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Prolonged exposure therapy for PTSD among spinal cord injury survivors: Study protocol for a randomized controlled trial

Mark B. Powers [a, *], Jamie R. Pogue [a], Nicholas E. Curcio [a], Sarita Patel [a], Andrea Wierzchowski [a], Estrella V. Thomas [a], Ann Marie Warren [a], Maris Adams [a], Emma Turner [a], Emily Carl [b], Katherine Froehlich-Grobe [c], Seema Sikka [c], Michael Foreman [a], Kiara Leonard [a], Megan Douglas [c], Monica Bennett [a], Simon Driver [c]

[a] Baylor University Medical Center, Dallas, TX, United States
[b] The University of Texas at Austin, Austin, TX, United States
[c] Baylor Institute of Rehabilitation, Baylor Scott & White Health, Dallas, TX, United States

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ABSTRACT

The National Spinal Cord Injury Statistical Center estimates 294,000 people in the US live with a spinal cord injury (SCI), with approximately 17,810 new cases each year. Although the physical outcomes associated with SCI have been widely studied, the psychological consequences of sustaining a SCI remain largely unexplored. Scant research has focused on posttraumatic stress disorder (PTSD) in this population, despite prevalence estimates suggesting that up to 60% of individuals with SCI experience PTSD post-injury, compared to only 7% of the general US population. Fortunately, prolonged exposure therapy (PE) is a well-researched and highly effective treatment for PTSD. However, no trauma focused exposure-based therapy for PTSD (e.g. PE) has not yet been tested in a SCI population. Thus, we aim to conduct the first test of an evidence-based intervention for PTSD among patients with SCI. Adults with SCI and PTSD ($N = 60$) will be randomly assigned to either: (1) 12-sessions of PE (2–3 sessions per week) or (2) a treatment as usual (TAU) control group who will receive the standard inpatient rehabilitation care for SCI patients. Primary outcomes will be assessed at 0, 6, 10, and 32 weeks.

1. Introduction

The National Spinal Cord Injury Statistical Center estimates 294,000 people in the US live with a spinal cord injury (SCI), with approximately 17,810 new cases each year [1]. Acute hospitalization and ongoing medical management are often required for those who survive a SCI. Additionally, individuals with SCIs are susceptible to multiple chronic conditions that are both injury-related (e.g., musculoskeletal injuries, pain) and non-injury related (e.g., obesity, hypertension, glucose intolerance, cardiovascular disease) [2,3]. Medical costs associated with a SCI are estimated at $523,000 in the first year post-injury with annual recurring costs estimated at nearly $80,000 [4], while the lifetime costs are estimated at $2.1 to $5.4 million depending on age of onset and neurologic level of injury [5].

Substantial improvement of clinical outcomes have occurred in the medical and rehabilitative management of people who have sustained a SCI. Notably, length of stay (LOS) in acute medical rehabilitation has decreased from 98 days to 31 days from the 1970s to now, respectively [1]. Although individuals with SCIs have lower life expectancies as compared to the general population, many people with SCIs are living 20–40 years longer than previous figures. Additionally, recent innovations in engineering and the widespread use of technology has allowed individuals with considerable impairments following SCI increased levels of autonomy and community involvement than in previous decades. These advances have offered people with SCI new technologies that may assist to restore and replace movement [6].

Although the physical outcomes associated with SCI have been widely studied, the psychological consequences of sustaining a SCI remain largely unexplored. Prior literature that investigates psychological functioning primarily addresses elevated rates of depression in individuals with SCI [7–11]. Scant research has focused on posttraumatic stress disorder (PTSD), despite prevalence estimates suggesting that up to 60% [12,13] of individuals with SCI experience PTSD post-injury, compared to only 7% of the general US population [14]. PTSD may occur after direct exposure to actual or threatened death or serious injury, by witnessing a traumatic event, or by being repeatedly exposed to de-

* Corresponding author. Baylor University Medical Center, 3409 Worth Street Tower, Suite C2.500, Dallas, TX, 75246, United States.
E-mail addresses: mark.powers1@bswhealth.org (M.B. Powers), seema.sikka@bswhealth.org (S. Sikka).

