

Mirror, Mirror

Reflections on using mirror feedback in stroke rehabilitation

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Multiple names

Mirror imagery

Mirror visual feedback

Mirror augmented feedback

A component of graded motor imagery

Mirror box therapy

Multiple purposes

Motor retraining [motor stimulation, motor practice]

Somatosensory retraining [somatosensory stimulation]

Reducing visual neglect [sensory augmentation]

Reducing pain [somatosensory and motor stimulation →→ motor practice]

Key principles

Neuroplasticity

dynamic and responsive formation of (new) neural connections [between visual and motor neurons, communication between hemispheres, body schema]



Functional equivalence

careful matching of motor imagery elements to desired action to stimulate the same brain areas & strengthen the memory trace of the task

Multi-modal is **magic**

learning (aka plasticity) is augmented with multi-modal inputs

How does it actually work?

Changes in somatosensory processing and cortical activation

- **Where the signals travel (representations)**
- **How they interact with other signals (activation patterns)**
- **How the brain remembers & localizes (maps)**
- **How the body responds (physically and physiologically)**

Show me the evidence....

Stroke

Multiple systematic reviews support benefits for improving motor function

(Rothgangel et al, 2011; Theime et al, 2012; Pollock et al, 2014; Perez-Cruzado et al, 2017)

Single studies support using mirror visual feedback in combination with:

NMES Yun et al, 2011; Lee et al, 2016

CIMT Yoon et al, 2014

Functional tasks: Lim et al, 2016; Park et al, 2014

Single studies support benefit for sensory retraining

(Carey & Matyas, 2005; Carey et al, 2011)

Complex regional pain syndrome

Systematic reviews & overview support pain reduction

(O'Connell et al, 2013; Smart et al, 2016)

Canadian Best Practice Guidelines for Stroke Care

Section 5.1: Recommendations on **management of the upper extremity** following stroke— General principles and therapies

- (ii) Following assessment to determine if they are suitable candidates, patients should be encouraged to engage in **mental imagery** to enhance upper-limb, sensorimotor recovery (Evidence Level: **Early-Level A**; Late-Level B).
- (v) **Mirror therapy** should be considered as an adjunct to motor therapy for patients with very severe paresis. It may help to improve upper extremity motor function and ADLs (Evidence Level: **Early-Level A**; **Late-Level A**).

Section 8: Recommendations on rehabilitation of visual perceptual deficits

- (ix) **Mirror therapy** appears to improve neglect (**Evidence Level B**) and may be considered as an intervention for unilateral inattention (Evidence Level B).
- (x) Combining **mirror therapy with limb activation** appears to be more effective than limb activation alone at improving neglect (**Evidence Level B**).

(2019 update)

2025 Update CBPGSC

- iv. **Mirror therapy** may be considered to improve motor and ADL function [Strong recommendation; Moderate quality of evidence].
- v. **Sensory stimulation** modalities (e.g., transcutaneous electrical nerve stimulation [TENS], and acupuncture) may be considered to improve upper extremity function [Conditional recommendation; Low quality of evidence].
- vi. **Biofeedback** in the form of visual and/or auditory signals during exercises of the upper extremity is recommended to improve motor function [Strong recommendation; High quality of evidence].
- vii. Individuals with stroke should be encouraged to engage in **mental imagery practice** to enhance upper extremity sensorimotor recovery as an adjunct to upper extremity rehabilitation [Strong recommendation; Moderate quality of evidence].
- viii. **Virtual reality**, including both immersive technologies such as head mounted or robotic interfaces and non-immersive technologies such as gaming devices, may be considered as adjunct tools to other rehabilitation therapies, to provide additional opportunities for engagement, feedback, repetition, intensity and task-oriented training [Strong recommendation; Moderate quality of evidence].
- ix. Therapists should consider **supplementary training programs** aimed at increasing the active movement and functional use of the affected upper extremity between therapy sessions, such as Graded Repetitive Arm Supplementary Program (GRASP), suitable for use during hospitalization and at home [Early - Strong recommendation; Moderate quality of evidence; Late- Strong recommendation; Low quality of evidence].

Consider using Mirror Therapy for:

Motor (re) learning

Supplementing loss of proprioception

Neglect

Pain

Sensory retraining

Supplementary training ?





