IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Review Article
December 2023 Vol.:26, Issue:2

Alternative Therapies for Phantom Limb Pain

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Marissa P. Berg[1], Kilynn R. Guiler[1], Caitlin E. Zlabek[1], Samuel P. Abraham[2*]

[1]Bethel University School of Nursing, Mishawaka, Indiana, USA

[2]Associate Professor of Nursing, Bethel University School of Nursing, Mishawaka, Indiana, USA*

Submitted: 22 November 2023
Accepted: 27 November 2023
Published: 30 December 2023

HUMAN JOURNALS
ijsrm.humanjournals.com

Keywords: PLP, alternative therapy, treatment, neuropathic pain

ABSTRACT

Background: Patients with phantom limb pain (PLP) experience excruciating pain in a limb that is no longer present. Traditionally, in the hospital setting, patients with PLP are treated with non-steroidal anti-inflammatory drugs (NSAIDs), antiseizure medication, beta-blockers, and muscle relaxers. **Purpose:** The purpose of this study was to review the literature and present alternate treatment options for PLP. **Method:** This was a thorough review of the literature. The review was based on patient, intervention, comparison, outcome, and time (PICOT) question: In patients with phantom limb pain, what is the effect of alternative therapies compared with methods offered by medical science? **Findings:** Themes included mirror therapy, prosthesis ownership, transcutaneous electrical nerve stimulation, peripheral nerve stimulation, acupuncture, virtual reality, targeted muscle reinnervation, and ambulatory continuous nerve block. **Conclusion:** It was determined that most of these therapies help with acute PLP than chronic PLP. Exploring alternative therapies is beneficial to help clients with PLP find pain relief.

INTRODUCTION

PLP is a debilitating pain that occurs in many patients who have undergone amputation of a limb. The pain can be described as throbbing, stabbing, sensations of electric shock, and cramping [1]. Gabapentin and other pain medications are used in hospitals to help alleviate that pain. Unfortunately, medications such as these do not always work to alleviate PLP for the patient, and many healthcare staff is unaware of other interventions to help them manage their pain. Thankfully, there is research to support different practices to lower PLP. Interventions such as mirror therapy, prosthesis ownership, transcutaneous electrical nerve stimulation, peripheral nerve stimulation, acupuncture, virtual reality, targeted muscle reinnervation, and continuous nerve block have been studied to treat PLP. The purpose of this study was to determine the effects these interventions have on decreasing PLP.

Background

The documentation of phantom limb pain dates to the American Civil War [2]. Many soldiers who lost a limb in battle would complain of searing pain in the missing limb. Many doctors at the time thought these were false claims because they could not imagine pain in an area that was no longer present. This was the beginning of understanding nerve pain. The term phantom limb syndrome was coined in 1871 by Silas Weir Mitchell, a surgeon who performed many of the amputations from the war. Many of the soldiers who suffered from phantom limb syndrome suffered in silence because of the number of doctors who discredited the idea [2]. Not many advances were made until the past 50 years. Treatments for PLP are now more heavily researched and various approaches have been attempted [3].

For hospitalization stays today, most of the treatment for PLP is medication alone. This works for some, but others can still feel the excruciating pain that comes from the missing limb. Instead of trying alternative therapies, the hospital staff continues to heavily medicate patients with little to no change in pain level. Fortunately, other options now exist. Relatively inexpensive interventions, such as mirror therapy [4], can be used as an adjunct to normal pharmacological therapies with members of the therapy hospital staff. Of these approaches, not one approach has yet been deemed the first-line treatment for PLP. To address this issue, further review was

conducted with the PICOT question: In patients with phantom limb pain, what is the effect of alternative therapies compared with methods offered by medical science?

1. METHOD

The method of research used was a review of the literature on alternative therapies for PLP. The two databases used for this review were Google Scholar and the Cumulative Index to Nursing and Allied Health Literature (CINAHL). The keywords used when searching these databases were alternative therapies for phantom limb pain, phantom limb pain studies, and alternative therapies compared to medication for PLP. These studies were published between 2018 and 2023, with the majority within the last three years for relevancy. Any studies chosen beyond that were selected because of the need for information on specific therapies. The selected studies included random sampling, convenience, observation, interdisciplinary overview, stratified sampling, and voluntary responses.