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tails of a traumatic event [15]. As three leading causes of SCI occur from motor vehicle collisions, falls, and violence, which are all defined as traumatic injuries [1], it is unsurprising that PTSD may present in higher rates among people with SCI compared to the general population.

Identifying PTSD symptoms early is imperative, as acute intervention has been shown to be highly effective [16,17] and may prevent the full development of the disorder, which may be diagnosed 30 days after the traumatic event [17,18]. Untreated PTSD is associated with increased risk for physical health problems, physician visits, and significant functional impairment across physical and psychosocial domains [19]. Further, PTSD is one of the most economically costly of all anxiety and trauma-related disorders because of a particularly high rate of work impairment, hospitalization, and physician visits [20,21].

Strong evidence suggests that PTSD often co-occurs with depression [22,23] and sleep disturbance in the general population [24–28]. Similar associations between PTSD and depression [10,23,29,30] and PTSD and pain [29,31] have been observed in SCI samples. Given the increased prevalence of depression, pain, and sleep problems among people with SCI and the associated negative effects of these problems on health and function [32,33], further investigation is warranted to examine whether treating PTSD can also reduce prevalence of these comorbid conditions.

Fortunately, highly effective treatments for PTSD exist. The most researched and highly effective treatment for PTSD is prolonged exposure therapy (PE) [16,34,35]. Previous research demonstrated that in 12 sessions over a 6-week period, 85% of patients with PTSD respond to treatment with the dropout rate similar to other non-exposure-based treatments (20%). Although PE is effective in treating PTSD among various populations (e.g., survivors of combat, rape, MVCs, natural disasters), this treatment has not been researched specifically among individuals with SCI diagnosed with PTSD. On the one hand, SCI inpatients (in a rehabilitation facility) offer a unique opportunity to screen for PTSD and offer evidence-based treatment for their PTSD symptoms while in the facility. On the other hand, this population presents potential obstacles to feasibility and efficacy. For example, these patients often have physical rehabilitation appointments from 8am to 4pm each day. It is not yet known if such individuals will be willing and able to engage in difficult psychological therapy in addition to their existing demanding schedule. In addition, SCI patients all present as a group with significant physical functioning changes as part of their medical sequela.

To our knowledge, there are no published studies on PTSD treatment in a SCI population. Given the profound impact of PTSD on health and functioning and the higher rate of symptoms compared to other trauma populations, there is a critical need for evidence-based interventions to address PTSD in those with SCI. Thus, we will conduct the first test of a first-line evidence-based treatment for PTSD (PE) among patients with SCI.

2. Methods

The Institutional Review Board of Baylor University Medical Center approved this study. This project is supported by the National Institute on Disability, Independent Living, and Rehabilitation Research (90IFRE0003) and is registered on clinicaltrials.gov (ID: NCT03624218). This study is currently in the recruitment phase. The study is currently conducted at an inpatient rehabilitation hospital in the South Central United States.

2.1. Specific aims & hypotheses

1. Evaluate the efficacy of the PE intervention on PTSD symptoms among SCI survivors diagnosed with PTSD via a randomized controlled trial (RCT).

Hypothesis: Individuals with SCI and PTSD randomized to the PE intervention for PTSD will show statistically significantly greater improvements in PTSD symptoms as measured by the PTSD Symptom Scale – Interview for DSM-5 (PSSI-5) compared to the treatment as usual (TAU) control group [16,36–39].

2. Examine the efficacy of the PE intervention on secondary outcomes including self-reported PTSD negative cognitions, depression, pain, sleep, quality of life, posttraumatic growth, and substance use.

Hypothesis: Compared to the TAU control group, those randomized to the PE will experience: a) significantly greater reduction in self-reported PTSD negative cognitions as measured by the PTCI [16] b) significantly greater reduction in depression as measured by the Beck Depression Inventory II [16,40], c) significantly greater reduction in pain as measured by the Numerical Rating Scale [29,41], d) significantly greater improvement in sleep as measured by the Pittsburg Sleep Quality Index Addendum [42], e) significantly greater improvement in quality of life as measured by the SCI-Quality Of Life [43,44]. f) significantly greater posttraumatic growth as measured by the PTGI [45], and g) significantly greater reduction in substance use as measured by the AUDIT-C and DAST [46–48].

