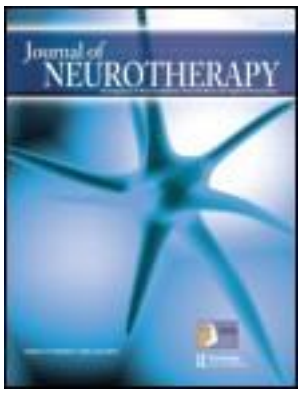

Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

Cranial Electrotherapy Stimulation in the Treatment of Posttraumatic Stress Disorder: A Pilot Study of Two Military Veterans

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Published online: 02 Mar 2012.

To cite this article: Alfred G. Bracciano , Wen-Pin Chang , Stephanie Kokesh , Abe Martinez , Melissa Meier & Kathleen Moore (2012) Cranial Electrotherapy Stimulation in the Treatment of Posttraumatic Stress Disorder: A Pilot Study of Two Military Veterans, Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience, 16:1, 60-69, DOI: 10.1080/10874208.2012.650100

To link to this article: http://dx.doi.org/10.1080/10874208.2012.650100

Journal of Neurotherapy, 16:60–69, 2012

ISSN: 1087-4208 print/1530-017X online
DOI: 10.1080/10874208.2012.650100

Routledge
Taylor & Francis Group

CRANIAL ELECTROTHERAPY STIMULATION IN THE TREATMENT OF POSTTRAUMATIC STRESS DISORDER: A PILOT STUDY OF TWO MILITARY VETERANS

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This case study investigated the effects of cranial electrotherapy stimulation (CES) on the prevalence and intensity of posttraumatic stress disorder (PTSD) symptoms and self-perceived improvement of performance and satisfaction in daily activities in war veterans. Two male Caucasian veterans (ages 54 and 38) diagnosed with PTSD participated in these case studies with a pretest–posttest design. The Canadian Occupational Performance Measure (COPM) and the PTSD Symptom Scale–Interview (PSS-I) were administered before and after the 4-week CES treatment. The participants self-administered the 4-week CES treatment protocol using Alpha-Stim SCS CES device in their home for 20 to 60 min a day, 3 to 5 days a week with a comfortable, self-selected, current level between 100 and 500 microamperes. They were asked to document the settings and responses in a daily treatment log. Through visual trend analysis and change scores, the results revealed daily PTSD symptoms decreased in frequency and severity for both participants from PSSI-I and daily treatment log. Self-perceived efficacy of performance and satisfaction as measured by the COPM also improved in the 54-year-old participant as his change scores (performance: +5.4; satisfaction: +7.9) were over the clinical significance of 2 points of COPM. Both participants reported a decrease in PTSD symptoms and an overall improvement in self-perceived occupational performance after a trial of CES. Findings from this study suggest that future research could contribute to the role of occupational therapists using CES in the treatment of veterans with PTSD. This preliminary study, if confirmed, indicates that CES could provide occupational therapists with a safe and effective way to reduce the symptom burden of PTSD while facilitating occupational performance for a rapidly increasing population of war veterans.

INTRODUCTION

The prevalence of mental health problems due to combat exposure is growing substantially. Greene-Shortridge, Britt, and Andrew (2007) indicated that 30% of soldiers have experienced some type of mental health problems upon returning from the war in Iraq; an estimated ''15 to 17% of troops returning from Iraq in 2004 experienced acute stress or posttraumatic stress disorder (PTSD)'' (Hoge et al., as cited in Green-Shortridge et al., 2007, p. 157). Hoge et al. (2004) indicated that PTSD is becoming a frequent occurrence among this population and health services are indispensible to address mental health problems. The specific mental health problems associated with PTSD include anxiety, insomnia, and depression (Friedman, 2012). Other health-threatening behaviors, such as alcohol and drug use and high-risk behaviors

Received 25 July 2011; accepted 31 October 2011.

Thanks to Dr. Larry Price, PhD, Professor of Psychometrics and Statistics, Texas State University and Dr. Kelli Mu, PhD, Chair, Occupational Therapy Department, Creighton University for their review and assistance with the statistical analysis.

