Improving Access to Care for Women Veterans Suffering from Chronic Pain and Depression Associated with Trauma

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Abstract

Objective. Access to care has become a priority for the Veterans Administration (VA) health care system as a significant number of veterans enrolled in the VA health care system reside in rural areas. The feasibility and effects of a novel clinical intervention that combined group therapy and biofeedback training was evaluated on women veterans living in rural areas.

Methods. The study was conducted at selected community-based outpatient clinics (CBOCs) in Texas. Thirty four women veterans with chronic pain and comorbid depression and/or posttraumatic stress disorder (PTSD) were recruited. Five sessions of education/therapy were delivered via telemedicine in combination with daily home practice of a portable biofeedback device (Stress Eraser®, Helicor, New York, NY, USA). Participants responded to self-report questionnaires at baseline, at posttreatment, and at 6-week follow-up. Daily practice logs were also maintained by participants.

Results. The clinical protocol was acceptable, easy to administer, and associated with statistically significant decreases in self-reported pain unpleasantness, pain interference, depressive symptoms, PTSD symptoms, and sleep disturbance at posttreatment. Improvements were maintained at 6-week follow-up. Qualitative analyses indicated that many participants 1) wished to continue to meet as a support group in their respective CBOCs and 2) felt less isolated and more empowered to cope with their problems of daily living as a result of the treatment.

Conclusions. It is feasible to provide treatment to women veterans living in rural areas by utilizing video-teleconferencing technology between larger VA medical centers and facilities at CBOCs in more rural settings. A controlled trial of the intervention is warranted.

Key Words. Rural; Women Veterans; Chronic Pain; Depression; Trauma; Biofeedback

Living in rural areas is one of the greatest barriers impeding access to health care [1,2] and has contributed to the underutilization of care by veterans who need these services [3]. Approximately 41% of 8 million veterans enrolled in the Veterans Administration (VA) health care system reside in rural or highly rural areas of the country [4,5]. The VA conceptualizes rural as areas that are not designated as urban as in the Census and highly rural as communities with less than seven civilians per square mile [2]. The disparities in health care for individuals living in rural compared with urban areas has been found to be
associated with reduced health-related quality of life [3]. In an effort to serve rural veterans, the VA health care system instituted and opened 800 community-based outpatient clinics (CBOCs) around the country to provide rural veterans with primary, mental health, and specialty care [2].

Pain management remains as one of the most important health care needs of our veterans. For example, 47% of 1,800 veterans who returned from duty after serving in the Iraqi and Afghanistan theaters reported experiencing pain, and 59% of those exceed the VA clinical threshold of 4 on a 0–10-point numeric pain rating scale [6]. In another sample of veterans seen in a polytrauma site, pain was present in 71% of those exposed to blast trauma [7]. Along with persistent and chronic pain, a substantial portion of veterans exposed to combat develop posttraumatic stress disorder (PTSD) and comorbid depression [8].

In addition, women veterans are currently one of the fastest growing groups in the VA system [9]. In 2010, there were total 1.84 million women veterans [10]. Texas currently possesses the second largest population with 158,500 women veterans [11]. Empirical evidence suggests that women are more likely than men to meet criteria for PTSD following traumatic events [12] and on average, report greater PTSD symptomatology [13]. Women veterans have also been subjected to military sexual trauma (MST) at greater rates than their male counterparts [14]. Research has indicated that due to the high frequency of depression and MST, there is an increasing need for treatment for physical and comorbid mental health issues that may result from military service of women veterans [15]. There is also evidence that women veterans have a higher prevalence of pain compared with male veterans [15]. Moreover, individuals who experience chronic pain and have a history of trauma may also be significantly at risk for developing major depressive disorder [16–18]. Thus, the comorbidity and strong associations among depression, PTSD, and chronic pain [15,19,20] support the need for interventions that simultaneously target all three conditions.

One possible reason for the significant overlap among PTSD, pain, and depression symptoms is that all three may share similar biological exacerbating mechanisms. This possibility is supported by the link between the sympathetic hyperarousal (decreased regulation of the hormone norepinephrine) and altered hypothalamic-pituitary-adrenal axis functioning, alteration in the endogenous opioid system, and sleep disturbance [21]. Thus, autonomic nervous system (ANS) dysregulation, characterized by a high baseline state of autonomic hyperarousal and decreased parasympathetic activity, is a potential pathogenic mechanism factor that could potentially contribute to the development and maintenance of depression, PTSD symptoms, and chronic pain.