The nursing levels of evidence hierarchy were used for the review. Level one was the highest level of evidence, and level seven was the lowest [5]. The 15 studies chosen were selected because of the relevance of the topics and the broad representation of the different therapies. Chosen studies were over a specific alternative therapy, to concur whether the therapy was effective in treating phantom limb pain. Exclusion criteria included: the study was not over a specific alternative treatment for PLP, or the study was not current.

2. REVIEW OF THE LITERATURE

This section describes the findings from several literature sources that pertain to alternative therapies for PLP. Fifteen studies met the inclusion criteria. Seven alternative therapies were identified which are as follows: mirror therapy, prosthesis ownership, transcutaneous and peripheral nerve stimulation, acupuncture, virtual reality, targeted muscle reinnervation, and continuous nerve block. These studies were summarized, and themes captured.

Mirror Therapy

Mirror therapy is one of the most common alternative therapies found for the treatment of PLP [1,2,6,7,8]. The first clinical experiments with mirror therapy were conducted in 1996; subsequently, there has been minimal research use of this therapy [4]. In the practice of mirror

therapy, participants rest a mirror vertically in front of them. The intact limb faces the reflective part of the mirror to be visualized by the participant, while the amputated limb is hidden behind the mirror [8]. Using the unaffected limb, several exercises are performed in front of the mirror, such as observation of different positions, basic motor exercises, exercises using sensory stimuli, motor exercises using various objects, and mental practice [7]. The recommendation was for participants to practice mirror therapy for 20 to 30 minutes daily for optimal results.

Five studies included sample sizes ranging from a minimum of one participant to a maximum of 98 participants. Pain was measured before and after each mirror therapy session to assess effectiveness. Overall, it was concluded that mirror therapy reduced PLP and improved QoL [quality of life] and psychological status in the short term [6]. Rothgangel et al. [7] determined mirror therapy had a small but non-significant effect on the duration and average intensity of PLP, while the other studies found mirror therapy to be an extremely effective treatment modality for patients experiencing PLP [4]. Collins et al. [1] expressed that mirror therapy is noninvasive and perhaps one of the least expensive and most effective modalities used for the treatment of PLP. Wang et al. [9] were adamant there is fair-quality evidence that mirror therapy is beneficial for reducing phantom limb pain. In a unique case report, Forch et al. [10] found that the use of mirror therapy was successful with an individual with an intellectual developmental disorder suffering from PLP. If a mirror is available, mirror therapy can be used anywhere at any time and is effective in decreasing the pain levels in those with PLP. Listed in Figure 1 are the summarized benefits of mirror therapy.

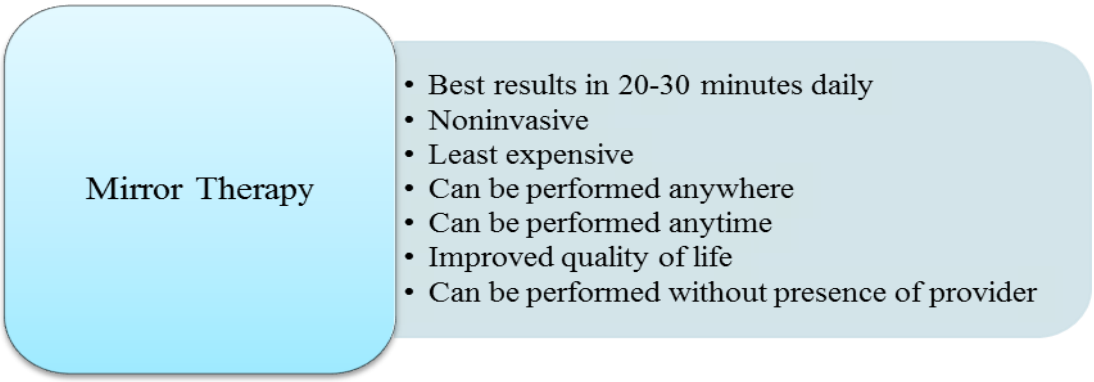


Figure No. 1: Benefits of mirror therapy

Prosthesis Ownership

Prosthetic devices are used with some amputees to partially institute the amputee's body integrity [11]. In one study, a PHANTOMMIND database was created, and 2382 participants above the age of 18 had valuable data that was analyzed. A questionnaire was developed, and amputation-related information, prosthesis-related features, and characteristics of painful and non-painful postamputation phenomena related to the affected limb were featured [11]. The results indicated that higher levels of prosthesis ownership were significantly related to lower PLP and residual limb pain. To paraphrase, having an artificial body part tricks the mind into thinking the part is real, leading to a reduction in PLP.

