Significances of Mirror Box Therapy in Phantom Limb Pain and Stroke Rehabilitation: A Perspective Review

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ABSTRACT

The mirror box technique was developed by neuroscientist Mr. Vilayanur. S. Ramachandran, who obtained an M.B.B.S from Stanley Medical College in Madras and subsequently obtained a Ph.D. from Trinity College at the University of Cambridge. Mirror box therapy has become a widely accepted method of restoring motor function following a stroke. Mirror box therapy was originally used in the 1990s, to treat chronic pain associated with phantom limb syndrome following limb amputation. Mirror therapy or mirror visual feedback is a therapy for pain or disability that affects one side of the patient more than the other side. Mirror therapy is used to improve motor function after stroke. During mirror therapy, a mirror is placed in the person's midsagittal plane, thus reflecting movements of the non-paretic side as if it were the affected side. Stroke is the leading cause of neurological disability worldwide. It affects the motor or cognitive level and needs to be treated as early as possible. One of the therapies most commonly used to restore the sequelae of stroke is mirror therapy. The mirror image of the normal body part helps reorganize and integrate the mismatch between proprioception and visual feedback of the removed body. Thus, enhancing the treatment effect for phantom limb pain. The clinical effect of mirror therapy is much more significant than any other treatments.

KEYWORDS: Mirror box therapy, phantom limb pain, proprioception, sequelae of stroke

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Definition
A mirror box is a box with two mirrors in the center(one facing each way), help to alleviate phantom limb pain and also for stroke rehabilitation.[1]

Indications
➢ Phantom Limb Pain
➢ Stroke rehabilitation[2]

Phantom Limb Pain
➢ A phantom limb is the sensation that an amputated or missing is still attached to the body and is moving appropriately with other body parts. Although not all phantom limbs are painful, patients will sometimes feel as if they are gesturing, feel itches, twitch, or even try to pick things up.
➢ Phantom sensations may also occur after the removal of body parts other than the limbs, e.g. after amputation of the breast, extraction of a tooth (phantom tooth pain) or removal of an eye (phantom eye syndrome).
➢ A slightly different sensation known as phantom pains can also occur in people who are born without limbs and people who are paralyzed.
➢ Phantom pain occurs when nerves that would normally innervate the missing limb cause pain. In extreme cases, surgeons would perform a second amputation, shortening the stump, with the hope of removing the inflamed nerve endings and causing temporary relief from the phantom pain. But instead, the patients phantom pains increase. In some cases, surgeons even cut the sensory nerves leading into the spinal cord or in extreme cases, even remove the part of the thalamus that receives sensory signals from the body.[3]

Mechanism of phantom limb pain
A change in "Neuromatrix" is responsible for phantom limb sensations. Phantom limb sensations are due to this reorganization in the somatosensory cortex, which is located in the post central gyrus, and which receives input from the limbs and body[4].

Guidelines to use a mirror box

- Mirror box in which a mirror is placed vertically in front of the patient and has patients look at the mirror reflection of the normal arm so that the reflection is optically superimposed on the felt location of the phantom thus creating the visual illusion that the phantom has been resurrected.

- Presuming there is no jewellery on the affected side, remove any wrist watches and rings from your unaffected side. If you have any tattoos or scarring, try to cover this up to make a total illusion.

- The patient puts his intact hand in one side, of a box and "inserts" his phantom hand in the other side

- Once the patient places the intact hand into one compartment of the box the mirror produces a "stereo isomeric image" of the other hand.[4]

- The patient observes in the mirror the image of his real hand, and then asks to make similar movements with both "hands", which suggests to the brain real movement from the lost hand.

- Depending on the pain and disability state, decide on an appropriate activity to perform with the good hand. This could range from just looking at the mirror image to finger movements, or taking weight through the hand.