Heart rate variability (HRV) is one component of the ANS and has often been used as an indicator of ANS dysregulation. There is also preliminary evidence that depressed HRV might be a major contributing factor of PTSD and chronic pain. For example, Tan and colleagues reported that a group of returning veterans had depressed HRV, relative to available normative data [7]. Tan and colleagues later reported that veterans with PTSD showed significantly depressed HRV and that HRV biofeedback significantly reduced PTSD symptoms, particularly those in the avoidance and emotional numbing cluster [22]. HRV biofeedback has also been reported by other investigators to reduce symptoms of PTSD [23], chronic pain in patients with fibromyalgia [24], and depressive symptoms [24,25]. The device utilized in this study to increase HRV—the Stress Eraser® (SE; Helicor, New York, NY, USA)—has been shown to decrease subjective stress-related complaints and increase work performance in community samples [26].

In addition to interventions that increase HRV, education and group therapy also have a track record for benefiting PTSD symptoms, pain, and depression [27,28]. However, access to ongoing group and education interventions has been limited for women veterans residing in rural settings partly due to the distance and partly due to the discomforts they have participating in mental health services dominated by male veterans. For example, Ouimette and colleagues reported that women veterans who were sexually victimized in the military services are less likely to utilize VA health care services [29]. One method of making education/support therapy groups more accessible is to offer gender-specific treatment interventions utilizing telemedicine technology, which has become more readily available in VA settings. Studies have shown that the use of telemedicine has been successfully applied to the treatment of a number of chronic medical conditions and disabilities [30]. Despite its increasing availability, however, the new technology has not yet been widely used.

This study was designed to evaluate the feasibility of an innovative treatment for women veterans residing in rural settings and who suffer from chronic pain and/or depression associated with trauma. The treatment protocol combined biofeedback training and education/support group therapy delivered via video-teleconferencing. We hypothesized that the treatment protocol would be acceptable to the women veterans and would be associated with significant reductions in chronic pain (as indicated by improvements in measures of pain intensity, pain unpleasantness, and pain interference), symptoms of PTSD, and depressive symptoms. As secondary exploratory analyses, the study also sought to explore the effects of the intervention on sleep disturbance, which is a symptom often associated with chronic pain, PTSD, and depression, in order to determine if such an outcome should be included in future clinical trials testing the efficacy of the intervention. The study also conducted exploratory investigation of the frequency of SE use, reported immediate changes from the SE use, and associations among them.
Methods

Design

This study compared pretreatment with posttreatment self-reported measures to assess changes associated with the intervention. The intervention consisted of 6 weeks of home practice with the SE biofeedback device, where participants kept a log of their daily practice of the SE. The biofeedback training was coupled with weekly clinical video-teleconference (CVT) support sessions. A follow-up assessment was conducted 6 weeks after the final session to determine if the subjects maintained any improvement in the outcome measures for at least the short term. The study also used focus groups to determine participant acceptability of the SE device and their acceptability of CVT. The study used a convenience sample of women veterans living in rural areas served by the Conroe and Lufkin Texas CBOCs who expressed interest in the study.

Participants

Women veterans were recruited through 1) physician referrals from two VA CBOCs affiliated with the Michael E. DeBakey VA Medical Center (MEDVAMC) in Houston, Texas, and 2) posters and flyers displayed at the CBOCs and at the main MEDVAMC. To be eligible, the participants had to: 1) be veterans residing in rural areas served by the CBOCs in Conroe and Lufkin, Texas; 2) have a chronic pain condition; and 3) have either PTSD or depression, or both. Individuals were excluded for: 1) the presence of acute or cancer-related pain; 2) significant cognitive impairment; 3) current alcohol or substance abuse; or 4) severe psychopathology (e.g., hallucinations or active psychosis) that would prevent the individual from following basic instructions and requirements of the study.