Additionally, Erlenwein et al. [12] highlighted myoelectric-controlled prosthesis ownership lowering PLP for upper limb amputations. A myoelectric-controlled prosthesis is externally powered and controlled by electrical signals, generated naturally by muscle activity. The study indicated enhanced use of a myoelectric prosthesis in upper-extremity amputees was associated with reduced PLP. It was also noted that the more the patient uses this prosthetic device, the more pain relief occurred. A prosthesis with a feedback function seems to be a promising therapeutic tool to reduce PLP because it addresses sensorimotor incongruences after amputation [12].

Transcutaneous and Peripheral Nerve Stimulation

Therapies such as transcutaneous electrical nerve stimulation (TENS) and peripheral nerve stimulation (PNS) are techniques that have shown promising results. TENS is a therapy where electrical current runs through electrodes that adhere externally to the skin. In one study, Limakatso et al. [13] evaluated TENS on a 36-year-old male patient who had a left limb amputation right below the hip joint. In this study, the patient underwent high-frequency TENS (100 Hz) for 15 minutes, followed immediately by 15 minutes of low-frequency TENS (10 Hz). The patient underwent this therapy once a day for three days. By the end of the first session, the patient had reported complete pain relief and increased awareness of the phantom limb. After three days of therapy, there was no PLP reported by the patient. The results indicated TENS may be effective in reducing acute PLP and its interference with sleep and mobility [13].

In comparison, Vathakul et al. [14] evaluated 20 patients with three observations made during one TENS therapy session. Before starting the therapy, the patient's initial pain scores were recorded. After 30 minutes of TENS, patients' pain scores were reevaluated. If there was no change, then TENS was lengthened to an extra 15-30 minutes. At the end of the session, patient satisfaction was assessed on a scale of (0-100) and the presence of any adverse effects. The results showed that 19 out of 20 patients reported clinically significant pain relief where pain scores decreased by more than 30%. There were also no adverse effects or events reported during the session with any of the participants [14].

In another study, Pagan-Rosado et al. [15] discovered the positive effects of peripheral nerve stimulation (PNS) which is a neuromodulation intervention that can be utilized to treat refractory manifestations of chronic pain, including post-amputation pain. During this therapy, a temporary stimulator is implanted, guided by an ultrasound, as close to a selected nerve as possible. Three patients who had an amputated limb underwent PNS therapy and had temporary devices implanted for 60 days. During the therapy, the patients' PLP decreased significantly. When the device was removed, the patients' PLP worsened or went back to baseline. It was concluded that temporary PNS provides substantial short-term pain relief and improved physical functionality, although this therapeutic effect is temporary and does not extend long-term after device removal [15].

Acupuncture

Case studies indicate that historically, acupuncture has been successfully used for the treatment of chronic pain, particularly in conventional medical settings [16]. Liu et al. [17] analyzed acupuncture and its effects on PLP. There were six participants in the study, which aimed to observe the changes in plasma NPY (neuropeptide Y) and PGE2 (prostaglandin E2) levels before and after acupuncture in patients with PLP, and to evaluate the effects of acupuncture on the peripheral circulation of the residual limbs. Acupuncture was performed twice a week for four weeks. The needles were inserted into the affected limb for 30 minutes, twisting and turning every 10 minutes. Blood components (NPY and PGE2) were assessed on the first and last day of the study, along with skin blood flow (SBF) and oxygen saturation (SO2). The results were significant and determined that acupuncture is effective in treating PLP. Along with the analysis

of blood components and peripheral circulation, the participants felt their PLP was gone, they were able to return to activities of daily living and felt satisfied with the treatment they received [17].

Virtual-Reality

What we see has more meaning about phantom limb pain. Collins et al. [1] shared that similar to mirror therapy, with virtual reality (VR), a patient can see the missing limb moving naturally. When VR is implemented, two different types of VR can be used: non-immersive VR and immersive VR. With non-immersive VR, the technology will either simply mirror your existing limb, or react to your body movements. For the patients using this for PLP, the augmented limb can move based on the patient's remaining portion of that limb, and even uses neuroelectrical signals so that the patient can move the augmented hand or foot with their brain. Immersive therapy has this same technology, but it simulates an environment where the user can use the augmented limb to complete simple tasks [18].

