



ORIGINAL RESEARCH PAPER

Physiotherapy

A STUDY TO ASSESS THE EFFECT OF MIRROR BOX THERAPY IN THE REHABILITATION OF UPPER LIMB AMPUTATION IN REDUCING PHANTOM LIMB PAIN.

KEY WORDS: Pain, Amputation, Phantom pain, Mirror box therapy, Rehabilitation

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ABSTRACT

BACKGROUND: Phantom limb pain is a major problem after limb amputation. During recent years, there has been accumulating data implicating “mirror therapy”, as helpful in the treatment of phantom limb. Mirror therapy is a non-pharmacological treatment using representations of movement, the efficacy of which plays a crucial role in reducing phantom limb pain.
AIM/ OBJECTIVES: The main aim of the study is to assess the effect of mirror box therapy in the rehabilitation of upper limb amputation in reducing phantom limb pain.
METHOD: Thirty patients with upper limb amputation ranging between the age between 40 to 70 years, were recruited in this study. All patients were assigned mirror box therapy for 4 weeks. The upper limb phantom movements taught to the amputees are Elbow Flexion (EF), Elbow Extension (EE), forearm pronation (FP), forearm supination (FS), Wrist flexion (WF), Wrist extension (WE), hand open (HO), Hand close (HC). Outcome measures were assessed immediately after treatment. Pre and post test scores were analyzed.
RESULTS: Statistical analysis was done which showed a significant improvement in post-test assessment scores. The result showed significant improvement in term of pain, after performing mirror box therapy in rehabilitation for upper limb amputation
CONCLUSION: The study concluded that pain was reduced in the upper limb amputation patients after performing mirror box therapy for 4 weeks.

INTRODUCTION:

In recent years, many articles have been published indicating the growing interest of the positive and negative sensations felt by people with amputation in their missing limb, including phantom limb sensations and phantom limb pain.⁽⁹⁾ Mirror therapy is a type of motor imagery whereby the patient moves his unaffected limb while watching the movement in a mirror, this in turn sends a visual stimulus to the brain to promote movement in the affected limb.

The term phantom limb related phenomena encompass all visual space occupied by their phantom limb. The box has been reported to induce vivid sensations of movement originating from the missing limb, improving motor control over a paralyzed phantom limb, and to reduce phantom limb related phenomena. It has been suggested that mirror box therapy may work by providing a mean to link the visual and motor systems to recreated coherent body image and update internal models of motor control. The basis of this possible effect has been assumed to be as a result of the activation of mirror neurons in the hemisphere of the brain that is contra lateral to the amputated limb, firing when a subject observes an action or observe someone else performing it. A development of mirror box therapy is one of the use of virtual reality technologies in which the patient does not look into the mirror but looks at a personal computer screen in which the movements of the anatomical limb are transposed into the movements of a virtual limb and presented in the phase of the persons missing limb.⁽¹¹⁾ One emerging treatment producing perceived positive effects of PLRP is mirror therapy. By placing a mirror para-sagittally between the arms and viewing the reflected movement of the intact limb while attempting simultaneous movement with phantom limb, the patient perceives the reflection to be their amputated limb. It has been suggested that its restitution might relieve it. Ramachandran et.al used mirror box such that movement of the intact arm was perceived as the movement of the amputated limb and reported an evidence of changes in the movement and pain of the phantom. Mirror training is thought to reverse cortical reorganizational characteristics. The path physiological of phantom limb sensation and PLP is not yet well understood; however, complex peripheral and central

mechanisms have been suggested. On the basis of effect of visual feedback through a mirror in patients with phantom pain, mirror therapy was employed with more patients. This movement relieved some of the patients from the awkward position and pain of their phantom arm.

AIM / OBJECTIVE OF THE STUDY:

The main aim of the study is to assess the effect of mirror box therapy in the rehabilitation of upper limb amputation in reducing phantom limb pain.

RESEARCH DESIGN AND METHODOLOGY:

An experimental study design was conducted with 30 patients within the age group of 40 to 70 years who fulfilled the inclusion and exclusion criteria.

INCLUSION CRITERIA:

- AGE: 40-70 years
- Only male patients are included.
- Amputation taken from Trans humeral to ray amputation.
- Amputation within 1 year.
- Patient with no deformity.

EXCLUSION CRITERIA:

- Any sensation problem
- Mental disorder
- Any cognition impairment
- Any proprioceptive impairment

PROCEDURE:

The study consists of 30 samples. The samples are selected according to inclusion criteria and exclusion criteria after which, informed consent has been obtained. Mirror box therapy was applied to all participants for 30 minutes every day (3sets per day) for 4 weeks. The mirror box therapy technique was used as simple technique based on descriptions in the existing literature. The patient was seated comfortably in front of a modular box with a mirror placed with its reflecting surface medially to their maiming limb. When the patient looked at himself in the mirror, the reflected image appeared with both limbs. The patient was asked to make a flexion extension movement (90 to 180degrees) of

their maiming limb and at the same time to try thinking that he was also moving the amputated limb. After the four weeks practice period, the mirror box therapy which was practiced & followed in a piece of booklet was collected and they were told to keep the mirror if they wanted to continue practice the mirror therapy. All pain medications were gradually discontinued over four weeks of mirror therapy. The upper limb phantom movements in amputees are Elbow Flexion (EF), Elbow Extension (EE), forearm pronation (FP), forearm supination (FS), Wrist flexion (WF), Wrist extension (WE), hand open (HO), Hand close (HC).