Device and Telehealth Technology

Biofeedback

The study used the SE (see Figure 1) as an aid for training participants to increase HRV. The SE is a small, portable, pocket-sized biofeedback device available for consumer purchase. Approved by the Food and Drug Administration as a Class II 510(k) notification exempt medical device for relaxation training and stress reduction, the device utilizes operant conditioning principles to assist the users to breathe in resonant frequency with the aid of visual and auditory signals. The SE has a built-in mechanism whereby participants automatically earned SE (performance) points for each “correct” breath approximating the resonant frequency of 6 breaths per minute. Each individual has a unique breathing rate, called resonant frequency (around 6 breaths per minute). While resonant frequency varies slightly from individual to individual, it typically ranges from 5.5 to 7 breaths per minute [31]. Breathing at one’s resonant frequency has been shown to increase HRV [32], which in turn has produced beneficial effects such as reduction in depressive, anxiety, and pain symptoms. For instance, the SE has been shown to be accurate in detecting cardiac rhythms [33] and to be effective in 1) increasing HRV associated with reductions in PTSD symptoms [7,23], 2) reducing persistent pain associated with fibromyalgia [24], and 3) improving sleep quality [34,35]. To the authors’ knowledge, no studies have been published reporting the reliability of the biofeedback device for measuring HRV.

Telehealth Technology

The study used existing VA video-teleconference equipment (PolyCom VSX 5000, Polycom, Inc., San Jose, CA, USA) already installed in conference rooms at MEDVAMC and CBOCs. With T-1 bandwidth connections between the main hospital and the local clinics, adequate video quality with minimal lag time was experienced. The facilitators in Houston and the participants at the local CBOC could adjust the camera at their respective endpoints during sessions to allow individual close-ups or wide-angle views of the entire room. To maintain patient confidentiality, all video-teleconferencing connections were established using the VA private network, a highly secured electronic communication network behind the VA firewall. On-site technical support was available for each session.

Measures

Screening Measures

Cognitive impairment was evaluated using the Short Orientation–Memory–Concentration Test of Cognitive Impairment (SOMC), a validated brief six-item screening measure of cognitive impairment. Elements of the
Pain Intervention for Rural Women Veterans

Presence of psychopathology or substance abuse were evaluated using the Mini-International Neuropsychiatric Interview (M.I.N.I.), a brief structured interview that is widely used by clinicians to screen for psychiatric disorders based on the Diagnostic and Statistical Manual of Mental Disorders, Version IV (DSM-IV) classification [38]. The M.I.N.I. consists of 21 items and is designed to elicit information on depression, anxiety disorders, suicidal ideation, PTSD, alcohol/substance abuse, auditory and/or visual hallucinations, and paranoia. The M.I.N.I. was used in conjunction with existing VA electronic patient records to determine eligibility (i.e., no suicidal/homicidal ideation, alcohol or substance abuse, or active hallucinations). Sheehan et al. reported 85% agreement overall between expert psychiatrist diagnoses and M.I.N.I. diagnosis results. Additionally, they reported high concordance with other widely used standard clinical interviews that are longer, such as the Structured Clinical Interview for DSM-IV. Further, negative and predictive values were 0.85 or higher, and sensitivity was 0.70 or greater for their study’s diagnosis categories [38].

Study Outcome Measures

PTSD symptoms were measured using the PTSD Check List—Civilian version (PCL-C), a 17-item self-report instrument that is used to measure levels of distress associated with PTSD symptoms over the past 30 days [39]. Respondents answer the items on a five-point scale (1 = not at all, 5 = most or all of the time), resulting in scores ranging from 17 to 85 (higher scores indicating greater PTSD symptoms). The PCL-C has demonstrated high internal consistency (α ranging from 0.85 to 0.94) and test-retest reliability [40].

Depression symptoms were measured using the 10-item Center for Epidemiological Studies—Depression Scale (CES-D 10), a self-report scale [41]. The CES-D 10 measures the presence and severity of depression by asking respondents to endorse the frequency of symptoms experienced in the past week on a four-point scale (0 = rarely or none of the time, 3 = most of the time), resulting in scores ranging from 0 to 30 (higher scores indicating greater depression symptoms). The CES-D 10 has also been found to have good predictive accuracy (Kappa = 0.97) and test-retest reliability (r = 0.71) [41].

