Innovative Technology to Improve Functional Outcomes for Vascular Amputees: Case Studies

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ABSTRACT

Objective: Describe the ***functional outcomes*** for vascular amputees who participated in a study to investigate the effectiveness of combining of two interventions, to eliminate electromagnetic fields and mirror therapy to decrease phantom limb pain. This poster focuses on the case study descriptions of their individual functional outcomes and improvement in quality of life.
Setting: Inpatient rehabilitation and home health.
Participants: Nine subjects with acute amputation (48 hours after surgery) and five subjects with previous amputations (8-28 months post surgery).
Intervention: The combination of two interventions: Use of amputee limb cover eliminating electromagnetic fields and use of mirror therapy for sensory cortex reorganization.
Measures: The quantitative measures, completed at three points (pre-treatment, post treatment, and 4 weeks post treatment) included residual limb temperature and edema, phantom limb pain/discomfort, ADL tasks, and quality of life outcomes.
Results: All measures showed significant change. Activities of daily living showed significant improvement, including self care: (F=4.27, p< .001), walking (F=2.6, p=.016), car transfer, (F=2.5, p=. 02), low chair transfer (F=4.5, p< .001), and sleep (F=5.61, p < .001). Gains were significant in life satisfaction (F=4.64, p < .001), mood (F=7.6, p<.001) and quality of life (F=3.32, p=.004). ***Acute amputees decreased the time from prosthetic fitting from the typical 12 weeks to 8 weeks. Prosthetic wearing times for previous amputees increased from 0-2 hours per day to 8-12 hours per day*** with some subjects changing from complete immobility to resuming functional activities.
Conclusions: This poster presents individual case stories of the subjects and the impact of improving functional independence and quality of life.

BACKGROUND

- Phantom limb pains (PLP) are painful sensations perceived in the missing portion of the amputated limb affecting 90% of individuals with amputations to some degree.[1]
- Electromagnetic fields (EMF) can affect the nervous systems of individuals which can result in adverse health consequences; conversely the absence of EMF, has been shown to reduce chronic pain and improve wound healing. [2-3]
- Farabloc technology [4] uses a fabric that is woven using 9.5% steel wire fibers consisting of iron, nickel, chromium and nylon. It has been shown to have significant shielding effects on high frequency EMF (greater than 1MHz).[5]
- Mirror Therapy has been shown to significantly reduce PLP in individuals with an amputation, using a mirror placed between the amputated and non-amputated limb, in which the non-amputated limb is observed while performing bilateral synchronous exercises, such that it appears that both limbs are intact. [1, 6-8]

METHODS

Subject Age: Mean = 59 years (SD=11.2), range 48-78
Materials and Intervention: Farabloc cover was designed and fitted to each individual's residual limb and used on limb 23 hours every day. Subject completed 15 minutes of mirror therapy every day.
Outcome Measures: Functional performance quality of life.
All measures were taken at baseline or Pre-Treatment, after 4 weeks of daily intervention or Post-Treatment, and after 4 weeks of non-intervention or Maintenance.
Design and Analysis: A repeated measures design was used, with two groups, 3 time periods. ANOVAs and post hoc tests were used to compare the intervention between the three times.

INDIVIDUAL CASE STORIES

Pre-Intervention: A 73 year-old Caucasian male had pre-existing diabetic peripheral neuropathy prior to his amputation and spent the majority of his time on the couch due to pain and resulting poor tolerance of his prosthesis. Prosthetic use was limited to two hours per day.
Post Intervention: After intervention, he is wearing his prosthesis 10 hours per day and is able to ambulate with the use of a straight cane only. He has resumed yard work, he has returned to the Amputee Support Group and enjoys evenings, going out to restaurants with his wife.

Pre-Intervention: Prior to the study, this 51 year-old Hispanic woman was incapacitated and remained in bed with phantom limb pain every 30 minutes. She was unable to tolerate wearing her prosthesis and the pain severely limited her quality of life, prevented her from participating in the care of her teenage daughter and resulted in a debilitating depressive episode.
Post Intervention: Within 17 days of beginning the protocol, she was tolerating wearing her prosthesis an average of 8 hours per day *(note decrease in edema and improvement in shape of residual limb)*. She has return to important roles in her life, including that of mother, with significant improvement in her quality of life.

Pre-Intervention: This 63 year-old African American female was unable to use her prosthesis due to wound healing complications. Negative pressure wound therapy was attempted but eventually she underwent a residual limb revision of the initial amputation to improve the shape of her residual limb. Her poor self-concept prevented her from participating in community activities.
Post Intervention: After eight weeks, she was able to fit and wear her prosthesis during her waking hours (12 hours per day). Her improved self-concept has meant that she has returned to community participation tasks - especially church attendance, which was very important to her, with significant quality of life improvement.

Pre-Intervention: This 62 year-old African American male was only able to tolerate wearing his prosthesis for two hours per day due to phantom limb pain. The pain and poor tolerance of prosthesis interfered with functional tasks he needed to perform, such as cutting the grass.
Post Intervention: He is able to tolerate wearing his prosthesis for 12 hours per day. This participant reports that he puts his prosthesis on in the morning when he gets up and takes it off at night when he goes to bed, with increased participation in occupational roles and routines greatly improved. He is now able to cut the grass while wearing his prosthesis.

ACKNOWLEDGEMENTS & CONFLICT OF INTEREST STATEMENT

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DISCUSSION

This combined treatment protocol reduced phantom limb pain such that the participating amputees increased their participation in their activities of everyday life and subsequently improved their quality of life.

Of the eleven acute subjects, nine indicated improvement in functional performance and quality of life measures. The exceptions had medical complications that required them to drop from the study.

Of the five subjects with amputations from 8-28 months previously, all five improved on most measures of functional performance and quality of life measures.

Functional outcomes from this study are promising. If future research demonstrates the same outcomes as this study, an alternative treatment protocol to decrease and possibly eliminate the debilitating effects of phantom limb pain in amputees would be established.

CONCLUSION

This protocol provides a cost-effective, drug-free alternative to current phantom limb pain treatments. If the time between amputation and prosthetic fitting can be decreased, as it did in this study, medical costs can be significantly reduced. The results of this study show robust findings that the function and quality of life for our older adults with vascular disorders can be improved through use of innovative technology and intervention.

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