

Auditory Feedback In The Treatment Of Upper Limb Phantom Pain: A Medical Hypothesis

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Abstract

Phantom limb sensation and/or pain are a common complaint after amputations. In recent years there has been accumulating data implicating mirror visual feedback or mirror therapy as helpful in the treatment of phantom pain. On the other hand, there is no published data on utilizing auditory feedback for treatment of phantom pain. We introduce a new medical hypothesis that auditory feedback may be of added benefit in the treatment of phantom limb pain when used in addition to mirror visual feedback and serve as a valuable part to the complex multisensory processing of body perception in amputee patients.

INTRODUCTION

There are over 130,000 limb amputations in USA each year¹. Nearly every amputee experiences some form of phantom limb effects such as phantom sensation (voluntary or involuntary movements of the amputated limb, certain positions or sense of tactile stimulation of the amputated limb), telescoping, and/or phantom spasms. Additionally, a significant percentage of amputee patients may also experience phantom limb pain (PLP). The estimated prevalence of PLP varies from 49% to 83%². PLP may negatively impact the quality of life of amputee patients and consume significant medical resources. The pathophysiology of phantom limb sensation and PLP is not yet well understood; however, complex peripheral and central mechanisms have been suggested³. A myriad types of treatment for PLP have been attempted, the outcomes of which have largely been variable.

Mirror therapy for phantom pain was first described by Ramachandran and Rogers-Ramachandran³. Mirror therapy has recently received more attention with reports of an increased number of patients achieving beneficial outcomes^{4, 5, 6, and 7}.

The concept, also known as Mirror Visual Feedback (MVF) has also demonstrated positive effects in other diseases, such as stroke and complex regional pain syndrome^{8,9}. As it is that mirror therapy is based on visual feedback, it is possible that other types such as auditory feedback may augment the treatment of PLP. To date, we know of no cases in which

auditory feedback therapy for PLP has been described. The purpose of this article is to introduce a medical hypothesis that auditory feedback may be of added benefit in the treatment of PLP, when used in addition to MVF.

CASE PRESENTATION

A 24-year-old motorcyclist with no significant past medical or social history collided with a moving automobile and was ejected 100 feet into the air. He sustained multiple injuries including a large chest wall avulsion and a partial amputation of the left arm. The limb was not salvageable, requiring amputation, with a small residual fragment of the left scapula remaining (Fig.1).

Figure 1

Fig. 1 High level left upper limb amputation. Digital photograph of post-traumatic anterior thorax demonstrating complete absence of the left upper extremity and shoulder, fourteen weeks after initial injury.



Left scapulothoracic dislocation and severed left brachial plexus was also found intraoperatively.

He received ten weeks of acute care in the surgical-medical unit, after which he was transferred to the acute rehabilitation unit where almost immediately, his PLP became his major complaint.

He reported his pain episodes as variable in number, ranging from 15 minutes to 1 and ½ hour, 3 to 6 times per day. On average, he rated the pain at an 8-10 out of 10 on the visual analog scale (VAS). He consistently experienced the feeling that his left fist was severely clenched and he could not release it from the cramping that became a burning, and searing pain.

This persisted despite a series of aggressive pain management methods through the administration of naproxen 250 mg three times a day, tramadol 50 mg four times a day, morphine extended release 150 mg two times a day, hydrocodone/acetaminophen 5/500 every 4 hours as needed, lidocaine patch: 2 patches every 24 hours, gabapentin 400 mg four times a day and the use of a transcutaneous electrical nerve stimulation (TENS) unit. The pain was so severe that it affected patient's blood pressure as well. He required treatment with clonidine 0.4 mg two times daily, metoprolol 125 mg two times daily, and lisinopril 20 mg daily. Over the course of two weeks, it was suggested that the employment of mirror therapy might provide some measure of relief. A vertically supported mirror in a frame was fashioned for easy positioning against his midline chest

with him seated in a chair. In leaning slightly forward, he was able to watch the reflection of his right arm during motions as if doing biceps curls, opening and closing the fist, pronating and supinating the outstretched 'arms', and clapping his hands, while attempting to concentrate on doing these movements as if bilaterally. He performed these maneuvers for 15 minutes at a time at least twice daily. During the mirror therapy course his mother started to clap her hands in synchrony with the patient's movement of his hand towards the mirror. This gave the illusion of not only seeing but also hearing imaginary hand clapping. We encouraged this form of auditory feedback and it was continued throughout his acute rehabilitation stay by his mother and therapist. Although MVF was started initially for the treatment of this patient's PLP, auditory feedback at first performed unintentionally by the patient's mother, was thereafter simultaneously performed along with the mirror therapy. The patient began to report some decrease in the intensity of the left upper extremity phantom limb pain by the end of the second week of his therapy. He rated his maximal pain as 6 out of 10 on the VAS. All pain medications except gabapentin were gradually discontinued in two weeks of mirror therapy. Gabapentin was decreased to 400 mg three times a day.

His blood pressure decreased as well. At the end of the third week he was only on lisinopril 20 mg daily. At the time of discharge, he was only on 5 mg lisinopril daily and gabapentin 300 mg bid. His other rehabilitation goals were met sooner than initially projected, and he was discharged to home with continuation of outpatient mirror and auditory feedback therapy, as well as further outpatient therapy care.

DISCUSSION

In the time since the phrase 'phantom limb' was introduced by Silas Weir Mitchell more than 130 years ago, hundreds of cases have been described. Many studies have sought to elucidate the pathophysiology in attempt to further develop treatments for phantom limb sensation and pain although it still remains poorly understood. In the non amputee, signals sent from the motor and premotor cortex are verified by proprioceptive, sensory and visual feedback. In an amputee there is no verification, resulting in a conflict between the incoming and outgoing of information to the cortex. Mirror therapy may play a role in this sensory feedback through the illusory (mirror) image of the lost limb. Furthermore, auditory feedback created by familiar sounds such as hand clapping may additionally enhance this feedback.

Recently discovered multisensory modulations, activations and connectivity at the earliest stages of perceptual processing may support a multisensory treatment approach to phantom limb and PLP, with the possibility of stimuli congruency contributing even further¹⁰. Shams L (2009) defined congruency as the relationship between stimuli that are consistent with the prior experience of the individual or relationships between senses found in nature¹⁰. For instance, visual illusion of clapping hands is combined with an auditory feedback (the familiar sound created by clapping hands) produced by a therapist or a third person. Another example could be snapping with fingers creating very specific sound produced by the patient himself.

Whether the lessening of PLP in this case was due to the mirror therapy alone or to the combined MVF and auditory feedback is not definite. Further research comparing mirror therapy alone against combined MVF and auditory feedback may be beneficial in answering this question.

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