Pain intensity and unpleasantness were measured using adapted versions of measures sensory intensity and affective magnitude of pain [42]. Pain intensity refers to the magnitude of felt pain, and pain unpleasantness refers to how unpleasant or disturbing the pain is. In the current study, participants were asked to rate their average pain intensity and unpleasantness in the past 7 days on a 10-point numerical scales (1 = no pain at all, 10 = the most intense or unpleasant pain imaginable). Pain interference was measured using four-item Pain Interference Short Form v1.0 of the Patient-Reported Outcomes Measurement Information System [43]. The items selected asked participants to rate the magnitude of pain interference with day-to-day activities, work around the home, ability to participate in social activities, and enjoyment of life. The items were answered on a five-point scale (1 = not at all, 5 = very much), summed to result in a score that could range from 4 to 20, and converted to a T-score.

Sleep disturbance was assessed using the Medical Outcomes Study Sleep measure [44], a 12-item scale that asks the respondent to recall the quantity and quality of sleep over the past month, including questions on sleep disturbance, snoring, perceived sleep adequacy, daytime somnolence, and feeling rested, and awakening short of breath or with a headache. The nine-item Sleep Problem Index was computed for this study. The Medical Outcomes Survey Sleep Problem Index has been found to be reliable and valid, with internal consistency coefficient estimates of over 0.73 among a sample of 1,011 US adults [45].

Daily SE Practice Monitoring

In addition to the other outcome measures, all participants were asked to complete daily practice log in conjunction with daily SE practice. Using the form, participants were instructed to record the date and duration of practice, the SE points earned during each practice session, and a prepractice and postpractice ratings on their well-being. Specifically, participants rated pain intensity and pain unpleasantness on a seven-point Likert scale, as well as responded “yes/no” to the questions of “less distressed mood” and “less anxiety” after each practice session.

Procedure

After receiving referrals, potential participants were screened for eligibility by telephone using an Institutional Review Board-approved structured interview. Eligible subjects were invited to the next scheduled orientation meeting for the treatment group at the CBOC closest to their home. Those who could not attend were wait-listed to be invited to the next orientation meeting. Participants in the treatment group attended five group sessions in 6 weeks (once per week at their local CBOC).

The first session consisted of a face-to-face group orientation consisting of an overview of project goals and expectations, informed consent enrollment, the completion of baseline surveys, and SE biofeedback device training (including completion of a SE daily practice log). The four subsequent sessions, each lasting approximately 90 minutes, consisted of CVT group-based treatment that included continued training with the SE biofeedback device, education, pain-coping skills training, and support.
elements. The number of sessions was chosen to balance the need for the intervention to be long enough so patients can master the SE usage and gain benefit from group therapy, and the need to minimize participant burden.

Each session (after the introductory session) began with the group facilitator eliciting questions or concerns regarding SE use. Each session had educational information delivered in a style that encouraged discussion among the group members. The educational content of each of the group sessions are as follows:

- Session 2 focused on the definition and symptoms of chronic pain, depression, and PTSD, as well as on proposed mechanisms that may maintain these conditions, and the history/background of the participant’s chronic pain;
- Session 3 focused on the topics of values and acceptance drawn from acceptance and commitment therapy techniques;
- Session 4 focused on cognitive behavioral strategies that can be used to cope with chronic pain, depression, and trauma; and
- Session 5 focused on utilizing mindfulness relaxation and imagery skills to cope with the chronic pain.

In between each weekly session, the participants were contacted twice by phone to ensure daily practice of biofeedback, as well to identify and troubleshoot problems with the SE. These phone calls generally lasted no more than 5 minutes, and in cases where participants were unreachable, a voice message was left requesting them to return the call if they had any issues with or questions about the SE. The last session was conducted face to face and involved completing posttreatment surveys, a focus group, and debriefing session. Topics discussed during the focus group included the acceptability of treatment delivered via video-teleconference technology, general feedback about the treatment, and suggestions for future treatments. Participants were also asked to complete the same set of survey questions a third time at 6 weeks posttreatment.

Data Analyses

Sample size calculations were obtained using effect size estimates of past studies that have found smalleffect sizes using similar biofeedback interventions on reducing pain, PTSD, and depression. A power analysis indicated that a sample size of 25 was required to detect a significant reduction in all three target symptoms (based on 80% power). Independent t-tests and Pearson’s chi-square tests were conducted to compare characteristics between participants who completed treatment and who dropped out. For the primary and secondary treatment outcome variables, data were analyzed by utilizing analyses of variance and paired sample t-tests. Effect sizes were calculated between: 1) pretreatment and posttreatment, and 2) pretreatment and 6-week follow-up. As secondary exploratory analyses, the SE logs were compiled and the findings were presented. Additionally, bivariate correlations were conducted to examine the associations between SE use and the outcome variables of the study.

