Helper does LESS THAN HALF the effort. Helper lifts, holds or supports trunk or limbs, but provides less than half the effort.
02	<b>Substantial/maximal assistance</b> - Helper does MORE THAN HALF the effort. Helper lifts or holds trunk or limbs and provides more than half the effort.
01	<b>Dependent</b> - Helper does ALL of the effort. Patient/resident does none of the effort to complete the activity. Or, the assistance of 2 or more helpers is required for the patient/resident to complete the activity.
07	Patient/resident refused
09	Not applicable - Not attempted and the patient/resident did not perform this activity prior to the current illness, exacerbation, or injury.
10	Not attempted due to environmental limitations (e.g., lack of equipment, weather constraints)
88	Not attempted due to medical condition or safety concerns

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