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(e.g., sexual abuse, unprotected sex, and suicide attempts), are also related to or manifested in PTSD (O'Hare, Shen, & Sherrer, 2010). PTSD is caused by multiple etiologies including neurobiological, psychological, and behavioral factors, which can lead to neurobiological dysregulation, thereby altering the functioning of catecholamine, hypothalamic-pituitary-adrenocorticoid, endogenous opioid, thyroid, immune, and neurotransmitter systems (Friedman, 2012).

According to the American Psychiatric Association's (APA's) *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev. [*DSM–IV–TR*]), individuals suffering from PTSD may reexperience the traumatic event through recurring dreams, flashbacks, and hallucinations; may avoid thoughts, feelings, activities, places, and conversations associated with the event; may experience hyperarousal symptoms; and may have feelings associated with depression (APA, 2000). PTSD is also associated with an increased number of both lifetime and current physical symptoms and conditions, which can limit a person's performance in daily life activities and life satisfaction (Tanielian & Jaycox, 2008), which may lead to significant disabilities or impairment in their daily functioning (APA, 2000; Bobo, Warner, & Warner, 2007; Dowben, Grant, & Keltner, 2007). Currently, treatment of PTSD usually involves a multidisciplinary approach, using pharmacotherapy and psychological interventions. A wide variety of pharmaceutical drugs is currently prescribed to treat PTSD (Dowben et al., 2007; Friedman, 2012). Psychological interventions, such as ''desensitizing'' the nervous system and ''learning desensitization,'' are often begun early in the treatment process (Bobo et al., 2007; Friedman, 2012). However, due to the high prevalence of PTSD among military personnel and the challenges and barriers facing practitioners to provide care (Hoge et al., 2004), it would be critical to investigate the treatment effectiveness of additional options that can be applicable to other healthcare providers, such as occupational therapists who can play an important role in meeting the physical and psychosocial challenges resulting from military personnel returning from war (Amaker, Woods, & Gerardi, 2009). Thus, this study examines the use of cranial electrotherapy stimulation (CES), a physical agent modality that is clinically legitimate for occupational therapists to consider as an adjunctive method (Bracciano, 2008).

CES is a safe and innovative modality for treating conditions, such as physical pain, anxiety, and depression, and applies a low-level pulsed electric current through the brain via clip-on electrodes attached to the earlobes (Kirsch & Gilula, 2007). CES employs microcurrent waveforms with different frequencies to alter the electrical activity of the brain, increase state of relaxation and decrease anxiety, insomnia, and depression (Kirsch & Gilula, 2007). Previous studies reveal that CES can induce a calming effect on the brain called an ''alpha state,'' which is a prevailing alpha rhythm of the brain electrical activity that will reduce subjective feelings of anxiety (De Felice, 1997). Because of this alpha state, studies have observed decreased anxiety-provoking symptoms, such as muscle tension and stress (De Felice, 1997; Kennerly, 2004, 2006). In addition, studies indicate that CES appears to influence the limbic system (Gilula & Kirsch, 2005), which has been implicated in the pathology of PTSD (Francati, Vermetten, & Bremmer, 2007; McEwen, 2002). Furthermore, CES can decrease the anxiety, insomnia, and stress that are often manifested in PTSD (e.g., Kirsch & Gilula, 2007; Kirsch & Smith, 2004).

Purpose of the Present Study

Although previous studies provide indirect evidence that CES could decrease symptoms seen in PTSD and modify neural structures associated with PTSD, there is a paucity of information about using CES in veterans with PTSD. In addition, there is no information about changes in daily activity functions due to changes in PTSD symptoms after intervention. The purpose of this pilot study, therefore, was to identify the effect of CES on veterans with PTSD. This study investigates whether CES has an effect on decreasing the occurrence and intensity of PTSD symptoms in veterans and enhanced their self-perceived performance

and satisfaction in daily life activities. We hypothesize that CES would be a useful physical agent modality to decrease PTSD symptoms and enhance daily living performance and satisfaction.

