Using Mirror Therapy in the Home Environment: A Case Report

Dawn M. Nilsen, Theresa DiRusso

OBJECTIVE. Mirror therapy (MT) is a potential intervention to improve function after stroke. How to apply this intervention in practice is not clear. This case report illustrates the feasibility and effectiveness of a self-administered home-based MT program.

METHOD. A home-based MT program was practiced over 5 wk. The participant was encouraged to use MT for 30 min 5×/wk. Therapist contact occurred 1×/wk to monitor performance. An independent evaluator administered three outcome measures pre- and postintervention: Upper Extremity Sensory and Pain sections of the Fugl-Meyer Assessment; Jebsen-Taylor Test of Hand Function, and the Manual Ability Measure–20.

RESULTS. The participant engaged in a mean of 39.23 (±7.44) min of MT per day and used a variety of the recommended activities. Change scores indicated improvement on all of the included outcome measures.

CONCLUSION. This case report suggests that a predominantly self-administered home-based MT program is feasible and effective at improving function after stroke.

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OTA’s Centennial Vision calls for occupational therapy to be a “science-driven and evidence-based profession” (AOTA, 2007, p. 613). Therefore, it is critical that clinicians abandon traditional treatment interventions not supported by effectiveness studies in favor of those that are supported by sound evidence (Fleming-Castaldy & Gillen, 2013). Mirror therapy (MT) has emerged as a viable intervention to improve upper-extremity (UE) function and ADL performance in stroke survivors (Thieme, Mehrholz, Pohl, Behrens, & Dohle, 2012). A recent randomized controlled trial reported improved motor performance and enhanced temperature sensation in chronic stroke survivors who received 60 min of MT 5 days/wk for 4 wk as part of an outpatient task-oriented occupational therapy program. Interestingly, the improvements at the impairment level did not appear to transfer to improved activity or participation (Wu, Huang, Chen, Lin, & Yang, 2013). Nonetheless, they do add to a growing body of literature that suggests that MT may improve sensorimotor performance above standard care. During MT, a person performs movement of or receives touch to the unimpaired limb while watching its mirror reflection superimposed over the (unseen) impaired limb; this process creates a visual illusion whereby movement of or touch to the unimpaired limb is attributed to the impaired limb (Ramachandran & Altschuler, 2009). Although this visual illusion is a common ingredient in published MT effectiveness trials, the actual treatment protocols differ considerably (Thieme et al., 2012). For example, some studies have encouraged performance of unilateral (Cacchio, De Blasis, De Blasis, Santilli, & Spaccia, 2009) or bilateral (Lee, Cho, & Song, 2012; Yavuzer et al., 2008) active range of motion (AROM) exercises, and others have incorporated the use of functional movements with objects (Thieme et al., 2013), sensory stimulation activities (Thieme et al., 2012), or a combination of bilateral transitive movements, gross motor tasks, and intransitive movements (Wu et al., 2013). Additionally, the amount of MT provided in published studies has varied considerably. For instance, minutes
of MT provided range from 10 min to 60 min/session; the frequency of sessions ranges from 1 or 2 to 7 sessions/wk, and the length of intervention ranges from 3 to 6 wk (Thieme et al., 2012). Most of these intervention have taken place in rehabilitation settings or a combination of hospital and home settings (Thieme et al., 2012). Thus, how best to apply this intervention in clinical practice is less than clear.

One area of interest is whether MT can be effective at improving occupational performance in a chronic stroke survivor when administered solely as a home program that is largely self-administered and integrated into a client’s normal daily routine. Given that a large majority of stroke patients are discharged to the community versus institutional care postrehabilitation (Reistetter et al., 2010), coupled with the pending changes to the U.S. health care system, it is important to identify effective interventions that can be managed by chronic stroke survivors and their caregivers in the home setting. Evidence has suggested that MT may improve motor recovery in stroke survivors above standard care. It appears easy to administer and requires little financial investment. As such, it may be an appropriate intervention to use in the home setting. This case report illustrates the feasibility of administering a home-based MT program that is tailored to a specific client’s needs and is principally self-administered. It also shows that such a program can be effective in improving occupational performance in a chronic stroke survivor. We hope this case report will encourage clinicians to find novel ways to incorporate evidence from effectiveness studies to meet their clients’ needs.

