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Scientific/Clinical Article

Somatosensory rehabilitation for allodynia in complex regional pain syndrome of the upper limb: A retrospective cohort study

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ABSTRACT

Study Design: Retrospective cohort study.
Introduction: Somatosensory rehabilitation is a standardized method of evaluation and conservative treatment of painful disorders of vibrotactile sensation, including the mechanical allodynia and burning pain of complex regional pain syndrome (CRPS).
Purpose of the Study: The purpose of this study was to examine the effectiveness of somatosensory rehabilitation for reducing allodynia in persons with CRPS of 1 upper limb in a retrospective consecutive cohort of patients.
Methods: An independent chart review of all client records (May 2004-August 2015) in the Somatosensory Rehabilitation Centre (Fribourg, Switzerland) identified 48 persons meeting the Budapest criteria for CRPS of 1 limb who had undergone assessment and treatment. Outcomes of interest were the French version of the McGill Pain Questionnaire (Questionnaire de la Douleur St-Antoine [QDSA]), total area of allodynia as recorded by mapping the area of skin where a 15-g monofilament was perceived as painful, and the allodynia threshold (minimum pressure required to elicit pain within the allodynic territory).
Results: This cohort was primarily women (70%), with a mean age of 45 years (range: 18-74). Mean duration of burning pain was 31 months (range: 1 week-27.5 years), and baseline QDSA core was 48. The average primary area of allodynia was 66 cm^2 (range: 2.6-320), and the most common allodynia threshold was 4.0 g. The average duration of treatment was 81 days. At cessation of treatment, the average QDSA score was 20 (effect size Cohen's d = 1.64). Allodynia completely resolved in 27 persons (56% of the total sample where only 58% completed treatment).
Discussion: This uncontrolled retrospective study suggests that somatosensory rehabilitation may be an effective treatment with a large effect size for reducing the allodynia and painful sensations associated with CRPS of the upper limb. More work is in progress to provide estimates of reliability and validity for the measurement tools for allodynia employed by this method.
Level of Evidence: 2c.

Introduction

Complex regional pain syndrome (CRPS) is a neuropathic pain condition; it typically presents with autonomic and inflammatory symptoms accompanying burning pain and sensitivity in a limb.[1,2] Although there is no defining diagnostic test for CRPS, clinical diagnostic criteria are used to assist in the differentiation of the symptoms from the normal sequelae of trauma or nerve injury.[2,3] Although it is often associated with an acute injury, it can

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become chronic in nature.[4,5] Factors associated with poor prognosis include somatosensory changes such as burning pain and allodynia[6,7] as well as motor symptoms such as persistent stiffness and contracture.[5,7] Severe allodynia has been associated with poor response to medical interventions[8] and is a pragmatic barrier to participation in traditional rehabilitation programs. Although physiotherapy and occupational therapy are considered the foundation for management of CRPS,[9-11] there is a need for more evidence-based rehabilitation interventions.[12-14]

Somatosensory rehabilitation is an umbrella term for a standardized method of evaluation and conservative treatment of painful disorders of cutaneous vibrotactile sensation, including mechanical allodynia with or without spontaneous neuropathic pain, as well as the burning or "boiling" pain of CRPS.[15] The theoretical basis is 2-fold: neuropathic pain by definition originates from some form of lesion in the nervous system[16] and somatosensory alterations, including both tactile hypoesthesia and mechanical allodynia, cause pain. Altered somatosensory perception of all signals from this area as pain can be explained by peripheral sensitization and/or central sensitization.[17-19] First proposed over 16 years ago, the key tenets in somatosensory rehabilitation for the identification and treatment of static mechanical allodynia include:

- precise psychophysical evaluation of the skin using a 15-g monofilament to define the territory that is painful to touch;
- formation of an anatomical hypothesis of the peripheral nerve branch(es) underlying the painful territory and contributing to the aberrant afferent pain signalling and perception;
- avoiding reinforcement of the sensitization mechanisms by minimizing evocation of pain by temporarily limiting touch (and consequently functional use) of the painful zone; and
- comfortable somatosensory "counter stimulation" (tactile and/or vibratory) on an anatomically related cutaneous branch (a proximal cutaneous area of the same branch or arising from the same cord of the brachial plexus).[15]

Although the clinical application of somatosensory rehabilitation method (SRM) has been well described in non–peer-reviewed literature,[15,20] to date, there have only been a few peer-reviewed articles focusing on the effectiveness of the technique with specific populations, addressing both allodynia and hypoesthesia across a spectrum of nerve lesions.[21-23] Given the need for clinical modalities to address the allodynia that limits both activities of daily living and participation in rehabilitation for persons with CRPS, this study will seek to evaluate the clinical results of the SRM for this population.