METHODS

Participants

A case study with pretest–posttest design was used. Three participants were recruited from the Forty and Eight, a local Veterans of Foreign Wars Hall, which is an independent honor organization of male and female U.S. veterans committed to promoting the well-being of veterans located in Omaha, Nebraska. These participants were eligible in this study because they have self-reported PTSD diagnosis and prior service in any U.S. military branch. Because one participant failed to complete the study, Table 1 presents only the demographic information of the two participants.

Measurement

Two participants completed both pretest and posttest assessments that identified self-perceived occupational performance, and presence and severity of PTSD symptoms. The Canadian Occupational Performance Measure (COPM) was used to assess self-perceived occupational performance (Law et al., 1998), whereas the PTSD Symptom Scale–Interview (PSS-I; Foa & Tolin, 2000) was used to measure presence and severity of PTSD as defined in the *DSM–IV–TR* (APA, 2000).

The COPM is a standardized measurement tool designed to detect change in a client's self-perception of occupational performance over time (Law et al., 1998). It uses a scale of 1 (significant impairment in ability to perform the activity, the activity has no importance to participant, and he or she is not very satisfied with his or her performance) to 10 (no impairment, the activity is very important to the individual, and he or she is very satisfied with his or her performance). The COPM provides a self-rating of one's (a) ability to perform the identified activities in self-care, productivity, and leisure; (b) personal importance of the identified self-care, productivity, and leisure; and (c) satisfaction with the current performance. The validity and measurement reliability of the COPM have been examined extensively in the context of various situations. Results have supported the reliability with intraclass correlation coefficients for the mean scores for performance: 0.67 (95% confidence interval), and validity for disability and impact profile: 74% validity, and use for clients within various settings (Canadian Association of Occupational Therapists, 2005).

The PSS-I is a 17-item semistructured interview that assesses the presence and severity of PTSD symptoms. It compares favorably to the widely used Clinician-Administered PTSD Scale; the PSS-I exhibits excellent convergent validity in relation to the Clinician-Administered PTSD Scale. Similarly, the PSS-I has been found to exhibit excellent internal consistency and interview-rater reliability and is less time consuming to administer, taking approximately 20 min to complete (Foa & Tolin, 2000).

The PSS-I assesses reexperiencing, avoidance, and hyperarousal symptoms. For example, the PSS-I evaluates symptoms, rating them on a

TABLE 1. Characteristics of Participants

Characteristic	Participant 1	Participant 2
Time since PTSD onset	10 years	10 years
Age	54	38
Sex	M	M
Race/Ethnicity	Caucasian	Caucasian
Educational status (year)	2-year degree	College senior
Marital status	Divorced	Single
Present interventions	Pharmacotherapy	None
Known comorbidities	Fibromyalgia	Bipolar disorder

0-to-3 scale, ranging 0 (*not at all*), 1 (*once per week or less/a little*), 2 (*2 to 4 times per week/somewhat*), and 3 (*5 or more times per week/very much*). An example of a question asked is, ''Have you had recurrent or intrusive distressing thoughts or recollections about [the event]?'' (Foa et al., 2005; Foa & Tolin, 2000).

Procedures

The procedure of this study was approved by the Institutional Review Board of Creighton University. After the procedure of the study was explained and informed consent was obtained from the participants, they completed both the PSS-I and COPM at the laboratory of Creighton University before the CES implementation in their respective homes. To ensure adequate interpretation of the participants' subjective responses to the PSS-I, the study investigators were simultaneously involved in administering the PSS-I and independently scored the PSS-I for the same participant during the interview. To ensure score consistency, they then discussed the participant's responses to determine a final score. The study investigators administered the COPM to both participants in order to maintain consistency with the administration of each assessment.