Method

Research Design

This study is a pretest–posttest case report, and it was exempt from review according to Columbia University’s Institutional Review Board.

Participant

D.M., a 63-yr-old man, sustained a right hemorrhagic stroke resulting in left hemiparesis, without significant cognitive or perceptual impairments, 27 mo before the start of this treatment program. He had received both inpatient and outpatient rehabilitation services in the past and remained under the care of a physiatrist. He was well known to both of us. D.M. was retired, volunteered at his local community hospital on the rehabilitation unit, and lived at home with his wife. He was ambulating independently, and he was able to complete most of his basic activities of daily living (ADLs) and many instrumental activities of daily living (IADLs), including driving locally, independently. Yet, he still reported not feeling recovered and felt he still had rehabilitation work to do. His stated areas of concern were as follows: lack of sensation (tactile), UE pain that interfered with function, and decreased use of the non-dominant left arm and hand for ADL performance. D.M. was highly motivated and had the cognitive capacity to engage in a self-directed treatment program; thus, MT was proposed as a possible intervention strategy. After discussing the idea with D. M., he decided to try to incorporate the program into his daily routine.

Outcome Measures

We selected three outcome measures to reflect D.M.’s stated areas of concern:

1. The UE section of the Fugl-Meyer Assessment (FM), Sensory section (scores range from 0 to 12, and higher scores indicate better sensation) and Pain section (scores range from 0 to 24, and higher scores indicate less pain; Fugl-Meyer, Jääskö, Leyman, Olsson, & Stegлинd, 1975). The FM has high test–retest reliability ($r = .99$) and inter-rater reliability ($r = .96–.97$; Duncan, Propst, & Nelson, 1983).

2. The Jebsen–Taylor Test of Hand Function (JTTHF; Jebsen, Taylor, Trieschmann, Troetter, & Howard, 1969). The JTTHF evaluates hand function, and it has strong test–retest reliability ($r = .67–.99$; Jebsen et al., 1969; Stern, 1992) and validity in predicting hand use in ADLs (Lynch & Bridle, 1989). We summed the times for six of the seven subtests (the writing subtest was removed) of the JTTHF to provide a total time score; faster times indicate greater hand function.

3. The Manual Ability Measure–20 (MAM–20), a self-report measure of hand function. Scores range from 0 to 100, and higher scores indicate greater hand function (Chen, 2011). The MAM–20 is a shortened version of the MAM–36, which is an instrument that has established validity (Chen & Bode, 2010).

These measures were administered pre- and posttreatment by an occupational therapist (Theresa DiRusso) who was not involved with developing or monitoring the MT intervention.

Intervention

A home-based MT program was developed to address D.M.’s specific areas of concern, and it was designed to be mainly self-administered. The program was designed on the basis of published reviews of MT intervention studies (Grünert-Plüss, Hufschmid, Santschi, & Grünernt, 2008; Thieme et al., 2012). The intervention took place in the participant’s home environment. Because intervention lengths of published protocols range between 3 and 6 wk, an approximate midpoint of 4 wk was originally chosen. However, scheduling of the posttesting session became an issue, so the length of the protocol was extended to 5 wk.

Before the start of the intervention, D.M. was educated by an occupational therapist with knowledge of the MT literature (Dawn M. Nilsen) regarding the purposes of the MT program, the set-up and appropriate use of the mirror box, the suggested MT activities, and the suggested dosing of MT. MT activities were chosen on the basis of information contained in published reviews (Grünert-Plüss et al., 2008; Thieme et al., 2012) and modified to address D.M.’s stated areas of concern. This modification resulted in the development of four main categories of activities (see Table 1). Unfortunately, we could not find details regarding sensory stimulation protocols used during MT. Because the evidence to guide the selection of sensory stimulation programs for people
after stroke is insufficient (Doyle, Bennett, Fasoli, & McKenna, 2010), the sensory stimulation activities were based on the first author’s (Nilsen’s) clinical experience.