Incorporating Mirror Therapy into Home & Clinic programs

Client education and home programs

Education is key to achieving an effective dose and duration of MVF; may need to engage family members as well

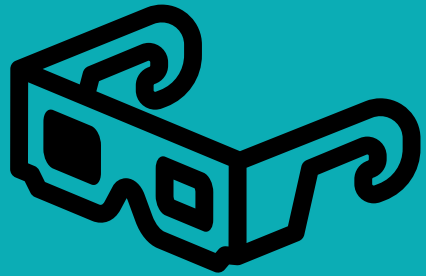
May need to understand some basic principles to get 'buy in'

Pick the examples and stories that work for you, and rehearse them, construct educational materials that utilize them, and reinforce regularly

Athletes use motor imagery to practice and train

Motion-sickness as an example of a sensory-mismatch

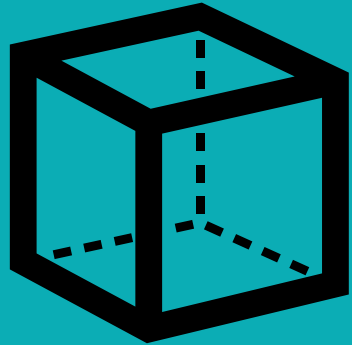
Test for the illusion:



do they feel like they are

looking **through** the mirror ?

Try a couple of short sessions in the clinic:



Can they concentrate?

Do they get any pain?

Does it make them dizzy or queasy?

Do you see a response inside the box?

Contraindications

Vision impairments

Reports of nausea or vestibular responses (i.e. dizzy, off-balance, falls or fear of falling)

Negative changes in limb temperature or weight

Pain invoked or increased

Profound hemi-neglect

Distortions



Fatigue

Falls risk

'Reflective' Summary

MT is helpful for upper extremity (re)training for both motor and sensory changes, including pain

Mirror visualization (action observation) is good for pain and motor stimulation with low function

Mirror augmented bilateral training most effective when task-based

An alternative to conventional rehab if pain is a barrier

Sessions should be between 20-30 minutes for motor practice; shorter repeated sessions may be better for a painful limb

Daily practice is ideal – minimum number/week unknown, #/day unknown

Adherence and 'buy-in' is key

Your turn to share...

Did you use MVF for motor or sensory goals?

What was the most valuable aspect of MVF?

Do you think it is more helpful for the upper or lower limb?

Did you notice/have anyone report adverse effects?

Your turn to share...

MVF is intended as an adjunct. What other modalities did you find it a helpful combination with?

What do you think the best metric is to capture improvements related to MVF?

Any clinical pearls to share based on your experience?

Case studies

Mr. Shell is a 75-year-old male, 2 weeks post left MCA stroke. He is currently attending inpatient rehab for right sided weakness and mild aphasia. He demonstrates **moderate to severe hemiparesis** of his right upper extremity, his dominant arm, but has intact sensation. Therapy team is wondering whether there is a component of learned nonuse or 'learned paralysis'. During the initial assessment, Mr. Shell emphasized the importance of music in his life and often reminisces about his time spent teaching piano lessons.

What might intervention look like?

Motor stimulation (+ tactile inputs to leverage intact sensation?)

Facilitated bilateral hand-over-hand

NMES + MT

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How would aphasia influence this?

Facilitate communication with pictorial instructions

Easy communication for red flags (like dizziness, fatigue)



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How could we measure change?

Motor function tools

ROM

Case studies

Mrs. McCarthy suffered a right thalamic stroke 1 year ago. Despite a good recovery of voluntary movement that allowed independence in daily activities, the 50-year-old woman presents with allodynia and a burning pain in the left upper limb. Mirror therapy for sensory retraining is being considered. Mrs. McCarthy is an avid baker and her goal is to be able to wear an oven mitt without significant discomfort.

What might intervention look like?

Looking in the mirror – somatosensory stimulation

Moving bilaterally with the mirror – identify ‘target’ motions

Task based movements – multi-modal inputs

Bilateral tactile stimulation – *as close as you can get, as far away as you need to be to not produce pain*

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How could we measure change?

painDETECT – short, specific questions addressing both allodynia and burning pain
(Packham et al, 2017)

Neuropathic subscale of the **SF-McGill Pain Questionnaire**
(Packham et al, 2019)

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How could we measure change?

Rainbow Pain Scale – threshold test for allodynia (Packham et al, 2020)

Ten Test – hypo and hypersensitivity (Uddin et al, 2013)

Radboud Evaluation for Sensitivity – compares sensitivity across actual stimuli

- also addresses hypo and hypersensitivity (Packham et al, 2018)

New References

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LET'S TALK!

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