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NURSING MANAGEMENT AND MIRROR THERAPY FOR PHANTOM  
LIMB PAIN

by

BRIDGET HENRY

A thesis in partial fulfillment of the requirements  
for the Honors in the Major Program of Nursing  
in the College of Nursing  
and in The Burnett Honors College  
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## **ABSTRACT**

Phantom limb pain may occur after the accidental removal or surgical amputation of a limb. Phantom limb pain is the experience of pain in the limb that is no longer present. The clinical management of phantom limb pain is essential in the overall reduction of patient rehabilitation and poor patient outcomes. A patient's degree of phantom limb pain is influenced by their personal response to loss and pain and can have devastating effects to a person's social performance, occupational role, family role, relationships, and involvement in activities or hobbies. Like most chronic pain, phantom limb pain decreases the quality of life. Not all amputees who suffer from chronic pain respond to traditional therapies. The purpose of this integrated review of the literature was to explore current research and determine the efficacy of mirror therapy in the treatment of Phantom limb pain in amputees. A database search of CINAHL, PubMed (MEDLINE), and OneSearch was conducted. Mirror therapy had no reported side effects, was inexpensive, and was capable of being practiced at home and at the bedside. Relevant findings in the literature revealed a significant decrease in phantom limb pain when using mirror therapy for more than 4 weeks. Although limited research on the use of mirror therapy as an intervention for amputees, existing research supports the efficacy of mirror therapy for the management of phantom limb pain. Nurses and healthcare providers need education on mirror therapy to advocate for their patients to ensure the best possible outcome and reduction of phantom limb pain. Further research on mirror therapy is needed.

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## INTRODUCTION

An estimated 1.5 million amputees live in the United States. A majority of these individuals experience lower limb amputation from either traumatic injury or peripheral vascular disease (Wolff et al., 2011). Phantom limb pain (PLP) occurs after the accidental removal or surgical amputation of a limb. Phantom limb pain is when a patient experiences pain in the limb that is no longer present (Wolff et al., 2011). Virani, Green, & Turin (2014) estimated that 80-90% of all amputees report experiencing phantom limb pain while Chapman (2011) has documented rates as high as 97%. This difference may be attributed to the subjectivity of pain, definitions of pain, and the report or collection of data either by the patient or the health care worker (Chapman, 2011). Phantom limb pain does not depend on the nature in which the amputation occurred: surgical or traumatic (Wolff et al., 2011).

A patient's degree of phantom limb pain is influenced by their personal response to loss and pain. Within the first six months of an amputation with phantom limb pain, a patient will experience a very poor quality of life (Virani et al., 2014). Phantom limb pain inflicts a social and psychological strain on a patient. This additional strain along with the existing stress of coping with the physical loss of a limb increases phantom limb pain and creates a cycle of stress and pain on a patient (Virani et al., 2014). According to Virani et al. (2014), 88% of patients experiencing phantom limb pain are unemployed due to this cycle of stress and pain; and with each year of persistent phantom limb pain, their chance of returning to work or remaining in successful employment decreases.

Phantom limb pain is utilized alongside many other therapies including, pharmacological interventions, physical therapy, limb recognition, imagined movements, auditory feedback therapy, and transcutaneous electrical nerve stimulation. Limb recognition is the process of having participants view photographs of an upper and lower limb in various positions and alignments, and imagine the pain that might be experience if participant mimicked the same position with their remaining limb. Imagining motion therapy includes the presentation of photos of upper and lower limbs in various positions and alignments and asking the patient imagine watching themselves perform the movement without physically performing the movement (Moseley, 2006). Transcutaneous electrical nerve stimulation (TENS) is a form of electrotherapy for alternative pain control (Wilcher, Chernev, & Yan, 2011a).

Phantom limb pain is commonly measured using the Numerical Rating Scale (NRS), the Visual Analog Scale (VAS), and the McGill Pain Questionnaire. The NRS is a 0-10 scale that can measure a multitude of things such as function and pain, 0 being none and 10 being the most. The participant selects a number that best places the value of their pain. The VAS is a 10mm or 100mm line, 0 being no pain while 10 or 100 being the most severe. The participant places a dot representing their pain along the line of the VAS and the dot is measured in millimeters, thus placing a quantitative measure on pain. For both the NRS and VAS, a decrease in millimeters or number indicates a decrease in pain post-intervention. The VAS and NRS are commonly used in the clinical and research setting for the measurement of perceived pain and intensity. The ease of administration and short duration of the assessment is the rationale behind using these unidimensional methods of pain measurement (Kahl & Cleland, 2005). The VAS and NRS have both demonstrated moderate validity for the measurement of pain while the VAS has