To aid performance of the activities, D.M. was provided with an AROM exercise sheet containing photographs of the motions to be performed, a tool box of items (i.e., common objects of different sizes, shapes, and textures) from which he could self-select to perform object manipulation and object transport activities, and sensory stimulation application items (cotton swabs and pencils with erasers). D.M. was encouraged to continue with his normal daily activities, which included volunteering at a local hospital 2 days/wk and attending outpatient physical therapy 2×/wk (addressing left lower-extremity weakness and high-level balance issues). He was asked not to engage in an active occupational therapy program outside of the therapy received as part of the home-based MT program, and he indicated he would comply with this request.

During the first intervention session, the MT activities were reviewed, demonstrated, and practiced as needed. D.M. was instructed to set up the mirror box in approximately the midsagittal plane between the upper extremities but to adjust the mirror as needed so that the mirror reflection of the unimpaired limb was superimposed over the impaired limb. He was instructed to perform all activities bilaterally, concentrating on the mirror reflection of the unimpaired arm and hand, while attempting to move the impaired arm and hand inside the mirror box as best as possible (Figure 1).

For the sensory stimulation activities, D.M.’s wife was instructed in the application of the sensory stimulation, which involved applying stimuli simultaneously to the forearms, wrists, and hands of both UEs, while DM concentrated on the mirror reflection. The sensory stimulation was later progressed to applying stimuli to the impaired arm and hand only, with D.M. attempting to identify the location of the touch. Concentration on the mirror reflection during this phase was designed to assist D.M. with maintaining attention to the impaired limb while attempting to localize the touch sensation. The sensory stimulation protocol was started in the 2nd week to allow DM the opportunity to develop a routine with using the mirror box with activities that he could perform independently. DM was instructed to engage in MT 30 min/day, 5×/wk. This dosing was chosen because it was the most frequently cited dosing in published studies.

The program was designed to be self-directed, with therapist contact occurring 1×/wk (5 sessions) for 30 min to monitor performance, provide suggestions, and answer questions as needed. For example, suggestions for progression of activities were made during this time (e.g., decrease shoulder support during AROM exercises; change shoulder, elbow, and forearm position during squeezing of a sponge; increase the distance of the forward and side-to-side wiping motions on the table; work with sponges of different sizes and textures). D.M. was provided with a treatment log for recording both the types of activities practiced with the mirror box and the total number of minutes MT was performed per day.

In the last therapist contact session, a semistructured interview was conducted to ascertain information regarding D.M.’s experience of the treatment program. D.M. was asked the following questions: (1) Which activities did you find the easiest to do? (2) Which activities did you find the most difficult to perform? (3) Which activities did you like doing? (4) Which activities did you find the most useful? (5) Which activities did you find the least useful? (6) What are your general impressions about the MT home program? (7) Will you continue using MT now that the treatment program is over?

**Data Analysis**

We evaluated treatment logs and the informal interview to provide descriptive information about the types of activities engaged in and the dosing of MT. To determine the dosing of MT, we calculated the frequency of the MT session per week and the number of minutes of therapy per day to determine the range, mean, and standard deviation of the number of minutes of MT engaged in over the course of the intervention. To determine the effectiveness of the intervention related to the participant’s areas of concern, we

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<th>Table 1. Suggested Mirror Therapy Activities</th>
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<td>Category of Activity</td>
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calculated changes scores ($\Delta$) by subtracting the pretest scores from the posttest scores for each of the outcome measures.

Results

Although D.M. was instructed to perform MT for 30 min/day, 5×/wk, treatment logs indicated that he performed between 30 and 45 min of MT per day at a frequency of 4 or 6 days/wk. The mean number of minutes per session was 39.23 (standard deviation = 7.44), indicating he engaged in more MT than prescribed. Inspection of the logs indicted that he performed all of the activities as instructed in each session starting in the 1st week through the 5th week of the intervention period (AROM exercises, object manipulation [grasp/release] with objects of different textures [e.g., sponges, balls], wiping or dusting the table with sponges or cloths of different textures [e.g., scouring sponge vs. soft sponge, silk cloth vs. terrycloth], and object transport.