3. To assess the feasibility and fidelity of delivering the PE intervention to people with a SCI in an inpatient rehabilitation setting who have screened positive for PTSD. Participant adherence, duration of treatment, replication, and challenges implementing the intervention in this patient population will be assessed. Feasibility (acceptance and implementation) and fidelity will both be assessed with standardized measures (see Table 1).

Hypothesis: PE will be feasible, acceptable, and fidelity will be high (similar to other PE RCTs) in the SCI population of individuals with PTSD [36].

2.2. Power analysis

As our proposed sample size of 60, this application is not powered to detect small differences between treatment conditions. However, consistent with the aims of a Stage IB study, our primary goal is determining 1) the feasibility of the new intervention and 2) whether a Stage II study is warranted. Here we estimate the effect sizes that we will be able to detect as statistically significant with 80% power for Aim 1.

Optimal Design Plus Empirical Evidence software was used to conduct the power analysis for this hierarchial linear model (HLM). For 0.80 power at $\alpha = 0.05$, a total of 60 participants would be sufficient to detect a significant treatment effect size of 0.8. Thus, given that previous meta-analyses have indicated a large effect size ($g = 1.08$) for RCTs comparing PE to control conditions including treatment as usual for PTSD outcomes [16], we will have sufficient power to detect a significant effect.

2.3. Overview

A total of 60 adults with SCI and PTSD will be randomized to either a PE intervention or the TAU control group. Participants in the PE intervention will meet with a trained study therapist 2–3 times a week for 4–6 weeks. All participants will complete assessments at weeks 0, 6, 10, and 32.

2.4. Participants

Participants will be individuals with PTSD, who have been diagnosed with either a traumatic or nontraumatic SCI for greater than or equal to 30 days, and who are currently admitted to an inpatient rehabilitation hospital. Each individual will be screened with a PSSI-5 to determine that they meet criteria for PTSD. It is not required that the index trauma is related to the SCI. In addition, participants must be will-

Table 1
Schedule of measures for PTSD intervention.

Instrument (Outcome/Aim)	Measurement Schedule				
	Baseline	Treatment	6-week	10-week	32-week
Primary Outcome Measure					
PSSI-5 (1)	X		X	X	X
Secondary Outcome Measures					
MINI (Screening)	X				
PDS-5 (2)		X			
BDI-II (2)	X	X	X	X	X
PTCI (2)	X	X	X	X	X
NRS (2)	X			X	X
PSQI-A (2)	X			X	X
SCI-QOL (2)	X			X	X
PTGI (2)					X
AUDIT-C (2)	X			X	X
DAST-10 (2)	X			X	X
Therapy and Medication Questionnaire (2)	X		X	X	X
Therapist Adherence and Competence Rating Scale (3)				X	
Participant Satisfaction Survey; Provider				X	
Satisfaction Survey (3)				X	
Adherence to Conditions (3)				X	
Other Measures					
Demographic Data	X				
Injury-related Data	X				
C-SSRS	X	X	X	X	X

Note. AUDIT-C: Alcohol Use Disorder Identification Test-Consumption; BDI-II: Beck Depression Inventory; C-SSRS: The Columbia Suicide Severity Rating Scale; DAST-10: Drug Abuse Screening Test; MINI: MINI International Neuropsychiatric Interview; NRS: Numerical Rating Scale for pain; PDS-5: Posttraumatic Diagnostic Scale – Self-Report for DSM-5; PSQI-A: Pittsburgh Sleep Quality Index Addendum for PTSD; PSSI-5: PTSD Symptom Scale – Interview for DSM-5; PTCI: Post-Traumatic Cognitions Inventory; PTGI: Posttraumatic Growth Inventory; SCI-QOL: Spinal Cord Injury – Quality of Life. Injury-related Data will be pulled from patients EMR at the end of study procedures. The C-SSRS will be administered if a participant indicates any suicidality on any measure during any interview or contact.

ing and able to provide informed consent, understand inclusion and exclusion criteria, and accept the randomized group assignment.

