A case report on phantom limb pain treated with mirror box therapy

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ABSTRACT
Objectives: To study and report the effect of mirror box therapy in the management of phantom limb pain after an upper limb amputation.
Results: A diagnosed case of phantom limb pain of left upper limb was treated with mirror box therapy for 4 months with customized training protocols. 4 repeated assessments at the end of each month were performed using Verbal Rating Scale.
Conclusion: The patient had notable clinical recovery following mirror box therapy for 4 months.
Key words: phantom limb pain, mirror box therapy, verbal rating scale

INTRODUCTION
Phantom limb pain is a perception of sensation or pain from a limb that is absent or amputated. Patients with phantom limb pain experience the limb as if the amputated limb is still attached to their body and the brain continues to obtain messages from nerves that have carried impulses from the missing limb before amputation. Treatment techniques like Analgesics, Acupuncture and TENS had insufficient conclusion about the recovery. Novel approaches like Mirror Box therapy has proven to be effective in treating the patients with Phantom limb pain.

CASE REPORT
Mr. Iqbal (Name – not real), 46 years old carpenter met with a road traffic accident three months back. His left hand and distal 1/3rd of forearm was crushed under the vehicle and he had to undergo an emergency amputation on the same day. He started getting physiotherapy from the third day after the surgery at Zayad Hospital, Lahore, Pakistan. These days he is attending Physiotherapy OPD for follow-up rehabilitation and artificial limb fixation. He complains of constant pain over the amputated left hand even after the surgery. He rated the pain as ‘severe’ (4/5) on a verbal rating scale.
After careful examinations and discussions with the experts, our team of rehabilitation concluded that Mr. Iqbal is suffering from Phantom Limb Pain. This phenomenon is less strange in situations like amputations, especially in hand. One can define ‘Phantom Limb Pain’ as a pain experienced in the absent body part1. Technically, The International Association for the Study of Pain (2010) defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”. This suggests pain is not only a physiological process, but an experience that people interpret individually, regardless of whether there is actual injury to the body1.
Medications, Conventional therapy for pain control including TENS, compression therapy, habituation training etc. could not bring about any difference in his condition. Our team of rehabilitation had to try something more than the regular therapy for this condition. Mr. Iqbal, otherwise, was fit for an prosthesis fixation. Three months of active physiotherapy gained him a good and ideal stump.
On an extensive internet survey, we found 12 reviews of RCTs, 19 RCTS and at least 80 case series and cases with similar manifestations. Most of the case studies reported phantom sensation from amputated upper limb. 53 case studies described the treatments they offered for their clients. It supported the management protocol adopted by our team for Mr. Iqbal.

Based on the literature survey, it is noted that there are numerous factors which contribute to the phantom limb pain. Peripheral factors may include temperature, neuromas, Axonal sprouting in the amputated part and central factors may include cortical reorganization of the cerebral hemispheres, changes in the dorsal ganglion of the spinal cord and sympathetic activation. We also studied the scope of “Mirror Box Therapy” in the treatment of Phantom Limb Pain. This is a technique in practice among the physiotherapists and occupational therapists of the west, ever after Dr. V Ramachandran, Neuro Scientist - Behavioral Neurology and Psychophysics, California University, USA has described it for the first time.

**MIRROR BOX THERAPY**

Mirror box therapy, akas, Virtual box therapy is a form of rehabilitation therapy in which a mirror is placed between the arms or legs so that the image of the non-affected limb gives the illusion of normal movement in the affected limb or the amputated limb. Mirror box is a kind of virtual imagery technique in which the brain is masked to help alleviate phantom limb pain in which patient feel they still have the amputated limb. It is a process of rehabilitation which helps the patient to feel that their phantom is moving there by reduces the noxious stimuli towards the brain. Mirror box may be used for a variety of problems such as complex regional pain syndrome, phantom limb pain, stroke and focal dystonia. (Figure 1)

**Figure 1: Mirror box Therapy**

The ‘Wikipedia’ describes, “Phantom limb pain (PLP) is a complex phenomenon that includes a wide variety of symptoms ranging from tingling and itching to burning and aching. During the past twenty years researchers have advanced a number of theories to explain phantom limb pain. Three of the most prominent are: 1) maladaptive changes in the primary sensory cortex after amputation (maladaptive plasticity), 2) a conflict between the signals received from the amputated limb (proprioception) and the information provided by vision that serves to send motor commands to the missing limb, 3) vivid limb position memories that emerge after amputation”.