In one study, participants were able to see their missing limb as if it were still there. By the end of this study, five of the eight participants saw more than a 30% decrease in their PLP [1]. Of the immersive studies, Vassantachart et al. [18] determined all of them recorded a reduced level of PLP. The results of non-immersive studies were also found to mirror the immersive findings. Erlenwein et al. [12] reviewed three studies overviewing the effectiveness of VR therapy of which, two of the three studies showed a decrease in PLP. When comparing these to other therapies such as mirror therapy, there were no significant differences in the results. A gap exists in long-term VR studies on the effectiveness of this treatment.

For the reason that a gap exists in long-term studies on VR therapy for PLP, it is difficult to say how much of an impact it will have on the future of PLP management. Although the short-term results are promising, the few studies that looked into the participants' pain after a year showed no improvement from baseline. This shows when the therapy is used for a limited time and stopped, PLP returns, and consistent use could produce better outcomes. Because of the technology required to do this therapy, implementing this into the hospital setting would be a luxury. Until there are consistent, long-term studies with this type of technology, it seems rare that any hospital system would adopt it as part of their treatment for amputees.

Targeted Muscle Reinnervation

Targeted muscle reinnervation (TMR) treats PLP by surgically adjusting the nerves that are damaged by the amputation and guiding them to an area where they can heal and not continually send signals to the brain. One study noted that reconfiguring the nerve-to-muscle relationship improved long-term chronic pain [19]. The current gold standard for residual limb pain is moving the cut nerves into an area that they can regrow. Patients in these studies underwent this procedure because of their current PLP. The surgeon identified which nerves needed to be surgically inserted and sutured to a healthy motor nerve or muscle. Patients underwent postoperative rehabilitation per hospital policy. Pain was assessed using a consistent scale so that results could be compared pre and postoperative. Mioton et al. [19] discussed the patient-reported outcome measurement system (PROMIS) pain scale when assessing the pain of the participants. Thirty-three patients who underwent the loss of a limb participated in this study. The pain was assessed at three-month intervals for one year. By the end of that year, it was found that pain decreased from 6.4 ± 2.6 to 3.6 ± 2.2. Fifty-eight percent of participants preoperatively were experiencing severe pain. Postoperatively, only 6% of the participants were experiencing severe pain. Although the results showed a promising decrease in PLP, it did not help in positively impacting the functionality of the limb [19].

The Dumanian et al. [20] study found that 28 major limb amputees showed similar results. Just like the previous study, patients were assessed every three months for a year. The pain was assessed using the 11-point Numerical Rating Scale and the PROMIS. This study resulted in an average decrease in PLP of 3.2. At the longest follow-up for each of the patients, 72% of them either reported no or mild PLP [20].

TMR shows promising results as a surgical therapy to treat PLP. Although the decrease in PLP could very well be placebo, considering the large mental factor contributing to the pain, many patients suffering from PLP would do this to get some relief no matter how it worked. It is a therapy that can be implemented in hospitals where staff and surgeons need to complete the surgery. In these studies, most patients saw a major improvement in their PLP. These findings cannot be ignored, although this procedure is more costly than the classic mirror therapy, it is another effective option with lasting results.

Ambulatory Continuous Nerve Block

Ambulatory continuous nerve block therapy was tested on 144 patients who had an amputation of a limb and who experienced PLP of at least a two or higher on the Numeric Rating scale (NRS; 0-10, 0 5 no pain; 10 5 worst imaginable pain) [21]. These patients were treated with this therapy for six days. This therapy disrupts reentrant neural pathways, which provoke dysfunctional reorganization in the somatosensory cortex. Conclusions were drawn and showed that a 6-day ambulatory perineural local anesthetic infusion substantially decreased phantom limb pain 4 weeks after the initiation of treatment. Additionally, the positive effects of this therapy often lasted up to six months. This non-opioid treatment presented promising results in reducing PLP [21].

3. SUMMARY OF RESULTS

The purpose of this literature review was to identify alternative therapies that are available and have been shown to reduce PLP in amputee patients. Fifteen studies were reviewed to explore several alternative therapies for patients who experience PLP. These studies revealed the effects of alternative therapies as shown in Figure 2. The findings included TENS and PNS are effective in relieving acute PLP; ambulatory continuous nerve block significantly lowers PLP; prosthesis ownership correlate to lower levels of PLP; regular mirror therapy is effective in relieving PLP; VR therapy is effective in lowering PLP; acupuncture is shown to decrease PLP; and TMR is an effective surgical option to lower PLP.