To ensure quality data and limit any possible adverse events, participants will be excluded for the following criteria: (1) patients in police custody; (2) less than 18 years of age; (3) non-English speaking; (4) patients with severe cognitive impairment (assessed through chart review, contact with speech therapy and/or licensed rehabilitation psychologist, and/or with the Cognistat); (5) patients who are acutely suicidal and/or have been admitted for a suicide attempt; (6) patients who are actively psychotic.

2.4.1. Participant screening

Potential participants will be prescreened using Electronic Medical Records (EMR) to determine SCI status and possible cognitive deficits. After prescreen, potential participants will be approached in their inpatient rehabilitation hospital rooms by trained clinical research assistants (CRAs) who will provide an overview of study procedures. Potential participants who express interest in participating in the study will review the informed consent form with a CRA and have the opportunity to ask questions. Participants who consent to participate in the study will be assessed for posttraumatic stress symptoms using the PSSI-5. If participants meet the symptom criteria according to the PSSI-5 and other inclusion/exclusion criteria, they will be enrolled in the study and complete a baseline interview with a CRA. CRAs will be the assessors for all subsequent interviews.

2.4.2. Baseline and randomization

After meeting inclusion criteria, participants will complete all baseline procedures (outlined in Table 1). Participants will then be allocated 1:1 via randomization into the PE intervention or the TAU control group. To reduce bias, assessors will be kept blinded to treatment conditions until after the completion of baseline assessment; randomization will be completed with pre-filled envelopes labeled 1–60 generated by a third party not involved in assessing or treating participants. Randomization will be computer generated and concealed by using a permutated block randomization scheme with a block size of 6.

2.5. Interventions

2.5.1. Prolonged exposure therapy (PE)

Participants randomized to the PE intervention will receive 2–3, 60-min sessions each week for 4–6 weeks (12 total sessions). We selected the 60-min format (over the 90-min format) for three reasons: (1) to meet the limited time demands of an inpatient rehabilitation facility; (2) one randomized [49] and one non-randomized [50] trial showed that 60-min PE was as effective as 90-min PE sessions in the treatment of PTSD; and (3) this format is feasible and has been completed under similar conditions (i.e. Emergency Department) [18,49]. The treatment is manualized [37,51] and includes: education about common reactions to trauma, breathing retraining, prolonged (repeated) imaginal exposure to trauma memories, repeated in vivo exposure to situations that participants are avoiding due to trauma-related fear, and discussion of thoughts and feelings related to the trauma. This processing discussion addresses participants' unrealistic beliefs about themselves and the world and helps them make sense of the trauma. Therapy will be performed in the participant's room to ease burden on those with limited mobility. Any missed PE session will be made up by scheduling multiple sessions in subsequent weeks. In the event a participant does not complete all 12 sessions within 6 weeks, the remaining sessions will be completed after the 6-week assessment in person or via phone contact if needed and noted to file for differential analysis. Virtual Sessions will also be offered if preferred by patients. The intervention will be supervised weekly and delivered by trained therapists, who attended a two-day PE workshop training. The weekly supervision format was developed by the authors of the treatment manual (Dr. Edna Foa and colleagues) and includes: a) review of participant symptoms, b) review of session content, c) review the session video, and review of plan for future sessions. Fidelity will be assessed using the Therapist Adherence and Competence Rating Scale.

2.5.2. Treatment as usual (TAU)

Participants in the control arm will only receive the standard clinical treatment administered to all SCI patients at the inpatient rehabilitation hospital. This includes an evaluation by a licensed clinical psychologist and continued follow-up psychotherapy, as needed (which does not include PE).

2.6. Post-treatment follow-up

CRAs will collect participants' contact information (i.e., telephone number, email, mailing address) during baseline procedures. Participants will be contacted to complete follow-up assessments at 6-, 10-, 32-weeks (See Table 1).

2.7. Assessment

Clinical Research Assistants (CRAs) are the independent evaluators/assessors who will administer the assessments. The post-baccalaureate/graduate level CRAs completed training including: a) a 2-day intensive PTSD workshop, b) training in the specific measures including mock administrations, and c) certification on the suicide mea-

sure/protocol (C-SSRS/Safety Plan). Also, the CRAs will attend regular fidelity/reliability meetings. These meetings will include listening to the assessment audio along with meeting attendees independently rating the symptoms. This will provide the opportunity for reliability assessments and prevent observer drift. Table 1 provides an overview of the frequency and timing of administration for the primary assessment instruments used for screening, to measure PTSD severity, pain, depression, sleep, and quality of life.