Though, In 2013 Tamar Makin (Oxford University) published the results of an experiment which challenges the theory of maladaptive plasticity (first advanced by Herta Flor). Makin’s research indicates that the cortical representation of the missing limb is actually stronger after amputation. That is, there is no cortical remapping after amputation.

The Wikipedia enlisted several studies, including large surveys of amputees, have shown that most currently available treatments for phantom limb pain, which range from analgesic and antidepressant medication to stimulation, are ineffective and fail to consider the mechanisms that underlie production of the pain.”
One approach that has gained a great deal of public attention is the mirror box developed by Vilayanur Ramachandran and colleagues. Through the use of artificial visual feedback it becomes possible for the patient to “move” the phantom limb, and to unclench it from potentially painful positions. Repeated training in some subjects has led to long-term improvement, and in one exceptional case, even to the complete elimination of the phantom limb between the hand and the shoulder. Dr. Ramachandren explains that, in mirror box therapy brain is tricked to believe that injured part is present. This improves synaptic activity which signals the brain that the amputated part is present and normal which leads to sensory motor congruence to re-establish and brain stops sending warning messages from the amputated or the injured part. Further, he challenges that scanning the brain using fMRI after regular use of mirror box induces changes in the brain, i.e. cortical reorganization (neural plasticity).

**REVIEW OF LITERATURE**

V Ramachandran (1996) utilized the method of virtual imagery box in treating the patients with phantom limb pain. 10 patients were recruited for the study out of which 6 patients could realize the movement of the phantom limb as a reflection in the mirror when the normal limb is been moved. 3 patients could perceive the sensations in the phantom limb when the normal limb is been touched. The authors worked on the concept of latent plasticity and re-entrant between the cerebral hemispheres. The study gave the conclusion of synesthesia in the phantom limbs.

Brenda (2007) conducted a study upon 22 patients in group of 3 with covered mirror, mental visualization and mirror box therapy for 4 months. They concluded that the mirror box therapy group showed a significant decrease in pain by 89% compared to that of the covered mirror group and mental visualization group.

Maclver (2008) described the effect of virtual imagery in the treatment of phantom limb pain. The study investigated 13 upper limb amputees with functional MRI [fMRI] before and after the intensive virtual imagery training. At the end of the study the patient demonstrated the activation or cortical reorganization of the amputated part to the training sessions. Martin Diers et al., (2010) conducted a study on upper phantom limb pain on 6 months post-operative patients which showed that using graded motor imagery and mirror box therapy decreased complex regional syndrome and phantom limb pain and improved function as well.

**INTERVENTION**

The patient was asked to keep both the limbs in the mirror box, where the left hand was masked and right hand was exposed. The mirror box therapy sessions included performing movements looking at the hand and to the mirror image for 10 - 60 seconds. As patient held his concentration on the image in mirror, he was instructed to perform simple movements of his right wrist and hand like turning hand up and down, flexion and extension of wrist, touching fingers with thumb for 15 – 30 repetition. Later, therapy ball was given to do acts like squeezing, gripping, holding etc. These movements were performed 2 times for 10 - 15 repetition every day for 4 months.

Mr. Iqbal was assessed 4 times in these months. He did not recognize any changes in the pain in the first two months. He was then asked to repeat the mirror therapy practice at least 4 times a day for 5 – 10 minutes per session. The repetitions of movements were also increased proportionally. Patient was also asked to repeat movements in slower and faster patterns.

After 3 months of therapy, Iqbal felt lesser intense in the pain and in the 4th month he reported the pain as “mild” on the Verbal Rating Scale (VRS). Meanwhile, Iqbal also was receiving motor reeducation program and distal upper limb prosthesis meant for cosmetic purposes.
CONCLUSION
In this case of ‘Phantom Pain’ after left hand amputation, we have found that “Mirror box therapy” has made clinically notable changes in the symptoms.

REFERENCES