Before the CES implementation, the study investigator explained the precautions and contraindications of the Alpha-Stim SCS CES devices (Electromedical Products International, Inc., Mineral Wells, TX; http://www.alpha-stim.com) and informed the participants on the application and use of the devices. All participants were advised to self-administer CES in their home for 20 to 60 min a day, 3 to 5 days a week for a duration of 4 weeks (Kirsch, 2007) and set to a comfortable current level between 100 and 500 microamperes. To ensure safety, proper usage of the devices, and thorough data collection, the authors issued each participant a binder consisting of an informed consent form, background information on CES and literature explaining its use with other conditions, a treatment log, and a list of precautions and contraindications. The equipment setup and application were demonstrated as part of the training.

The participants utilized the daily treatment log to document the severity and nature of the symptoms present before and after CES application (i.e., anxiety, decreased concentration), the duration/length of the CES application each day, and the CES electrical current parameters. Each week the study investigators talked by phone with each participant to answer any questions or concerns. Following the 4 weeks of self-administered CES, the participants returned to the university campus to complete the PSS-I and COPM posttests by the same study investigators who administered the pretests. Each participant's posttest results were compared to his own pretest results to identify any significant changes.

Data Analysis

The participants' pretest and posttest scores on the PSS-I and COPM were analyzed using the Statistical Program for Social Sciences program. Because this study was based on a small convenience sample, data analysis used descriptive statistics, a paired samples *t* test, and effect size measures. The alpha level (i.e., Type I error rate) for the paired *t* test was set at .05.

RESULTS

Paired samples *t* tests were conducted to determine if significance reductions occurred on the outcome measures contained in the treatment log (Tomita, 2006). Given a sample size of $n = 2$, the statistical power of any inferential statistical approach was untenable. Therefore, the *t*-test results were to be interpreted as descriptive measures of change only. Alternatively, results from the *t* tests were interpreted in light of practical significance (i.e., effect size expressed as the standardized difference from posttest to pretest within the two subjects); however, interpretation of the effect size should be viewed with caution due to the limited sample size.

Daily Symptom Ratings–Treatment Log

Both participants reported setting the Alpha-Stim SCS to a current level of 250 microamperes in their treatment log. Regarding daily

symptom severity ratings (10-point scale), the average pretest mean severity rating of 6 decreased two thirds over the month-long trial to a posttest mean rating of 2. The results of the paired samples *t* test for daily symptom severity indicated a significant reduction in symptoms ($p < .05$; effect size Cohen's $d = -1.61$). The weekly and overall symptom rating findings for each participant are summarized in Table 2 and Figures 1 and 2. The average decrease in self-rated symptom severity for Participant 1 and 2 during the intervention period were 3.85 and 4.3, respectively. Overall, the participants' daily symptoms improved over the course of the study as indicated by a decrease in self-rated symptom severity.

PTSD Symptom Scale–Interview

Average PSS-I scores for each participant demonstrated a decrease in PTSD symptoms between pretest and posttest assessment. The maximum score possible for the PSS-I is 51 indicating severe PTSD. The mean pretest score for Participant 1 was 34, whereas the mean posttest score was 13, indicating a decrease in severity and presence of PTSD symptomology over the course of the intervention. The mean pretest score for Participant 2 was 29, whereas the mean posttest score was 10, which demonstrated a decrease of PTSD symptomology of approximately two thirds. In addition, the PSS-I is composed of three subcategories (see Table 2 for full listing of the PSS-I and subcategory results for each participant).

Reexperiencing. A decrease between pretest and posttest *Reexperiencing* scores (maximum score = 15) were noted for both participants. For Participant 1 the change score was 5.0, and for Participant 2, the change score was 7.0.

Avoidance. Similarly, symptoms of *Avoidance* (maximum score = 21) also decreased for both Participants 1 and 2. The change score for Participant 1 was 8, whereas the change score for Participant 2 was 4.