2.7.1. Primary outcome measure – standardized PTSD interview (PSSI-5)

2.7.1.1. Posttraumatic stress symptoms interview. We will use the PTSD Symptom Scale-Interview Version (PSSI-5) to assess posttraumatic stress symptoms [52]. This interviewer-administered 20-item scale rates each of the DSM-5 symptom criteria on a 0–3 scale of frequency and/or severity. To meet criteria for PTSD, individuals must endorse at least one statement from each of the following symptom clusters: "Re-experiencing" and "Avoidance"; and at least two statements from the following symptom clusters: "Changes in Cognition and Mood" and "Increase Arousal and Reactivity". The PSSI-5 is a reliable and valid scale; it is sensitive to treatment effects and is highly correlated with the Clinician Administered PTSD Scale, another widely used PTSD interview assessment [53].

2.7.2. Secondary outcome measures – measures of PTSD (self-report), mood, and anxiety symptoms and side effects

2.7.2.1. The MINI International Neuropsychiatric Interview (MINI) [54]. This structured clinical interview will be used for screening of inclusion/exclusion diagnoses and has been effectively validated using the Structured Clinical Interview for DSM and the Composite International Diagnostic Interview with good concordance [54]. It assesses multiple DSM diagnoses such as Generalized Anxiety Disorer, PTSD, Bipolar Disorders, etc. These diagnoses will be used for analyses of comorbidity as a potential moderator of outcome and for descriptive statistics to characterize the sample.

2.7.2.2. The Posttraumatic Diagnostic Scale for DSM-5 (PDS-5) [55]. The Posttraumatic Diagnostic Scale for DSM-5 (PDS-5) is a 20-item, self-report measure that assesses PTSD symptom severity according to the DSM-5 criteria. The symptom items are rated on a 5-point scale of frequency and severity from 0 ("Not at all") to 4 ("6 or more times a week/severe"). Scores range from 0 to 80. Mean in veterans, community, and student trauma exposed participants = 30.39. A PDS-5 cutoff score of 28 or higher allowed for the best sensitivity (true positives) and specificity (true negatives) AUC = 0.86 which is greater than 0.5.

2.7.2.3. The Beck Depression Inventory-II (BDI-II) [56]. This widely used 21-item, self-report inventory measures severity of depressive symptoms. The internal consistency of the BDI-II is strong and it has been found to have good concurrent validity [57,58]. Scores are interpreted as follows: 0–13, minimal; 14–19, mild; 20–28, moderate; and 29–68, severe [59].

2.7.2.4. The Post-Traumatic Cognitions Inventory (PTCI) [60]. The PTCI is a 36-item instrument that assesses dysfunctional post-trauma cognitions across self, world, and self-blame to yield a total score. The scale has high internal consistencies and correlates with PTSD severity, anxiety, and depression [60].

2.7.2.5. The Numerical Rating Scale of pain intensity (NRS) [61]. The NRS is a commonly used validated measure of pain intensity [62,63]. This 11-point rating scale ranges in pain severity from 0 being "no pain" to 10 being "worst pain imaginable". The NRS has been recommended by the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials [64] as a core outcome measure in clinical trials of chronic pain and is specifically recommended for SCI-related pain [65,66].

2.7.2.6. The Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A) [67]. This 7-item, self-report instrument assesses the frequency of disruptive nocturnal behaviors, which are often associated with PTSD. The PSQI-A has satisfactory internal consistency and good convergent validity with two standard PTSD measures, and is considered a valid instrument for PTSD in clinical and research settings [68].

2.7.2.7. SCI quality of life- positive affect & well-being – short form (SCI-QOL) [69]. The SCI-QOL is a 10-item, self-report measure that assesses positive affect and well-being (e.g., "I thought positively about my future") in the past seven days on a 1 ("never") to 5 ("always") Likert scale. It has been demonstrated as a robust psychometric measurement tool [69,70].