The PICOT question was, “In patients with phantom limb pain, what is the effect of alternative therapies compared with methods offered by medical science?” The results show that there was a positive effect of alternative therapies that helped to reduce PLP in patients who have had an amputation of a limb. Many factors affect the outcomes of PLP, so clients may need to try more than one therapy to find their best match. It is important to consider how to put some of these therapies into effect in the hospital setting. Implementing some of these therapies, like mirror therapy, into nursing interventions may be a step in the right direction when creating a care plan for amputees who are experiencing PLP.

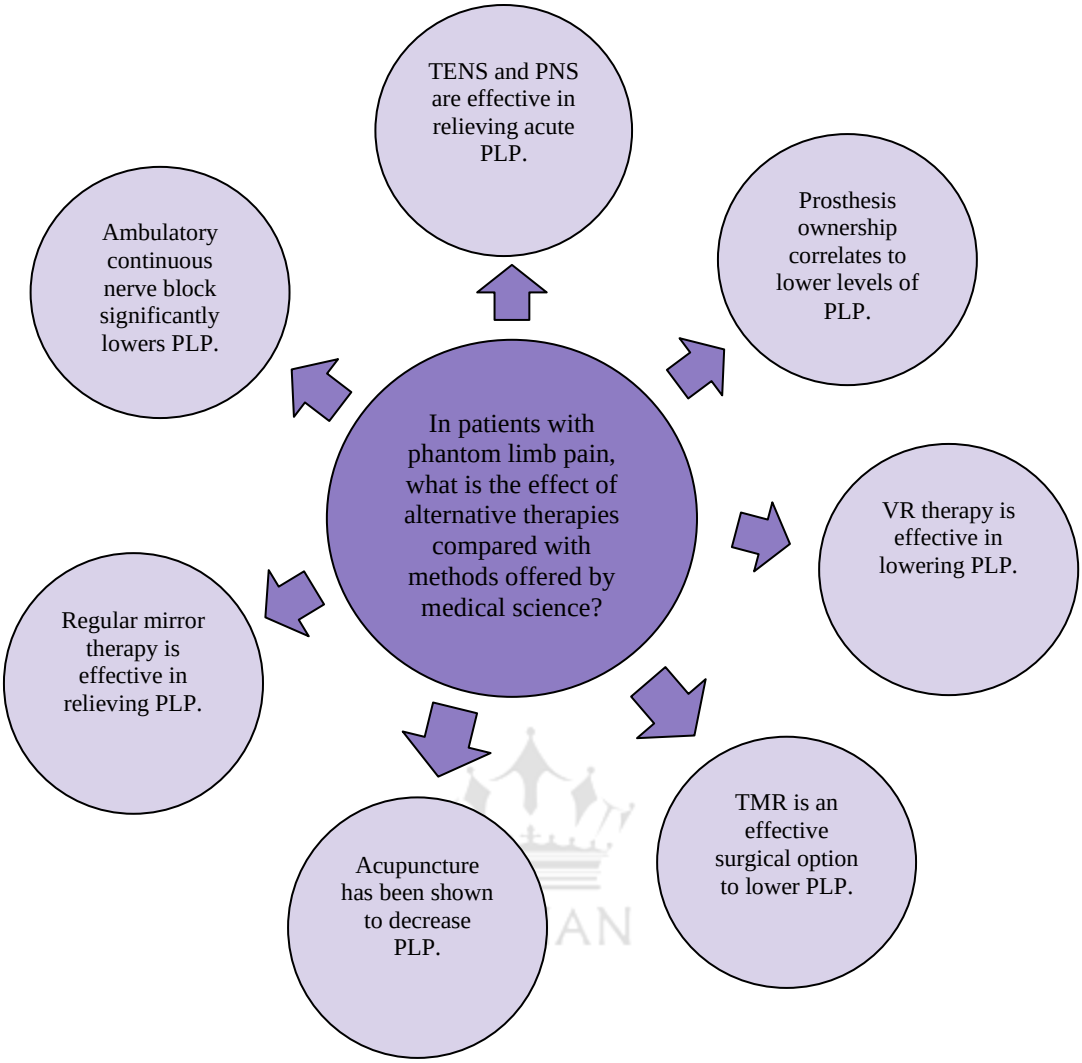


Figure No. 2: Alternative Therapies Related to Patients Experiencing PLP

4. DISCUSSION

In hospitals, patients are often prescribed medications such as "analgesics, anticonvulsants, antidepressants, muscle relaxants, and anesthetics [8]. These prescribed medications may work for some clients, but these generally do not completely relieve the symptoms patients are experiencing. Exploring alternative therapies is beneficial to help clients with PLP find pain relief. When comparing common therapies offered by medical science, it would be beneficial for patients with amputations to explore other alternative therapies. Alternative therapies are beneficial in helping reduce PLP [12]. It is valuable to acknowledge that there is no single therapy that will work for every client who struggles with PLP [1]. Clients experiencing PLP

may need to experiment with different therapies to find the right match. It is also important to consider the cost of some therapies when exploring options for clients. Therapies such as mirror therapy and TENS are inexpensive [4,13]. Whereas therapies such as VR and ambulatory continuous nerve block are more expensive [19, 21]. Additionally, there are strengths, weaknesses, and recommendations to consider.

Strengths and Weaknesses

A strength in the analysis of this study is the various types of literature gathered. These studies included alternative therapies that have been tested to lower PLP. Additionally, these studies showed promising results in lowering acute PLP with their participants. Patients can get quick relief which is a strength to using these various therapies. Lastly, therapies such as mirror therapy or TENS are more cost-efficient for patients experiencing PLP who are of lower socioeconomic status.

The primary weakness is the lack of sufficient research on how to relieve chronic PLP. Some researchers used smaller sample sizes and felt if they were successful then further studies could be conducted with a larger sample size. It would allow for further exploration of how efficient and effective alternative therapies are in treating PLP. Because PLP has recently been studied, it is difficult to find long-term studies that provide promising results.

Recommendations

Based on the findings of the various studies, it is recommended alternative therapies for PLP be further investigated. There are not many studies available with exceptional results about each alternative therapy, so it would be beneficial to complete further research about the different alternative therapies available and how resourceful they can be for amputees' with PLP. See Figure 3 for clinical applications of evidence-based practice for PLP. Within healthcare, it appears there is minimal use of alternative therapies for PLP mainly due to the lack of knowledge of alternative therapies within the healthcare system and the lack of research regarding alternative therapies. It is recommended that both staff and patients who suffer from PLP acquire further education on this topic. Within the hospitals and facilities that deal with amputees, it would be prudent to give education to the staff at these locations via staff in-

services, continuing education, informational flyers in staff restrooms and common areas, and having people come in and demonstrate how a specific therapy works.