Results

The study initially recruited 34 female veteran patients with chronic nonmalignant musculoskeletal pain living in rural areas in Texas under the care of the MEDVAMC in Houston, Texas. Three waves of treatment were conducted at two CBOCs, totaling six treatment groups in 2010. Seven participants withdrew before completion of treatment. Independent t-tests indicated a nonsignificant difference between the dropouts and completers in baseline self-reported pain intensity, t(32) = −0.53, pain unpleasantness, t(32) = −0.61, pain interference, t(32) = −1.66, depressive symptoms, t(32) = −1.09, and PTSD symptoms, t(32) = −0.96, all Ps not significant (n.s.). Further chi-square tests revealed that key demographic variables were not significantly related to dropout/completer rates, such as ethnicity, \( \chi^2(3) = 4.68 \), marital status, \( \chi^2(4) = 7.86 \), employment status, \( \chi^2(5) = 2.81 \), and history of MST, \( \chi^2(1) = 0.17 \), all Ps n.s. However, to be conservative, we have adopted the last observation carried forward statistical technique and replaced missing data with recruited participant’s most recent assessment values. The demographic characteristics of participants are presented in Table 1.

A summary of the mean and standard deviation scores of the outcomes measures taken at baseline, posttreatment, and at 6-week follow-up are presented in Table 2. Mauchly’s test indicated that the assumption of sphericity has been violated for the main effects of pain intensity, \( \chi^2(2) = 6.91, P < 0.05 \), and pain interference, \( \chi^2(2) = 7.40, P < 0.05 \). Therefore, degrees of freedom were corrected using Huynh–Feldt estimates, with \( \epsilon = 0.88 \) for the main effect of pain intensity and 0.87 for pain interference. The effect sizes from pretreatment to posttreatment, as well as pretreatment to 6-week follow-up are also presented. As can be seen, pain intensity did not significantly decrease from pretreatment to posttreatment, or pretreatment to follow-up. However, statistically significant improvements were found in pain unpleasantness, pain interference, depressive symptoms, PTSD symptoms, and sleep disturbance. These improvements appeared to be maintained at 6-week follow-up. The effect sizes for significant effects ranged from 0.21 to 0.55, all in the small to medium effect size range [46].

Descriptive results of the SE log during the 6-week program (42 days) are presented in Table 3. As can be seen, SE usage frequency and SE points obtained were highly variable, and associated with an average prepractice to postpractice session reduction of 0.5–0.6 points (on 10-point scales) in the pain ratings.

Bivariate correlation analyses of frequency of SE use, SE points, and the immediate SE use outcomes are presented in Table 4. Frequency of SE use and SE points were associated with pretreatment to posttreatment
decrease in pain intensity (moderate association) and pain unpleasantness (weak association), although these results were not statistically significant. Frequency of SE use was significantly associated with decrease in distressed mood and decreased anxiety, while SE points obtained was significantly associated with decrease in distressed mood. Additionally, decrease in distrusted mood and anxiety were strongly associated with decrease in pain intensity and pain unpleasantness.

Focus Group Summary

Focus groups conducted at the completion of the treatment protocol revealed several common themes. First, many of the participants commented that they found the CVT sessions to be just as acceptable as in-person sessions. Although a novel experience to see the group facilitator over the video-teleconferencing screen at first, they found it easy to adapt. A few participants said that

Table 1  Demographic and characteristics of the sample (N = 34)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>N (%)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>49.5 (10)</td>
<td></td>
<td>22–67 years</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>21 (61.76%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>9 (26.47%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4 (11.77%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>15 (44.12%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>12 (35.29%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single or widowed</td>
<td>7 (20.59%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not working due to pain</td>
<td>18 (52.94%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>7 (20.59%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homemaker</td>
<td>4 (11.76%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>5 (14.71%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving service-connected disability</td>
<td>18 (52.94%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received prior treatment for pain</td>
<td>27 (79.41%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical record diagnoses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic pain</td>
<td>34 (100.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressive disorder</td>
<td>20 (79.41%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttraumatic stress disorder</td>
<td>7 (20.59%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endorsed military-related sexual trauma</td>
<td>12 (35.29%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M = mean; SD = standard deviation.

