



Prevention of posttraumatic stress during inpatient rehabilitation post spinal cord injury: Study protocol for a randomized controlled trial of Brief Prolonged Exposure Therapy (Brief PE)

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ABSTRACT

Background: Scant research has focused on posttraumatic stress disorder (PTSD) in the SCI population, despite high prevalence estimates. Fortunately, prolonged exposure therapy (PE) is a well-researched and highly effective treatment for PTSD. Our recent clinical trial showed that standard 12-session PE was effective for PTSD treatment among inpatients with SCI. Early intervention with brief PE (3-sessions) delivered in the emergency department has also been effective for PTSD prevention, but has not been tested among people post-SCI. Thus, we aim to conduct the first test of the Brief PE intervention to prevent PTSD among patients with SCI.

Methods: Adults who have experienced a SCI (N = 200) will be randomly assigned during inpatient rehabilitation to either: (a) 3 60-min sessions of Brief PE (intervention group) or (b) treatment as usual (control group).

Results: The primary outcome measure (PTSD symptoms measured by the PSSI-5) and secondary outcome measures (depression, anxiety, pain, quality of life, sleep disturbance, and resilience) will be assessed at baseline, 1-month, 3-months, and 6-months. Hierarchical linear modeling (HLM) will be used to evaluate the effectiveness of the PE intervention on PTSD and secondary outcomes. Descriptive statistics will examine feasibility and will include the number of participants enrolled, the number of sessions completed, fidelity of Brief PE delivery, and average scores for difficulty and helpfulness of the intervention scales for those randomized to intervention.

Conclusions: Successful completion of this study will provide an evidence-based program to alleviate post-traumatic distress post spinal cord injury and prevent long-term development of PTSD.

1. Introduction

Although the majority of individuals who sustain a spinal cord injury (SCI) do not go on to develop a psychological disorder, evidence suggests that these individuals may be at a heightened risk compared to the general population [1]. Depression has been the most studied psychological consequence following SCI [2–5] however less research has focused on posttraumatic stress disorder (PTSD) in this population. The lack of research focus on PTSD after SCI is surprising as some prevalence estimates suggest up to 62% of individuals with SCI experience PTSD

post-injury, compared to only 7% of the general US population.[6–10] PTSD typically occurs after direct exposure to actual or threatened death or serious injury, by witnessing a traumatic event, or by being repeatedly exposed to details of a traumatic event.[11] Given that since 2015 the three leading causes of SCI have been motor vehicle injuries (38.2%), falls (32.3%) and acts of violence (14.3%) – are all traumatic events, [12] it is important to understand the consequences of experiencing trauma in individuals with SCI.

PTSD is one of the most costly of all anxiety and trauma-related disorders because of a particularly high rate of work impairment,

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hospitalization, and physician visits [13,14]. Strong evidence suggests that PTSD often co-occurs with depression [4,15–17], anxiety disorders [15], sleep disturbance [18–21], social dysfunction [15], and pain [22]. Given the significant impact of PTSD symptoms generally, as well as the impact this may have on rehabilitation and additional health comorbidities specific to the SCI population, there is a critical need for evidence-based interventions to address PTSD in those with SCI. Despite this, to our knowledge, there are no published studies on PTSD specific treatment in this population.

In SCI, as in other trauma diagnoses, the length of time post-injury appears to be associated with the likelihood of developing PTSD, with evidence suggesting that those with newer onset SCI have a higher risk of developing PTSD.[23] Findings from one study showed that 14% of those with SCI experienced posttraumatic stress symptoms in the first 6 months.[24] Risk factors associated with PTSD among patients with SCI include: cognitive appraisals of the injury; [25] issues at the time of trauma including dissociation and other physical and emotional reactions; [26] and anxiety, female gender, and dislike of expressing emotions.[27] In the general population, the strongest predictor of persistence of PTSD symptoms is avoidance of the trauma memory and other trauma reminders [28–30]. In fact, the degree of avoidance differentiates who will maintain PTSD symptoms after trauma exposure [31–35]. Thus, effective psychological treatment involves helping patients to stop avoiding and safely confront trauma reminders.

Fortunately, highly effective treatments for PTSD exist and within the general population, the most researched and highly effective treatment for PTSD is prolonged exposure therapy (PE).[36–39] Previous research demonstrated that in 12 (90-min) 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%).40 Based on this evidence, we conducted the first and only randomized controlled to date of PE for individuals with SCI who were diagnosed with PTSD [41].