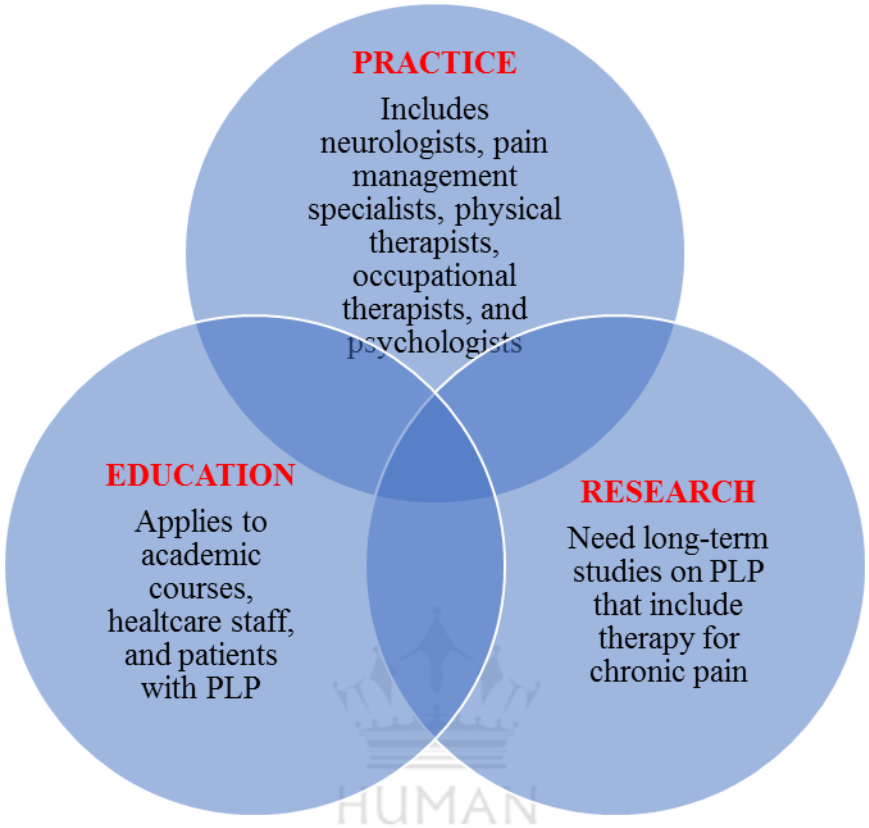


Figure No. 3: Application of evidence-based practice for PLP

5. CONCLUSION

There are several alternative therapies that amputees suffering from PLP can explore to help reduce the pain they are experiencing. While one treatment may not work for one patient, it may work for another. The findings of this study indicate therapies such as mirror therapy, prosthesis ownership, transcutaneous and peripheral nerve stimulation, acupuncture, virtual reality, targeted muscle reinnervation, and continuous nerve block are promising interventions for acute PLP.

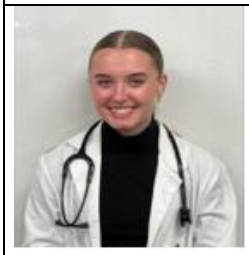
REFERENCES

1. Collins, K. L., Russell, H. G., Schumacher, P. J., Robinson-Freeman, K. E., O'Conor, E. C., Gibney, K. D., Yambem, O., Dykes, R. W., Waters, R. S., & Tsao, J. W. (2018). A review of current theories and treatments for phantom limb pain. The Journal of Clinical Investigation, 128(6), 2168–2176. https://doi.org/10.1172/JCI94003