demonstrated more sensitivity due to its ability to be more precise in the measurement. This means that the VAS and NRS show strong clinically, valid, and reliable in measuring pain intensity (Kahl & Cleland, 2005). The McGill Pain Questionnaire is regarded as a very reliable multidimensional measurement of pain because it assesses the sensory, affective, and evaluative dimensions of a patient's pain. However, because the McGill Pain Questionnaire is multidimensional, it is often not the favorable choice in clinical setting due to the length of time to administer. The McGill Pain Questionnaire was determined to be sensitive enough to detect changes over time and displays a high level of validity and reliability. This is because it provides qualitative and quantitative data that can be used for detailed statistical analysis during research (Kahl & Cleland, 2005).



## **BACKGROUND**

### **Phantom Limb Pain**

Phantom limb pain is classified as a type of neuropathic pain. Neuropathic pain can exist without cause. Neuropathic pain occurs when there is a disruption to the nervous system, triggering pain receptors to fire. This pain occurs without any protective function due to its abnormal activation (Chapman, 2011). Patients have reported the sensation of phantom limb pain as sharp, boiling, burning, crushing, itching, throbbing, squeezing, or tearing. Intensity can vary from dull unnoticeable pain to extreme, while patterns vary from seconds long to days. Phantom limb pain has been known to last a lifetime, and in many cases has transitioned to a chronic pain (Virani et al., 2014).

Phantom limb pain is not the same as other neuropathic related experiences like phantom sensation and residual limb (or stump) pain. Phantom sensation is a painless tingling or movement perception of the amputated limb. Residual limb pain is the pain felt in the remaining part of the limb that was amputated. Residual limb pain is normally temporary and dissipates within a few weeks; however if it persists, it may lead to phantom limb pain (Virani et al., 2014).

According to Wolff et al. (2011), previous systematic reviews found that conventional medical treatments for phantom limb pain do not provide consistent therapeutic results. Because of this, many patients and healthcare providers are looking for alternative and complementary interventions that may offer better or longer lasting pain relief for phantom limb pain (Chapman, 2011).

Phantom limb pain is complex, and its exact mechanism and pathophysiology is not fully understood (Chapman, 2011). Several theories offer insight into how phantom limb pain is

generated in a patient. Phantom limb pain is commonly described as a conflict between a patient's visual feedback mechanism and their proprioception of the amputated limb. This disconnect in the way a patient views their limb and the way their nerve endings sense the body's position of the limb may indicate that viewing an intact limb using a mirror could alleviate pain (Chan et al., 2007).

## **Treatments**

Treatment of phantom limb pain usually consists of a combination of nonpharmacological therapies and pharmacological interventions. Utilizing only one particular therapy for the treatment of phantom limb pain such as electrotherapy, mental imagery, or physical rehabilitation alone has little to no effect short term or long term (Wolff et al., 2011). It is suggested that instead of one therapy aimed at one mechanism of pain, management of phantom limb pain should target multiple aspects of pain with multiple therapies (Wolff et al., 2011).

## **Mirror Therapy**

Mirror therapy was first implemented in 1993 by Vilayanur Ramachandran, a neuroscientist who specialized in behavioral neurology and visual psychophysics. He tested the idea of placing a mirror vertically between an upper limb amputee with chronic phantom limb pain. Upon using this mirror therapy the patient achieved immediate pain relief. Ramachandran repeated the study again in 1996 and demonstrated that the visual feedback of viewing an intact limb relieved phantom limb pain, increased control of the remaining limb, reduced spasms, and paralysis that they attributed to functional neglect of the limb (Timms & Carus, 2015).

Mirror therapy is when a mirror is placed midline along the body, covering the amputated limb so that a patient can visualize two intact limbs. The patient then proceeds to perform guided movements of the intact limb in front of a mirror to visualize a “virtual” limb (Moseley, 2006). Studies examining mirror therapy typically use it with or compare it to other alternative therapies so that its effectiveness can be measured. Some comparison therapies include having patients’ view their intact limb in an opaque mirror or mentally visualizing a fully intact limb without moving their body (Chan et al., 2007).