TABLE 2. Pretest and Posttest Assessment Measurements

Test	Participant 1		Participant 2	
PSS-I (Range = 0–51)	34	13	29	10
Reexperiencing (0–15)	7	2	9	2
Avoidance (0–21)	15	7	9	5
Increased Arousal (0–15)	12	4	11	3
COPM				
Overall performance/satisfaction	4.6; 2.4	9; 10	5.6; 5.8	5.4; 5.8
Top five occupational performance problems	Finances/Community Management 4; 1 10; 10 Shopping/Socialization 6; 1 8; 10 Work 3; 1 10; 10 Reading 2; 1 8; 10 Volunteering 8; 8 N/A		Personal Care 4; 4 6; 6 Pet Care 10; 10 Hobbies/Leisure 2; 4 5; 7 Volunteering 8; 7 7; 8 Finances 4; 4 5; 4	Home Care 4; 4
COPM pre–post test Change				
Performance	N/A	+5.4		−0.2
Satisfaction	N/A	+7.6		0 (no change)
Daily treatment log (Symptom intensity: 10-point scale)	Pretreatment symptom severity	Posttreatment session symptom severity	Pretreatment symptom severity	Posttreatment session symptom severity
	Average (Range)	Average (Range)	Average (Range)	Average (Range)
Week 1	4.4 (3–8)	0.43 (0–2)	7.4 (7–9)	4
Week 2	3.0 (1–5)	0	7.8 (7–9)	3.9 (3–4)
Week 3	4.2 (2–6)	0.29 (0–1)	8.0 (7–9)	3.5 (3–4)
Week 4	4.9 (3–7)	0.29 (0–2)	8.1 (7–9)	3.3 (3–4)
Monthly average	4.1 (1–8)	0.25 (0–2)	7.9 (7–9)	3.6 (3–4)
Pre–post treatment change	Decrease in severity by 3.85		Decrease in severity by 4.30	

Note. PSS–I = PTSD Symptom Scale–Interview; COPM = Canadian Occupational Performance Measure.

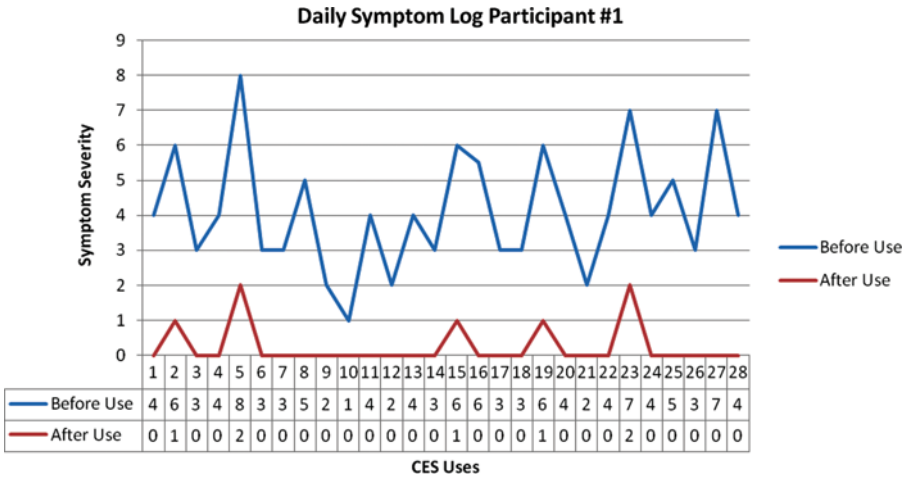

FIGURE 1. Participant 1 daily symptom log. *Note.* CES = cranial electrotherapy stimulation. (Color figure available online.)

Hyperarousal Symptoms. Hyperarousal symptoms also decreased for both participants. Participant 1 had a change score of 8, whereas Participant 2 had a change score of 8.