2. Puglionesi, A. (2018, September). *The Civil War Doctor Who Proved Phantom Limb Pain Was Real*. History. https://www.history.com/news/the-civil-war-doctor-who-proved -phantom-limb-pain-was-real
3. Aternali, A., & Katz, J. (2019). Recent advances in understanding and managing phantom limb pain. *F1000Research, 8(1167)*, 1-11. https://doi.org/10.12688/f1000research.19355.1
4. Chong, D., Pople, M., Hardy, T., Cowan, A., Birchley, D., Guy, A., McCarthy, R., & Welchman, S. (2023). Mirror therapy for the management of phantom limb pain: A single-center experience. *Annals of Vascular Surgery, 95*, 184-187. https://doi.org/10.1016/j.avsg.2023.03.033
5. Schmidt, N., & Brown, J. (2022). *Evidence-based practice for nurses: Appraisal and application of research* (5th ed.). Jones & Bartlett Learning.
6. Külünkoğlu, B., Erbachceci, F., Alkan, A. (2019). A comparison of the effects of mirror therapy and phantom exercises on phantom limb pain. *Turkish Journal of Medical Sciences, 49(1),* 101-109. DOI: 10.3906/sag-1712-166
7. Rothgangel, A., Braun, S., Winkens, B., Beurskens, A., & Smeets, R. (2018). Traditional and augmented reality mirror therapy for patients with chronic phantom limb pain (PACT study): Results of a three-group, multicentre single-blind randomized controlled trial. *Clinical Rehabilitation*, *32*(12), 1591–1608. https://doi.org/10.1177/0269215518785948
8. Yildirim, M. & Sen, S. (2020). Mirror therapy in the management of phantom limb pain. *The American Journal of Nursing, 120(3)*, 41-46. https://doi.org/10.1097/01.NAJ.0000656340.69704.9f
9. Wang, F., Zhang, R., Zhang, J., Li, D., Wang, Y., Yang, Y. H., & Wei, Q. (2021). Effects of mirror therapy on phantom limb sensation and phantom limb pain in amputees: A systematic review and meta-analysis of randomized controlled trials. *Clinical Rehabilitation*, *35*(12), 1710–1721. https://doi.org/10.1177/02692155211027332
10. Folch, A., Gallo, D., Miró, J., Salvador-Carulla, L., & Martínez-Leal, R. (2022). Mirror therapy for phantom limb pain in moderate intellectual disability. A case report. *European Journal of Pain (London, England)*, *26*(1), 246–254. https://doi.org/10.1002/ejp.1859
11. Bekrater-Bodmann, R., Reinhard, I., Diers, M., Fuchs, X. & Flor, H. (2021). Relationship of prosthesis ownership and phantom limb pain: Results of a survey in 2383 limb amputees. *PAIN, 162*(2), 630–640. *DOI:* 10.1097/j.pain.0000000000002063
12. Erlenwein, J., Diers, M., Ernst, J., Schulz, F., & Petzke, F. (2021). Clinical updates on phantom limb pain. *National Library of Medicine*, *6*(1), 888. https://doi.org/10.1097/pr9.0000000000000888
13. Limakatso, K. & Sevin, S. (2023). Managing acute phantom limb pain with transcutaneous electrical nerve stimulation: A case report. *Journal of Medical Case Report. 17*(209), 1-5. doi.org/10.1186/s13256-023-03915-z