2.7.2.8. The Posttraumatic Growth Inventory (PTGI) [71]. This 21-item scale assesses perceived positive outcomes following traumatic events, which includes following subscales: New Possibilities, Relating to Others, Personal Strength, Spiritual Change, and Appreciation of Life. The PTGI is modestly related to optimism and extraversion, and may be predictive of coping success and positively reconstructing perceptions of self and others post-trauma [71].

2.7.3. Other measures

2.7.3.1. Alcohol Use Disorder Identification Test-Consumption (AUDIT-C) [72]. This 3-item alcohol screen has been extensively validated to detect problem drinking and has been a recommended screening tool for alcohol screening. Items are scored from 0 to 4 and a score of greater than or equal to 4 for males and 3 for females showed the greatest sensitivity and specificity for the respective sexes [72].

2.7.3.2. Drug Abuse Screening Test (DAST). The DAST is a 10-item scale that assesses consequences related to the abuse of illegal and prescription drugs [73]. The DAST has established validity among substance abusing inpatients. With one point added for every yes except question 3, which is reversed scored, a score of 1–2 is considered low level of problems related to drug abuse, 3–4 is considered a moderate lever, 6–8 is a substantial level and 9–10 is a severe level [74–76].

2.7.3.3. Therapist Adherence and Competence Rating Scale [77]. This dichotomous scale requires the rater to assess the PE session facilitator on therapy elements (e.g., discussed post-trauma reactions, instructed client on breathing techniques) and therapist factors (e.g., engaged in interactive exchange with client). The overall therapist competence is then rated on a scale from 0 "very poor" to 5 "excellent." This scale will be completed for 15% of the sessions delivered per recommended guidelines [77,78].

2.7.3.4. Therapy history. Participant therapy history is assessed via a 5-item face valid questionnaire created for the study. Questions ask about current and recent therapy and medication use to account for any outside therapy the TAU or PE participants might be getting.

2.7.3.5. Participant satisfaction survey (adapted from evidence-based practice attitude scale [77]. This survey asks about experience with the clinical and study staff. Those randomized to the PE arm will receive an additional assessment about their experience of PE.

2.7.3.6. Provider satisfaction survey (adapted from evidence-based practice attitude scale) [77]. The first 15 items assess beliefs about evidence-based practice, perceived barriers, and institutional requirements. The next 8 items assess provider experiences with the training, supervision, and deployment of the PE intervention over the course of the study.

2.7.3.7. Adherence to conditions. Feasibility of implementation will be assessed by tracking session attendance to determine relative adherence in the PE vs. TAU groups. Both the PE and TAU sessions will be measured as the number of psychology appointments each group attended.

2.7.3.8. Demographic data. Participant demographic variables will be obtained through a standard self-report form and the participant's medical record. Information will include age, race, ethnicity, marital status, education level, employment, income, insurance status, veteran status, premorbid psychiatric history, and history of substance use.

2.7.3.9. Injury-related data. Participant injury-related variables from the acute SCI will be obtained from the EMR and the hospital trauma registry when available (TraumaBase CDM, Conifer, CO). Supplementary clinical information will also be extracted from the EMR provided by referring hospital upon admission to the inpatient rehabilitation hospital regarding: loss of consciousness at time of injury based on objective clinical assessments, Glasgow Coma Scale score at time of acute admission; length of stay in intensive care, number of days spent on ventilator, and positive alcohol and/or drug screen at time of admission. In addition, outcome-related variables during the rehabilitation stay (i.e., ASIA score, functional independence, length of stay, etc.), will be collected.

2.7.3.10. Suicidality. The Columbia Suicide Severity Rating Scale (C-SSRS) [79] will be administered to assess for current and past suicidal ideation, intent, and behavior as well as self-injurious non-suicidal behaviors if individuals indicate any suicidality on any measure (e.g. BDI-II item 9 at every visit and treatment session) or during contact (e.g. MINI diagnostic interview at baseline or spontaneously reported to a therapist/assessor). The C-SSRS demonstrates good reliability and validity [79,80]. If participants are found to be at risk, assessors or therapists will complete the empirically validated Safety Plan worksheet with the participant [81]. They will also report to the PI of the study and medical staff will be made aware if they are inpatient. If they are outpatient, first responders may be contacted to ensure participant's safety.