Mirror therapy has been successfully used to decrease pain in patients with Complex Regional Pain Syndrome (CRPS). Complex Regional Pain Syndrome is a form of chronic pain characterized by burning and hypersensitivity of the extremities. A literature review by Sayegh et al. (2013) analyzed 9 articles and concluded that mirror therapy should be included in the multidisciplinary treatment for CRPS. They determined that mirror therapy assisted with decreasing pain and increasing motor function in those with CRPS. Based on their conclusions, Sayegh et al. (2013) suggested the use of mirror therapy to aid in the reduction of other painful conditions such as phantom limb pain.

By targeting all aspects of phantom limb pain through mirror therapy used with appropriate medications, there may be a chance of reducing or even eliminating a patient’s phantom limb pain. This can increase the potential of having a positive impact on a patient’s social performance, occupational role, family role, relationships, and involvement in activities or hobbies, which would have an overall increase of their quality of life (Virani et al., 2014).

## **PROBLEM**

Several therapies exist for phantom limb pain, yet nurses lack sufficient knowledge of the most promising therapies to determine which they can implement and teach to decrease a patient's phantom limb pain. An evaluation of literature is needed to determine the effectiveness of mirror therapy and to inform nursing practice.

## **PURPOSE**

The purpose of this paper is to evaluate current research on mirror therapy for the treatment of phantom limb pain. This literature review will examine mirror therapy to determine its usefulness in reducing phantom limb pain.

## **METHOD**

Systematic searches were conducted using the CINAHL database, PubMed (MEDLINE) and OneSearch from 2005 to 2015. This search incorporated all articles and studies that involved any amputation population; from traumatic or military related injuries to peripheral vascular disease. Search terms included the following: phantom limb pain, amputation, phantom pain, therapy, treatment, management, mind-body medicine, motor therapy, mirror therapy, visual therapy, mirror visual therapy, and reflection therapy. A manual search of references from retrieved articles was also conducted. Because of the paucity of 5 evidence based intervention trials for phantom limb pain, both randomized-controlled clinical trials (RCTs) and studies of lesser methodologic rigor were included, including simple clinical trials, case reports, and case series. Studies were excluded if they (1) lacked an intervention, (2) were not published in English, and (3) did not address phantom limb pain. Studies outside peer-reviewed journals were not reviewed.

## FINDINGS

### Randomized Control Trials

A single blinded randomized trial was conducted by Moseley (2006) studying the effectiveness of graded motor imagery in the treatment of Phantom Limb Pain for 51 subjects. Data collection occurred via questionnaires, numerical rating scale, McGill Pain Questionnaire, and Visual Analog Scale. The experimental group utilized a variety of interventions including limb recognition, imagined movements, and mirror therapy (Moseley, 2006). The control group utilized interventions such as physiotherapy while maintaining their usual medical routine and a similar training load to that of the experimental group. However, they were instructed to not have similar therapies to those of the experimental group. Both groups underwent 6 weeks of their assigned interventions and were instructed not to change their medication regimen, begin any new treatments on their own, or to reduce any existing treatment unless instructed by their treating physician. The mean decrease in pain on the VAS was 23.4 mm for the experimental group and 10.5 mm for the control group. The experimental group also had a significant increase in function ( $p=0.001$ ) and in pain reduction ( $p = 0.001$ ). An increase in functioning was also measured using the Numerical Rating Scale. The experimental group improved 2.2 points while the control group increased 0.6 points on the NRS. The mean decrease in pain at follow-up valued 32.1 on the VAS for the experimental group and only 11.6 for the control group. Function also increased at follow up with a mean of 3.7 points on the NRS for the experimental group and 1.5 points for the control group (Moseley, 2006).

Brodie, Whyte, and Niven (2006) completed a randomized control trial testing the effect of viewing a moving “virtual” limb while moving the intact limb on phantom limb pain,

sensation, and movement. A total of 80 amputees participated in the study. The treatment group placed their intact lower limb into a constructed box with a mirror that reversed the image of the intact limb and obscured the residual limb, giving the appearance of two intact limbs. This intervention was compared to a control group which aligned their intact leg and residual limb to either side of the mirror while it was obscured so that they could view the intact limb but not its mirror image. Both groups performed 10 movements repeated 10 times with both limbs. Focusing on the aspect of phantom limb pain, three subjects in both groups reported the elimination of phantom limb pain following the intervention. A significant main effect for the number of descriptors for pain for both the treatment and control group was found ( $p < .05$ ). A significant reduction in the intensity of phantom limb pain intensity was found in both the treatment and control groups ( $p < .05$ ) (Brodie, Whyte, & Niven, 2007).