14. Vathakul, J., Kessava, N., Pooliam, J., Datu, M., Jitsinthunun, T. & Zinboonyahgoon, N. (2022). The analgesic effect of transcutaneous electrical nerve stimulation (TENS) on the opposite side for phantom limb pain. *Siriraj Medical Journal, 74(4)*, 239-244. http://dx.doi.org/10.33192/Smj.2022.30
15. Pagan-Rosado, R., Smith, B. J., Smither, F. C., Pingree, M. J., & D'Souza, R. S. (2023). Peripheral nerve stimulation for the treatment of phantom limb pain: A case series. *Case Reports in Anesthesiology*, *2023*, 1–4. https://doi.org/10.1155/2023/1558183
16. Lu, T. V. (1998). Acupuncture treatment for phantom limb pain. *Alternative Therapies in Health and Medicine*, *4*(5), 124.
17. Liu, H., Yang, F., Duan, J., Li, Z., Luan, H. & Ren, W. (2023). Effect of acupuncture on the serum and local micro circulatory biochemical parameters in phantom limb pain. *Acupuncture & Electro-Therapeutics Research, 48(3)*, 199-212. https://doi.org/10.3727/036012923X168667953174923
18. Vassantachart, A. Y., Yeo, E., & Chau, B. (2022). Virtual and augmented reality-based treatments for phantom limb pain: A systematic review. *Innovations in Clinical Neuroscience*, *19*(10-12), 48–57. https://europepmc.org/article/MED/36591552
19. Mioton, L. M., Dumanian, G. A., Shah, N., Qiu, C. S., Ertl, W. J., Potter, B. K., Souza, J. M., Valerio, I. L., Ko, J. H., & Jordan, S. W. (2020). Targeted muscle reinnervation improves residual limb pain, phantom limb pain, and limb function: A prospective study of 33 major limb amputees. *Clinical Orthopaedics and Related*

Research, *478*(9), 2161–2167. https://doi.org/10.1097/CORR.0000000000001323

20. Dumanian, G. A., Potter, B. K., Mioton, L. M., Ko, J. H., Cheesborough, J. E., Souza, J. M., Ertl, W. J., Tintle, S. M., Nanos, G. P., Valerio, I. L., Kuiken, T. A., Apkarian, A. V., Porter, K., & Jordan, S. W. (2019). Targeted muscle reinnervation treats neuroma and phantom pain in major limb amputees: A randomized clinical trial. *Annals of Surgery*, *270* (2), 238–246. https://doi.org/10.1097/SLA.0000000000003088
21. Ilfeld, B., Khatibi, B., Maheshwari, K., Madison, S., Esa, W., Mariano, E., Kent, M., Hanling, S., Sessler, D., Eisenach, J., Cohen, S., Mascha, E., Ma, C., Padwal, J, Turan, A. (2020). Ambulatory continuous peripheral nerve blocks to treat post-amputation phantom limb pain: A multicenter, randomized, quadruple-masked, placebo-controlled clinical trial. *PAIN*, *162*(3), 938-955, *DOI:* 10.1097/j.pain.0000000000002087

	**Marissa P. Berg** *Bethel University School of Nursing, Mishawaka, Indiana, USA*
	**Kilynn R. Guiler** *Bethel University School of Nursing, Mishawaka, Indiana, USA*
	**Caitlin E. Zlabek** *Bethel University School of Nursing, Mishawaka, Indiana, USA*
	**Samuel P. Abraham– *Corresponding Author*** *Associate Professor of Nursing, Bethel University, 1001 Bethel Circle, Mishawaka, Indiana, USA*