- Feel comfortable with your selected movements- 'conquer the movement' before progressing to a more challenging movement. Once u feel comfortable with a movement, try and perform it in a different context.[5]

- Overall, you will need to repeat movements, grade the movements from easy to more difficult and then enrich the movement with different contexts for best neuron health.

- Take care. If the hand in the box hurts or sweats, you may have taken the brain exercises too far even though the hand has not been harmed. Don't worry though, just take a break and try something a little less challenging next time.

- Move the painful hand in the box to the point where it starts to hurt a little(e.g. a loose fist) and then move the good hand which is outside the box a little bit further(e.g. a tight fist).[6]

- By placing a mirror between the feet, a similar therapy can be performed for the foot.[10]

Implications of the experiment

- The body self neuromatrix constantly expects sensory inputs from all part of the body to generate the awareness of the "self"

- When these inputs are missing from any part due to any cause the Matrix generates the input using pain the most "acute" of all sensations to create an illusion that the limb still exists[10]

- The phantom pain is the consequence of a mismatch between the brain's creation of a phantom limb and the visual realization that the limb does not exist.

- Moving the intact limb creates the illusion that the phantom limb is moving, and over time this illusion reduces the pain experienced by the patient. Several research studies using mirror therapy have produced promising results[7].

Stroke rehabilitation
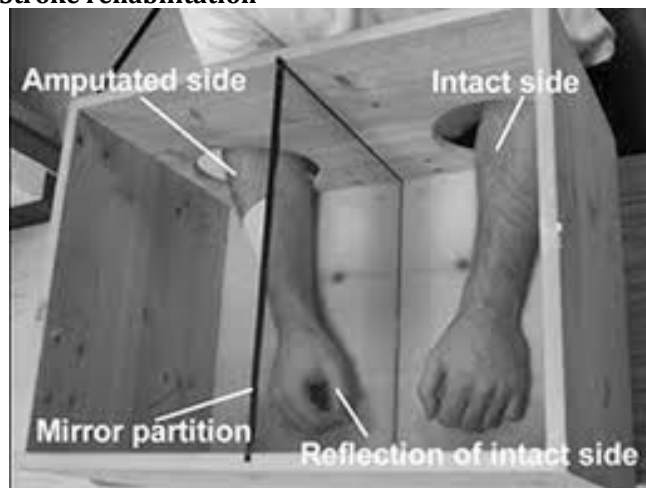
- When taking stroke rehabilitation exercises the use of a mirror has been proven to be a great asset. Increased disinhibition of the motor cortex allowing increased use of spared pathways within the damaged hemisphere, increased activity of motor command pathways in the affected hemisphere running to the spinal nerves and increased activation of the pathways from the unaffected hemisphere to supplement the damaged crossed corticospinal pathways. The term plasticity describes the ability of the brain to rewire itself and there is no better way to help this than the use of a mirror.[8]

- Visualizing and undertaking symmetrical bilateral movements post stroke enhance neuroplastic (Adaptation of nervous system to the stimuli) changes within the brain.

- Mirror therapy has been described in medical literature to be of benefit to 80% of users, but all therapies do not always show immediate results.

- The rate and amount of recovery much depends on the extent of the damage, and the intensity and duration of the therapy the patient receives. Recovery also is likely to be influenced by personality, life experiences and coping styles. Motivation to recover is a key factor in obtaining an optimal level of rehabilitation.

- The role of mirror box/visual therapy in this bilateral movement training is central to its success[9].

Conclusion

Pain relief associated with mirror therapy may be due to the activation of mirror neurons in the hemisphere of the brain that is contra lateral to the amputated limb. These neurons fire when a person either performs an action or observes another person performing an action. Alternatively, visual input of what appears to be movement of the amputated limb might reduce the activity of systems that perceive protopathic pain. Although the underlying mechanism accounting for the success of this therapy remains to be elucidated, these results suggests that mirror therapy may be helpful in alleviating phantom pain in an amputated lower limb.[11]

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