### **Case Reports**

Wilcher, Chernev, and Yan (2011) completed a case report on the effects of mirror therapy in combination with auditory feedback therapy for an upper limb amputee. A vertically supported mirror was positioned midline along the subject's chest while he was seated. The simple performance of bicep curls, opening and closing of the hands, and pronating and supinating the outstretched arm was completed for 15 minutes twice a day. In addition, the sound of a clap when the patient would simulate clapping was used as auditory feedback therapy. The subject reported his pain episodes occurred 3-6 times per day lasting from minutes to up to an hour and a half. His pain ranged from 8 to 10 out of 10 on the Visual Analog Scale (VAS). He was receiving as many as 6 medications for pain as well as the use of transcutaneous electrical nerve stimulation. This pain triggered an increase in his blood pressure, which required three



different medications to control. By the end of the second week of mirror therapy, the subject reported a decrease in pain intensity, rating his pain 6 out of 10 on the VAS and his blood pressure decreased. Gradual discontinuation of some pain and blood pressure medications occurred over the first 2-3 weeks eventually leaving the subject on only one pain medication and one blood pressure medication by the end of the study (Wilcher, Chernev, & Yan, 2011b).

### **Simple Clinical Trials**

Chan et al. (2007) performed a comparison of three groups in the study of phantom limb pain. A total of 22 subjects were randomly assigned to one of the three groups. Group one was exposed to a reflected image of their intact foot in a mirror, group two viewed their reflection in an opaque covered mirror, and group three used mentally visualized an intact limb. Each group was told that the therapy they completed was being evaluated for efficacy. Both the mirror group and covered mirror group performed movements with both their intact and amputated limb. The mental visualization group imagined performing movements with their amputated limb. All three groups performed these therapies every day for 15 minutes for 4 weeks. Number, duration and intensity of pain were recorded using the 100-mm visual analogue scale. Baseline results were similar among all three groups ( $p=0.62$ ). After the four weeks of treatment all participants in group one reported a decrease in pain. Group two had one patient report a decrease in pain while group three had two patients report a decrease in pain. Group one showed a significant decrease in pain ( $p=0.04$ ) from those in group two and three ( $p=0.002$ ). Nine participants from groups two and three switched to mirror therapy after the completion of the study. Eight of those nine reported a significant decrease in phantom limb pain ( $p=0.008$ ) by the end of another four weeks (Chan et al., 2007).

## **Retrospective Clinical Trial**

Casale, Damini, and Rosati (2009) retrospectively analyzed 33 patients who underwent mirror box therapy 20-30 days after their amputation for 30-minutes daily treatments, five days a week for three weeks. Patients were seated as they placed the mirror box medially facing their intact limb. Patients looked into the mirror and performed flexion-extension movements while imagining moving their amputated leg as well. All participants completed traditional rehabilitation that included exercising abdominal and residual limb muscles to improve movement of the remaining limb and increase range of motion and mobility with the use of prosthesis. The purpose of the analysis was to determine if mirror therapy reduced phantom limb pain or had any adverse reactions or side effects which could increase the intensity of their phantom limb pain. Results were reported in clinical diaries or observed and recorded psychologic interviews. Intensity and adverse reactions were reported and expressed on a 0-10 pain scale. Only 4 participants out of the 33 completed the mirror therapy. Those four patients reported no side effects or adverse effects after the treatment while the other 33 participants reported that their phantom limb pain was not the cause of their withdrawal. The mean pain intensity of those who withdrew was 7.3 out of 10 on the Visual Analog Scale while mean intensity for those who remained in the program was reported as “N/A” (Casale et al., 2009).

## DISCUSSION

All five articles reviewed resulted in some reduction of phantom limb pain. Three of the five reviewed articles compared mirror therapy to another intervention or therapy. Wilcher, Chernev, and Yan (2011) as well as Casale, Damini, and Rosati (2009) used mirror therapy to test its ability to reduce pain without the comparison to other interventions. All five articles determined that mirror therapy reduced phantom limb pain in amputees studied. Three studies determined that mirror therapy reduced the duration of phantom limb pain and increased overall physiologic function of the patient and remaining limb (Chan et al., 2007; Moseley, 2006; Wilcher et al., 2011). Mirror therapy was also noted to be effective in reducing the intensity of phantom limb pain (Casale et al., 2009; Wilcher et al., 2011).