Canadian Occupational Performance Measure

The identified self-care, productivity, and leisure listed as most important to the participants included Participant 1 with finances/community management, shopping/socialization, work, reading, and volunteering, and Participant 2 with personal care, pet care, home care, hobbies/leisure, volunteering, and finances. Participant 1 stated identical performance areas during both the pre- and posttest assessments; conversely, Participant 2 replaced pet care with home care during the posttest assessment. Table 2 illustrates the COPM assessment results for both participants. For Participant 1, the change score for the performance section of the COPM was +5.4, whereas the change score for the satisfaction section of the COPM was +7.6. For Participant 2, the change score for the performance section of the COPM was −0.2; there was no score change noted for the satisfaction section. The change scores of performance and satisfaction of the COPM

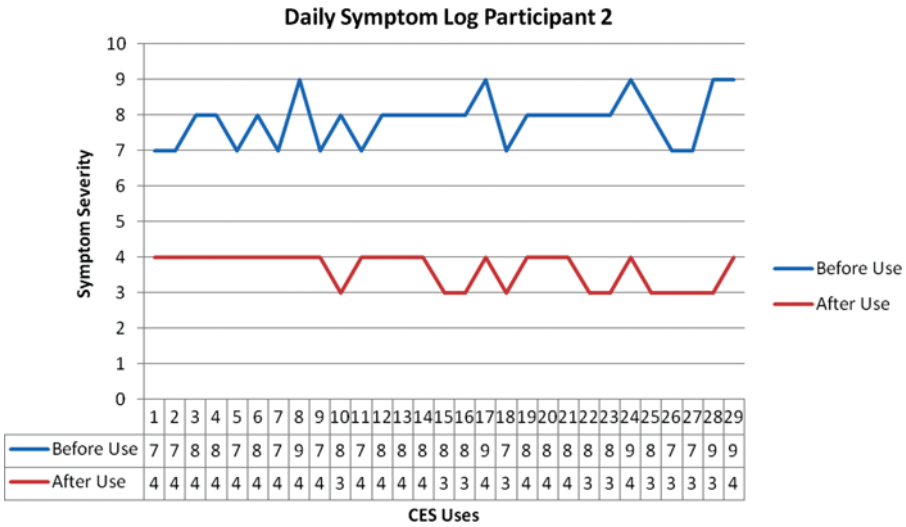

FIGURE 2. Participant 2 daily symptom log. *Note.* CES = cranial electrotherapy stimulation. (Color figure available online.)

for Participant 1 demonstrate clinical significance (i.e., >2 points; Law et al., 1998).

DISCUSSION

The purpose of this study was to examine the effects of CES on the symptoms of PTSD and the self-perceived efficacy of performance and satisfaction in daily activities present among military veterans. The results indicated that CES decreased PTSD symptoms in both veterans with PTSD. However, CES improved the self-perceived performance and satisfaction in daily activities in only one participant.

Symptom Severity in PTSD

Major symptoms of PTSD include chronic anxiety, sleep disturbance, irritability, and feelings associated with depression (Friedman, 2012). Overall, the severity of the participants' daily symptom ratings (i.e., impaired concentration, anxiety, irritability, and insomnia) as identified in the treatment log decreased over the course of the study. The PSS-I scores for each participant also illustrated a difference between the pretest and posttest assessment. Specifically, there was a decrease in Reexperiencing scores for both participants after intervention when compared to scores before the 4-week CES intervention. According to the *DSM–IV–TR* (APA, 2000), the traumatic event is reexperienced by means of recurrent dreams or memories, flashbacks, hallucinations, or distress during exposure to a symbolic event or location. The results of the present study also revealed a decrease in symptoms between pretest and posttest Avoidance scores. The *DSM–IV–TR* (APA, 2000) indicates that persons expressing symptoms of Avoidance may avoid thoughts, feelings, activities, places, and conversations associated with the traumatic event and may express diminished interests in prior meaningful occupations.

The results also demonstrated a decrease between pretest and posttest Increased Arousal scores. Persons experiencing Hyperarousal symptoms may experience difficulty sleeping, irritability, impaired concentration, increased startle response, and hypervigilance, all key components of PTSD (APA, 2000). Participants in the current study demonstrated reduced Increased Arousal scores, which are consistent with the findings of previous studies (Kirsch & Gilula, 2007; Smith, 2001; Southworth, 1999).