Table 2  Mean (SD), F values, and effect sizes of outcome measures at posttreatment and 6-week follow-up for all 34 recruited participants, where missing data were dealt using the last observation carried forward method

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
<th>6-week Follow-Up</th>
<th>F Value</th>
<th>d₁</th>
<th>d₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain intensity</td>
<td>6.78 (2.14)</td>
<td>6.18 (2.34)</td>
<td>6.29 (2.43)</td>
<td>1.92</td>
<td>0.27</td>
<td>0.21</td>
</tr>
<tr>
<td>Pain unpleasantness</td>
<td>7.24 (2.35)</td>
<td>6.29 (2.64)</td>
<td>6.26 (2.61)</td>
<td>4.73**</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Pain interference</td>
<td>66.90 (7.66)</td>
<td>63.71 (7.22)</td>
<td>63.80 (9.17)</td>
<td>6.72**</td>
<td>0.43</td>
<td>0.37</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>18.57 (7.04)</td>
<td>15.29 (6.50)</td>
<td>14.94 (7.08)</td>
<td>8.40***</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>PTSD symptoms</td>
<td>52.32 (15.90)</td>
<td>45.69 (15.43)</td>
<td>43.32 (16.68)</td>
<td>11.89***</td>
<td>0.42</td>
<td>0.55</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>75.96 (21.53)</td>
<td>68.21 (25.06)</td>
<td>69.21 (26.54)</td>
<td>3.86*</td>
<td>0.33</td>
<td>0.28</td>
</tr>
</tbody>
</table>

* P ≤ 0.5; ** P ≤ 0.01; *** P ≤ 0.001.

d₁ = effect size from pretreatment to posttreatment; d₂ = effect size from pretreatment to 6-week follow-up.

PTSD = posttraumatic stress disorder; SD = standard deviation.
because other participants were in the room with them during the session, they experienced a sense of being a “group.”

Next, most participants reported that they appreciated having access to treatment services closer to home. For many of these participants, the travel time back and forth from their home to the larger VA medical center would have far exceeded the time spent in group, which becomes a deterrent to them obtaining treatment. They also cited unfamiliarity with roads in a large city, high-volume traffic, and parking difficulties as factors that discourage them from seeking specialty treatment for their conditions.

Subsequently, a majority of participants across the treatment groups reported that they enjoyed being in a group specifically for women veterans. A few women veterans reported attempting to attend treatment groups for PTSD at some point or other; however, they usually found themselves a minority in a group consisting of mostly male veterans. Some of the participants stated feeling validated that they had a specific group that allows them to share their experiences and to draw strength from other women veterans who they can relate to more easily. In several of the treatment groups, participants started to exchange contact information with one another without the prompting of the group facilitator. They were interested in continuing to meet after the treatment group had ended.

**Discussion**

The aim of the current study was to examine the feasibility, acceptability, and potential effectiveness of providing treatment to women veterans using a novel treatment protocol that combines biofeedback training and group therapy delivered via video-teleconferencing. In the current study, 34 women veterans living in rural areas of Texas who had presented with chronic pain combined with PTSD, depression, or both were provided treatment.

The findings indicate that it is feasible to provide treatment to veterans living in rural areas by utilizing video-teleconferencing technology between larger VA medical centers and facilities at CBOCs in more rural settings. Relatively minor costs were incurred as the study utilized existing video-teleconferencing equipment. The biofeedback equipment itself did not cost substantially much.

**Table 3** Descriptive results of the Stress Eraser log

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean/Rate</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of SE use</td>
<td>3</td>
<td>95</td>
<td>31.93</td>
<td>18.02</td>
</tr>
<tr>
<td>Stress Eraser points</td>
<td>51</td>
<td>3,604</td>
<td>1,620.93</td>
<td>1,022.76</td>
</tr>
<tr>
<td>Change in pain intensity</td>
<td>0.33</td>
<td>-2.26</td>
<td>-0.53</td>
<td>0.68</td>
</tr>
<tr>
<td>Change in pain unpleasantness</td>
<td>0.33</td>
<td>-2.31</td>
<td>-0.58</td>
<td>0.69</td>
</tr>
<tr>
<td>Post-SE use reports (yes/no)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved mood</td>
<td></td>
<td>51%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved anxiety</td>
<td></td>
<td>40%*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Rates of improved mood and anxiety levels post-SE use was calculated by dividing the number of times participants endorsed “yes” by frequency of Stress Eraser use.