Figure 1. Examples of use of the mirror box: (A) active range of motion exercises; (B) object manipulation; (C) object transport.
activities (e.g., transporting items from one side of a divided container to the other side of the container). Sensory stimulation was instituted during the 2nd week of the protocol. This activity was performed during 100% of the sessions during Week 2, 67% of the sessions during Weeks 3 and 4, and 100% of the sessions during Week 5.

Regarding the effectiveness of the intervention, change scores pre- and post-intervention revealed improved sensation (FM Sensory: Δ = 1) and decreased pain (FM Pain: Δ = 12) in the left arm and hand. At the activity level, change scores pre- and post-intervention revealed improvements in hand function on both the performance-based (JTTHF total time: Δ = −127.55) and the self-report (MAM–20: Δ = 5.8) measures of hand function (Table 2).

When asked which activities he found the easiest or most difficult to perform, D.M. expressed that the AROM exercises were the easiest, and the object transport activities were the most difficult and frustrating to perform. He indicated that he was not able to feel whether he had the object in his left hand and that he could hear the object drop out of the hand, which made concentrating on the reflection in the mirror difficult. When asked which activities he liked engaging in the most, he indicated that he liked the AROM and sensory stimulation activities the best but that he had to depend on his wife’s assistance to perform the latter. When asked which activities he found most useful, he indicated he found all of them useful but found the object transport activities the least useful of all the activities. When asked to provide his general impression of the treatment program, he described it as easy to do and useful. He also indicated that he liked the MT. When asked whether he would use MT in the future, he indicated that he probably would.

### Conclusion

D.M. was able to effectively add MT to his normal daily routine, and he was able to carry out the program with minimal caregiver support. He performed all the activities unaided with the exception of the sensory stimulation activities, which likely explains why these activities were performed less frequently than other activities prescribed in the protocol. The object transport activities appeared to be the most difficult to perform and were perhaps the least useful of all the activities DM engaged in. However, because we did not obtain information regarding the number of minutes each individual activity was performed per day, we cannot draw definitive conclusions regarding his activity use. For instance, although treatment logs indicated he performed AROM, object manipulation, and functional tasks with objects once per session, it is unclear how much of the total treatment time was spent engaged in these activities. This information would have provided further information regarding activity usage and may have been useful for refining the treatment protocol for future use.

D.M. exhibited improvements pre- to postintervention on all of the included outcome measures. These results are consistent with previous outcomes suggesting that MT is effective in reducing sensorimotor impairments (Thieme et al., 2012; Wu et al., 2013) and improving ADL function after stroke (Thieme et al., 2012). Our results suggest MT had a greater impact on pain reduction than on sensory function. It is conceivable that D.M.’s reduction in pain led to the increased use of his arm and hand for ADL performance; however, we were unable to determine the exact nature of the relationship between these improvements. Further research is needed to determine whether MT is more effective at reducing certain types of impairments after stroke and whether the reductions in impairments produced by MT (i.e., pain reduction and sensorimotor function) directly influence improved activity and participation.

D.M. reported that MT was easy to do and that he found the overall program to be useful, and he indicated that he would likely use it in the future. This finding is important, because stroke survivors discharged from rehabilitation settings are recommended to continue to participate in regular exercise (Duncan et al., 2005). Given this information, clinicians may want to prescribe MT as a possible adjunct to home exercise programs for appropriate clients upon discharge from typical rehabilitation settings.

The results of this case report indicate that a home-based MT program that is largely self-administered and tailored to address specific client concerns is feasible and effective at improving occupational performance in a chronic stroke survivor. Limitations of this case report include lack of multiple baseline measurements, the inability to determine whether these improvements were maintained over time, and the generalizability of the treatment protocol. In addition to the areas indicated previously, future studies are needed to determine optimal activity selection and dosing, the effectiveness of unilateral versus bilateral MT training, the role of impairment level, and the impact of time poststroke.

### Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- MT may improve occupational performance in chronic stroke survivors.
- MT can be successfully self-administered by motivated clients as a home-based intervention.

### Acknowledgments

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References