Overall, these results were consistent with prior studies that demonstrated the effectiveness of CES on symptoms of anxiety/hyperarousal, irritability, sleep disturbance, and impaired concentration (e.g., Bystritsky, 2009; Gilula & Kirsch, 2005; Kennerly, 2006; Kirsch & Gilula, 2007; Kirsch & Smith, 2004; Smith, 2001; Southworth, 1999) as well as decreased muscle tension, agitation (Childs & Price, 2007), and stress (Giordano, 2006). Thus, the present study supported the use of CES as a treatment for common symptoms seen in PTSD, such as anxiety/hyperarousal, irritability, sleep disturbance, and its impact on performance and satisfaction in daily activities.

Impact of PTSD on Performance and Satisfaction

Because PTSD may significantly impair performance and involvement with daily tasks (APA, 2000; Bobo et al., 2007; Dowben et al., 2007), the pretest and posttest of the COPM assessment scores were analyzed. In the COPM, participants identified areas of difficulty in work, socialization, and personal care (see Table 2). However, only Participant 1 demonstrated a clinically significant change in his self-perceived performance and satisfaction.

It is important to note that although the COPM is designed to accommodate an individual's changing daily life by allowing substitutions within chosen daily life activity areas, this may have affected the overall performance and satisfaction scores of Participant 2 as he rated a differing performance area during the posttest assessment when compared to his pretest assessment. The length of the study may also have affected the individual's results on the COPM, as other studies have indicated that it may take longer for people to recognize their own renewed abilities such as improvements in sleep, mood, and pain (Cork et al., 2004).

However, we believe that CES may have the potential to improve performance and

satisfaction with daily activities enhancing the individual's overall quality of life due to the significant change in PTSD symptoms. Further research is needed to determine the potential for CES to improve performance and satisfaction with daily activities and quality of life due to the limited sample size of the study.

Limitations

The study is limited to participants in one location; therefore, it may not generalize to other states in which PTSD is managed differently, or in states where physical agent modalities are not included in the occupational therapy scope of practice. Furthermore, the sample size was both small ($n = 2$) and based on one of convenience. Participant bias may also impact the results of the study, as several outcome tools are self-rating scales. In addition, because the participants self-administered the treatment at home for 20 to 60 min a day, 3 to 5 days a week for a duration of 4 weeks, it is difficult to determine whether they were fully compliant with the CES protocol.

Implications for Clinical Practice

PTSD has become one of the signature wounds of the wars in Iraq and Afghanistan impacting a variety of daily activities and the performance of these activities, as well as the families and communities of these individuals. The occupational therapy profession supports the recognition of and intervention services for military personnel coping with combat-related PTSD (Amaker et al., 2009). Because this disorder may lead to significant disability or impairment in daily life functioning, health care professionals must prepare for the challenges presented by these recent wars and assist in minimizing the negative effects on both military personnel and society by providing an effective PTSD intervention as an adjunct or alternative to conventional psychological and/or pharmaceutical approaches.

The findings of this CES study may also suggest that occupational therapists and other healthcare clinicians consider using CES, a category of physical agent modalities, in the treatment and scope of practice for PTSD. Consideration of state licensing regulations requiring advanced certification in the use of physical agent modalities such as CES must be taken into account before use of this modality as a component of treatment by occupational therapists (McPhee, Bracciano, & Rose, 2008).

As the current conflicts in Afghanistan continues, the personal and social cost of PTSD on returning veterans and their families will escalate. If future research with appropriate sample size demonstrates the effectiveness of CES on improving the daily functioning in clients with PTSD, it may be necessary to include this in the professional educational training of physical agent modalities for practitioners and students in healthcare professions.

Future Research Directions

It is recognized that there is a great need for more research on the use of CES in the management of PTSD. A broader sample size including a larger number of participants from various geographical locations could be used in future research to extend the findings. In addition, further studies should utilize randomized controlled trials to account for placebo effects with the intervention. Because the current study recruited any military personnel who served during any war, it may be beneficial for future research studies to focus only on soldiers serving in the current wars in the Middle East.

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