SD = standard deviation; SE = Stress Eraser.

**Table 4** Bivariate correlation analyses of Stress Eraser factors and pre- to post-Stress Eraser use

<table>
<thead>
<tr>
<th></th>
<th>SE Use</th>
<th>SE Points</th>
<th>Decreased Pain Intensity</th>
<th>Decreased Pain Unpleasantness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of SE use</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE points</td>
<td>0.50**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased pain intensity</td>
<td>0.35</td>
<td>0.31</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Decreased pain unpleasantness</td>
<td>0.17</td>
<td>0.15</td>
<td>0.75***</td>
<td>1</td>
</tr>
<tr>
<td>Decreased distressed mood</td>
<td>0.43*</td>
<td>0.44*</td>
<td>0.58***</td>
<td>0.53**</td>
</tr>
<tr>
<td>Decreased anxiety</td>
<td>0.44*</td>
<td>0.36</td>
<td>0.58**</td>
<td>0.59***</td>
</tr>
</tbody>
</table>

Note: SE points refers to points earned with accurate synchronized breathing to the biofeedback device, with more points indicating better performance.

* $P \leq 0.5$, ** $P = 0.01$, *** $P \leq 0.001$.

SE = Stress Eraser.
Although a considerable amount of resources, i.e., time and energy, were utilized at the initial stage of the study to coordinate the logistics of the video-conferencing, and in training to use the video-conferencing equipment, there were minimal disruptions that occurred once the procedures were put into place. There were no technical problems encountered, and the quality of the communication over teleconferencing was good. The attrition rate of 20% is comparable with other interventions for chronic pain, with two meta-analyses reporting rates between 19% and 26% [47,48].

Effective communication between health care providers in the larger VA medical center and the CBOCs to facilitate the setup of treatment services for the veterans was an exceptionally important factor of the success of treatment delivery. This included factors such as advertisement of the program and referral from health care providers at the local CBOCs, coordination of time and venue for treatment sessions, and general support (via phone) for the veterans attending the treatment sessions. As we expected, the need for support over the phone (i.e., reminders to practice the SE daily as well as assistance in troubleshooting issues with the SE) gradually tapered through the 6-week treatment period. As such, we think that investing in such phone support is an important aspect of telehealth services to ensure treatment adherence and quality health care.

Subsequently, the treatment protocol that aimed to alleviate symptoms of chronic pain, depression, and trauma for women veterans was well-accepted by participants of the current study. Focus groups conducted at the end of each treatment group indicated that a majority of the participants thought that receiving treatment via video-teleconferencing was just as effective as it would have been had the treatments been provided in person. The veterans also reported being appreciative of being able to receive treatment at their local CBOCs, which takes less travel time to get to the VA medical center. Several participants across several groups of treatment showed interest in continuing to meet as a group after the 6-week treatment group had ended. According to the participants, having a support group specifically for women veterans made them feel special and better addressed the issues they were facing. The veterans found the ability to create peer relationships where they are able to relate to one another particularly beneficial.

The treatment protocol in the current study, which combined biofeedback training using the SE with group therapy, was associated with improvement in a number of key outcomes. Moreover, these improvements were maintained at 6-week follow-up. Although results indicated a nonsignificant decrease in self-reported pain intensity, there were statistically significant decreases in self-reported pain unpleasantness, pain interference, depressive symptoms, PTSD symptoms, and sleep disturbance posttreatment. The findings are consistent with previous findings, showing that biofeedback that aimed to increase HRV can improve trauma-related and pain-related symptoms [22–24]. In addition, the treatment effect sizes from this study were similar to those reported by Hassett and colleagues [24], who examined the efficacy of HRV biofeedback treatment for patients for fibromyalgia over 10 sessions for pain, depression, and sleep outcomes.