No side effects of mirror therapy were mentioned in any study. Only one study sought to determine if any side effects existed for mirror therapy and in doing so, determined that no side effects occurred and effective pain relief for phantom limb pain was achieved (Casale et al., 2009). Because of this finding, the researchers reported mirror therapy would be a beneficial and low risk home therapy for phantom limb pain. All participants who completed some form of weekly regimented mirror therapy experienced some degree of pain relief; however Brodie, Whyte, and Niven (2007) determined that a single session of mirror therapy produced just as significant pain relief as those who completed several weeks of mirror therapy. The study by Wilcher, Chernev, and Yan (2011) was the only study to show a reduction of medication from the use of mirror therapy and the almost complete independence of medication by the end of the case study.

All studies utilized pharmacological methods of pain treatment while participants completed mirror therapy. If a participant was already on pharmacological pain management, they were instructed to maintain the dose and type of drug used to limit the variables in the study. The pharmacological treatment of phantom limb pain, while testing the efficacy of mirror therapy, is congruent with the current practice and code of ethics for the prevention, treatment, and research of chronic pain such as phantom limb pain.

Although the rigor of the studies were not consistent and those of lesser level of evidence, all studies in this review of literature on mirror therapy show great promise and potential for mirror therapy to be used as an alternative or complementary intervention for phantom limb pain. Although some of the reviewed articles showed statistically significant data, the articles as a whole show immense clinical significance. Mirror therapy showed positive results in a wide age range of amputees from 20 to 83 years of age with various levels of limb amputations. The idea that mirror therapy can be utilized by any amputee with no side effects and relieve phantom limb pain after one session gives hope to those trying to alleviate their phantom limb pain or potentially reduce a medication regimen currently in place.

## **LIMITATIONS**

There is limited research on mirror therapy and its ability to reduce phantom limb pain in amputees. The focus of most current research is on standard physical therapy and the most effective pharmacotherapy options. There is also a lack of research examining mirror therapy alone against a control without special treatment. There is also the limitation that pain is a subjective symptom to study. The pathophysiology of phantom limb pain has limited understanding and is generally unknown. This leads to a limitation on determining exactly how mirror therapy, when successful, reduces pain. The ability to accurately measure the reduction of pain due to mirror therapy is dependent on a person's ability to report pain to begin with, motivation, and ability to participate. Several studies included additional therapies and variables addition to pain, such as anxiety, depression, and quality of life. While these symptoms often go together, singling out pain might lead to a stronger conclusion about the interventions impact on that specific variable.

## **RECCOMENDATIONS**

Pharmacological management alone may not be effective in managing phantom limb pain in the amputee population. However, due to the consequences of poorly treated phantom limb pain, it is imperative to implement better management of their pain. Though further research is warranted, based on preliminary studies, mirror therapy is found to be effective in the management of phantom limb pain in the amputee population regardless of how the amputation occurred or area of amputation. In addition, mirror therapy outcomes support improvement for quality of life of amputees.

### **Nursing Education**

Integrative therapy, such as mirror therapy, is increasingly being used by nurses and physical therapists for rehabilitation and at home therapy for amputees. Even with limited research, results demonstrate that education on the use of mirror therapy for the management of phantom limb pain is needed. Nurses and providers should be educated on safety measures related to mirror therapy, length of treatment, and ROM exercises that fit the capabilities of the patient.

Nurses and providers then should educate families about mirror therapy as options to help amputees better manage phantom limb pain at home. There should be an increase the number of programs available for certification and education on alternative and complementary medicine. Providers and nurses should take continuing education or certification courses on mirror therapy and complementary medicine to implement mirror therapy at the bedside and in inpatient settings. Nursing programs should incorporate education on complementary and integrative medicine into the curriculum, with specific education on mirror therapy for phantom limb pain.

## **Nursing Research**

This literature review has established that there are barriers to conducting research on the use of mirror therapy for the management of phantom limb pain, and further research is warranted. After reviewing the literature, it is recommended that interventions need to be created to overcome such barriers. Further research involving multiple academic disciplines such as physical therapy, occupational therapy, physicians, and pharmacists need to examine the safety, practicality, integration, and efficacy of teaching mirror therapy to amputees. In addition, research analyzing the efficacy of mirror therapy should be duplicated with larger sample sizes and higher levels of evidence for evidence based practice. Additional research should examine implementation strategies for bedside and at home mirror therapy. After these barriers have been addressed, future research should be conducted to consider any cultural or religious influence on phantom limb pain and its treatment.

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