Purpose of the study

Our primary objective was to answer the research question: How effective is somatosensory rehabilitation for allodynia in persons with CRPS of 1 upper limb? However, given this is a novel treatment method, our secondary objective was to explore the theoretical constructs and hypothetical relationships underpinning the method.

Methods

Design and setting

This retrospective study was based on a chart review conducted at a single center (the Somatosensory Rehabilitation Centre) in Fribourg, Switzerland, by an independent investigator (T.P.). All files of clients who were no longer receiving treatment at the center were reviewed, from its opening in July 2004 to August 2015. Clients were referred by a medical doctor, and assessments and treatments followed a detailed clinical protocol (described in the following section). Clients attended a weekly treatment session and were seen on alternate weeks by two occupational therapists trained in the SRM.[15] In this time frame, 14 different therapists were employed at the Somatosensory Rehabilitation Centre and contributed to the client records included in this study.

Subjects

All consecutive patient records identified as (1) meeting the Budapest criteria for CRPS[24] and (2) demonstrating static mechanical allodynia (defined as a painful response to stimulation with a 15-g monofilament) were included in this retrospective cohort, regardless of whether they attended or completed treatment. Persons identified as having CRPS who demonstrated tactile hypoesthesia but no allodynia was not included, as our focus was on allodynia. It is important to note all patients reporting spontaneous neuropathic limb pain are systematically screened using the Budapest criteria as a checklist as part of the initial evaluation at the Somatosensory Rehabilitation Centre, and these results were clearly documented in clinic files.

Outcome measures

The primary outcome measure was the French version of the McGill Pain Questionnaire (QDSA [Questionnaire de la Douleur St-Antoine])[25]; however, if the subject was unable to complete this assessment because of language barriers, other validated translations of the McGill were used. The QDSA is comprised of 58 pain descriptors, with sensory (35 word) and affective (23 word) subscales; words are further arranged in construct clusters (temporal, spatial, thermal, and so forth).[25] The subject is instructed to first choose all words that describe their current pain (yielding a total number of words/58). From these chosen words, the "best" word from each cluster is rated using a 0-4 scale (0 = absent, 1 = mild, 2 = moderate, 3 = strong, and 4 = very strong) to indicate the severity of this pain at the present time. These ratings are summed and converted to *z* scores for ease of interpretation, yielding a total score tQDSA/100, as well as sensory pain score (sQDSA)/100, and affective pain score (aQDSA)/100.

In the SRM, allodynia is quantified in 2 ways: allodynography and the rainbow pain scale.[15,21] Allodynography is a mapping technique using a standard 15-g stimulus (Semmes-Weinstein monofilament: mark 5.18) to outline the borders of the territory where application of the stimulus to the skin produces pain (30 mm on a 100-mm visual analogue scale [VAS], or pain at rest + 10 mm on a 100-mm VAS).[21] The territory of the allodynography is recorded visually on graph paper: see the study by Spicher et al, [21] for a detailed description of the technique. However, the mathematical area of the territory can also be estimated from measurements taken relative to invariant anatomical reference points. To account for the reality of a nonrectangular shape of the allodynic territory, we calculated the area of the allodynia as length (most proximal and distal points identified) × width (most lateral points identified) × 0.66; see Figure 1 for an illustrative example. The rainbow pain scale is a categorical scale rating the severity of the allodynia within the allodynic territory. This is tested with vision occluded by touching the center of the painful area with a series of monofilaments. Starting with the smallest pressure (0.04 g/2.83 log), a single stimulus is applied for 2 seconds with each monofilament (with a 10-second interval between applications), progressing to greater pressure categories (see Figure 2) until the subject indicates that the stimulus has become painful (30 mm on 100 mm visual analogue scale [VAS], or pain at rest + 10 mm on a 100-mm VAS). As soon as a stimulus is painful, the testing is