However, the treatment effect size of this study for the PTSD symptom outcome is smaller than that reported in other studies [22,23] examining HRV biofeedback to address PTSD symptoms. The reasons for the differences in effect sizes are not entirely clear and may be related to any one (or more) of the differences between the studies, including the mode of treatment delivery (videoconferencing vs live treatment), differences in the samples studied, or possible floor effects for PTSD symptoms in the current sample. As some support for the latter explanation, we found that only 22% of our sample had diagnoses of PTSD; thus, a majority of the participants had nonclinical levels of trauma-related symptoms at baseline to begin with.

The results from the exploratory analyses from SE logs maintained by the participants indicated that frequency of SE use and SE points obtained were positively associated with immediate positive outcomes such as improved mood and decreased anxiety. In turn, improved mood and decreased anxiety were strongly associated with decreased pain intensity and decreased pain unpleasantness. Thus, although frequency of SE use and SE points obtained were not statistically significantly associated with decrease in pain intensity and pain unpleasantness, it is possible that frequency of SE use and SE points were associated with the pain outcomes via their effects on mood and anxiety levels.

There are a number of limitations of the current study that should be considered when interpreting the results. First, the sample of women veterans studied here presented with multiple symptoms and issues, making them a challenging group to investigate. However, veterans with multiple/complex issues may be more common than those with only one issue or symptom, given the prevalence of comorbid mood disorders and history of trauma associated with chronic pain; it is very rare to find chronic pain as a sole presenting complaint. Second, given the small sample size of the current preliminary study, the power to detect significant treatment effects may have been reduced. Future research with larger sample sizes should be undertaken to investigate these outcomes further. Third, although we obtained information about frequency of SE use, the study was not designed to identify factors that predict this use. Future research should seek to assess potential factors that can impact delivery and success of the treatment, and evaluate their associations with treatment compliance and outcome.

Importantly, because this is an uncontrolled pilot treatment study, we cannot draw conclusions regarding the specific effects of the treatment program. However, the findings are promising (including the findings showing an association between SE use and positive outcomes). In addition,
although the model underlying the intervention studied was one hypothesizing dysregulation of the ANS as playing a role in the maintenance of chronic pain, the findings do not provide strong evidence for or against this model; it still remains speculative. Research is needed to more closely examine the associations between ANS dysregulation and important outcomes, as well as the extent to which measures of ANS dysregulation mediated treatment outcome. Finally, the intervention studied contained two components—biofeedback training and psychoeducation support. The design did not provide a way to determine which of these (if either) contributed to the positive outcomes. Future studies should further examine the importance of each component of treatment for chronic pain to determine which should be included to maximize treatment benefit.

Despite the limitations of this study, the findings show that the treatment protocol aimed at alleviating symptoms of chronic pain, depression, and trauma for women veterans in rural settings through utilization of video-teleconferencing technology is feasible, and that the intervention was well received by participants of the study. Moreover, the intervention was associated with improvement in a number of key outcomes, and frequency of the SE use and SE points obtained were positively associated with immediate positive outcomes. They suggest that this intervention involving biofeedback training and supportive group therapy delivered via video-teleconferencing technology may be found to be useful for addressing a significant need in the VA community. A full clinical trial testing the effects is warranted.

References
1 Schooley BL, Horan TA, Lee PW, West PA. Rural veteran access to healthcare services: Investigating the role of information and communication technologies in overcoming spatial barriers. Perspect Health Inf Manag 2010;7:1f.
20 Otis JD, Keane TM, Kerns RD. An examination of the relationship between chronic pain and post-traumatic


42 Price DD, McGrath PA, Raifli A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain 1983;17:45–56.


45 Hays RD, Martin SA, Sesti AM, Spritzer KL. Psycho-
metric properties of the medical outcomes study sleep 

46 Cohen J. Statistical Power Analysis for the Behavioral 
Sciences, 2nd edition. Hillsdale, NJ: Lawrence 

47 Duarte Macea D, Gajos K, Daglia Calil YA, Fregni F. 
The efficacy of web-based cognitive behavioral 
interventions for chronic pain: A systematic review and 

48 Warsi A, LaValley MP, Wang PS, Avorn J, Solomon 
DH. Arthritis self-management education programs: A 
meta-analysis of the effect on pain and disability. 