DATA ANALYSIS:

Inferential Statistics

- Intra Group Analysis – Paired Samples t-test

Paired Samples t-test

Hypotheses:

Null Hypothesis, $H_0: \mu_d = 0$

(i.e., there is **no significant effect** of the **Treatment** in terms of certain outcome measures)

Alternate Hypothesis, $H_1: \mu_d > 0$ (*Right-tailed test*)

(i.e., there is **significant effect** of the **Treatment** in terms of certain outcome measures)

	Count	Min	Max	Mean	SD
AGE	30	40	67	53.63	7.52
Week_1_Pre	30	8	10	9.60	0.56
Week_1_Post	30	7	9	7.77	0.63
Week_2_Pre	30	7	9	7.73	0.58
Week_2_Post	30	5	8	6.23	0.73
Week_3_Pre	30	5	8	6.23	0.73
Week_3_Post	30	4	7	5.00	0.59
Week_4_Pre	30	4	7	5.00	0.59
Week_4_Post	30	4	6	4.67	0.61

In this case, μ_d = mean difference between Pre and Post-test scores; d = difference $\rightarrow d = \text{Post Test Score} - \text{Pre Test Score}$
Level of significance, $\alpha = 0.05$

Test to be applied: Paired Sample t-test

Test Statistic:
$$t = \frac{\bar{d} - 0}{s_d / \sqrt{n}}$$

Descriptive Statistics of all Variables

The mean age of a person is 53.63 years with the standard deviation of 7.52 years. Similarly, the mean value of the outcome measure before the experiment at Week 1 (Pre) is 9.60 (SD = 0.56) and that of the outcome measure after the experiment at Week 4 (post) is 4.67 (SD = 0.61). In addition, the mean values of outcome measure appear to be gradually reducing from Week 1 through Week 4. However, the significance of the reduction in the outcome measure from Week 1 to Week 4 can be tested by the use of Paired t-test as shown in the next section.

Inferential Statistics:

Intra-Group Analysis (Within Group Analysis)

Testing the effect of the Treatment in decreasing the value of the Outcome Measure

H_0 : There is no significant effect of the Treatment in decreasing the value of the Outcome Measure

H_1 : There is significant effect of the Treatment in decreasing the value of the Outcome Measure

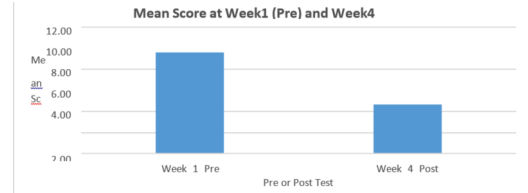
The above hypothesis is tested by the use of **Paired Sample t-test**.

Output of Paired t-test:

t-Test: Paired Two Sample for Mean

	Week_1_Pre	Week_4_Post
Mean	9.60	4.67
SD	0.56	0.61

Variance	0.32	0.37
Observations	30.00	30.00
Pearson Correlation	0.10	
Hypothesized Mean Difference	0.00	
Df	29.00	
t Stat	34.43	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.05	



RESULT:

The p-value (0.000) of the test statistic is less than 0.05, we **reject** the null hypothesis at 5% level of significance ($t = 34.43, p < 0.05$). In addition, the mean value of the outcome measure is **decreased** from Pre-test (9.60) to Post-test (4.67) due to the treatment.

DISCUSSION:

An experimental study was conducted for 30 patients with upper limb amputation. 30 patients received mirror box therapy for upper limb amputation to reduce the pain. Mirror box therapy has become a leading treatment for phantom limb pain. In the present study, 80 percent of patient stated that they had a painful period before the mirror box therapy and it was effective after the treatment with mirror box therapy.

30 patients practiced mirror therapy from Monday to Friday for 4 weeks and session was conducted for 30 minutes at home with a mirror, that was given to them. The therapy gave them ability to control their phantom pain.

Ramachandran vs. et al (2009) suggested that mirror therapy is alternative treatment for phantom pain relief. It provides the capacity to manage their pain by themselves.

The present study shows, pain is reduced after receiving mirror therapy. M Sumitani. M et.al says regular practicing of mirror box therapy at the duration of 10 to 30 minutes are effective in reducing pain.

Dietrich et.al says cosmetic prosthesis may block the positive effect of mirror therapy while during exercises the person may remove the prosthesis. Bradie et.al (2003) reported, mirror therapy activates the cortical pathways.

Ramachandran and altschuler (2010) states that mirror therapy represents the motor imagery and sensation it also allows for rehabilitation of pre-motor cortex to primary cortex. Mirror therapy indicate the visual feedback for the amputate patients (Moseley,2006).

Seidal et.al (2011) showed, the reduction of phantom limb pain was due to increased prefrontal activity which is associated with mirror neuron system. Hence, this study concluded that mirror box therapy decreases the phantom pain of amputated limb.

CONCLUSION:

The study concluded that there is significant effect of the treatment mirror box therapy in decreasing the value of the outcome measure from Pre-test to Post-test score which indicates that the pain has been reduced. Thus, mirror box

therapy proved beneficial in the rehabilitation of upper limb amputation in reducing the pain.

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