3. Data analysis

3.1. Aim 1

A HLM will be used to evaluate the efficacy of the PE intervention on PTSD symptoms across time. PTSD symptoms will be assessed based on the total score of the PSSI-5 at each study timepoint. The repeated measures will be nested within individuals, who will be nested within their treatment cohort, thereby accounting for correlation within cohorts. This HLM will provide a tailored time effect for each patient and has the added benefit of including data from participants who miss an assessment. Our HLM analyses will employ a 2-phase piecewise growth curve model to track improvement over the course of the 32-week study, which will allow for different slopes in each phase. The first phase of the growth model will include weeks 0–6 of the study (treatment phase) and the second phase will include weeks 6–32 (post-treatment phase). We will model a discontinuity in the growth curve between the first and second phases to reflect a potential increase in PTSD symptoms when treatment ends and the follow-up phase begins. We will model change over time as curvilinear within each phase, but drop curvilinear terms if they are not significant.

We will model the covariance matrix for the time component with a first-order autoregressive structure. In addition to the PSSI-5 total score, we will measure successful response to treatment using the Reliable Change Index (RCI) [82], which is calculated as the change in score from baseline to each time point divided by the standard error of the difference of the test. An RCI less than −1.96 indicates a significant decrease in symptoms. Participants who reach this mark will be labeled responders. This outcome will be analyzed using HLM with a logistic link function for the binary outcome of responders vs. non-responders.

Based on previous studies [31,83],we will examine whether other factors affect treatment. These factors will include severity of injury, female gender, and pre-morbid mental health issues. As such, each variable will be addressed in the HLM analysis as a covariate.

3.2. Aim 2

HLM will be used to examine the efficacy of the PE intervention to assess efficacy for secondary outcomes including depression, pain, sleep, and quality of life across time. Consistent with Aim 1, these models will use a 2-phase growth model with discontinuity between the treatment and follow-up phase, and covariate analysis will follow an identical statistical plan. These models will address relevant control variables (e.g., severity of injury, female gender, and pre-morbid mental health issues, etc.). We will use the Benjamini-Hochberg correction to account for the possible inflation of Type 1 error due to multiple significance tests on secondary outcomes variables.

3.3. Aim 3

Analysis for Aim 3 will include the reporting of descriptive statistics from the participant and provider satisfaction surveys, as well as the summarization of the adherence data. An overall adherence/competence rating will be based on the total number of therapy elements with a “yes” response and the total number of therapist factors with a “yes” response on the PE Adherence Scales questionnaire in order to assess for overall receipt of the intended intervention. An independent samples *t*-test will compare the overall adherence/competence rating between PE and TAU groups. Each score will then be categorized into “very poor”, “barely adequate”, “good”, or “excellent” ratings as described in the PE Adherence Manual. The ratings will be summarized for each session.

3.4. Missing data

Following Hall et al. [84] and Enders [79], we will use pattern mixture modeling to assess the effect of missing data. We will rerun our analyses coding for various missing data patterns (no missing data, sporadic missing, dropouts, etc.) to determine both if missingness impacts our findings and how the comparison between PE and TAU depends on the missing data pattern.

4. Discussion

Despite prevalence estimates suggesting that up to 60% of individuals with SCI have PTSD, little attention has been given to mental health interventions for this at-risk group in scientific literature [18,24,25,29]. Currently, no studies have examined the efficacy of PE for individuals with SCI. Thus, the primary goal of the present study is to provide initial evidence for the efficacy of PE for PTSD symptoms among individuals with SCI diagnosed with PTSD. In addition, we will examine the efficacy of PE for comorbid clinical problems including pain, depression, sleep, and poor quality of life. Lastly, the current study will determine the feasibility of conducting PE in an inpatient rehabilitation setting. Overall, the expected findings should: (1) provide information on the efficacy of PE in the reduction of PTSD symptoms in individuals with SCI; and (2) provide evidence for the feasibility of accommodating treatment to individuals with SCI in an inpatient rehabilitation setting.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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