Adults in our rehabilitation facility with SCI and diagnosed with PTSD ($N = 30$) were randomly assigned to either: (1) 12 60-min sessions of PE or (2) a treatment as usual control group who received the standard inpatient rehabilitation care for SCI patients. Preliminary results suggest that PE significantly reduced PTSD symptoms relative to the treatment as usual control condition (see Fig. 1). The improvement in symptoms was similar in magnitude to that seen in other trauma populations [40] and showed that this treatment approach is feasible in the inpatient rehabilitation setting [41]. Although feasible, we found that the standard 12-session PE treatment was difficult due to the nature of the inpatient rehabilitation setting, primarily the demanding schedule of physical, occupational, and other rehabilitative therapies. Further, although treating existing PTSD remains a priority, early intervention to reduce psychological distress and prevent PTSD for all individuals post SCI would be clinically preferable. If avoidance of trauma

reminders/memories is the maintaining factor for PTSD symptom persistence and the primary ingredient in evidence-based treatments for PTSD is exposure, then exposure shortly after the trauma may prevent PTSD. A recent meta-analysis [42] showed that the most effective brief early intervention to prevent PTSD was Modified Brief Prolonged Exposure Therapy (Brief PE) developed by Rothbaum and colleagues [43]. They conducted a randomized controlled trial of Brief PE (3 sessions) to prevent PTSD among patients admitted to a Level I Trauma Center emergency department. Analyses showed that the Brief PE reduced PTSD by half (relative to the control condition) at the 3-month assessment. This study also showed that Brief PE mitigated genetic risk for PTSD [44]. However, brief PE to prevent PTSD among patients with SCI in a rehabilitation setting has not been tested. Therefore, we aim to conduct the first randomized controlled trial of the Brief PE to prevent PTSD post SCI.

2. Methods

The overall goal of this project is to test a brief intervention (3 60-min sessions) to reduce psychological distress after SCI and to mitigate long-term post SCI distress including PTSD. This study has been approved by the Baylor Scott and White Research Institute Institutional Review Board (#021–339) and all procedures will follow the approved protocol and institutional ethical standards. This study is part of the Baylor Scott and White Spinal Cord Injury Model System and funded through a grant from the National Institute on Disability, Independent Living, and Rehabilitation Research (# 90SIMS0011). This study is currently in the start-up phase and is being conducted at the Baylor Scott and White Institute for Rehabilitation (BSWIR).

To achieve our goal, the proposed study consists of three specific aims.

Specific Aim 1: Evaluate the efficacy of the modified Brief PE intervention (relative to treatment as usual) delivered in an inpatient rehabilitation setting post SCI to reduce PTSD symptoms (primary outcome) at 1, 3, and 6 months from baseline using a randomized controlled trial (RCT).

Hypothesis. Individuals with SCI who receive the modified brief PE intervention will show statistically significantly greater improvements in PTSD symptoms as measured by the PTSD Symptom Scale – Interview for DSM-5 (PSSI-5) [45] relative to the treatment as usual control group.

Specific Aim 2: Examine the efficacy of the modified brief PE intervention on secondary health outcomes including depression, general anxiety, pain, quality of life, sleep disturbances, and resilience at 1, 3, and 6 months from baseline compared to usual care.

Hypothesis. Compared to the treatment as usual, those randomized to brief PE will experience significantly greater improvement in: (a) depression (Patient Health Questionnaire 9-Item; PHQ-9), [46,47] (b) anxiety (General Anxiety Disorder 7-Item; GAD-7), [48,49] (c) pain (Numeric Rating Scale; NRS), [50–53] (d) quality of life (Spinal Cord Injury-Quality Of Life; SCI-QOL) [54,55], (e) sleep disturbance (PROMIS Sleep Disturbance scale), [56,57] and (f) resilience (Connor-Davidson Resilience Scale; CD-RISC). [58].

Specific Aim 3: Assess the feasibility of delivering the modified brief PE intervention to people with SCI in the inpatient rehabilitation setting. Feasibility will be assessed by examining: (a) the number of participants who meet the inclusion criteria and consent to participate, (b) the number of sessions completed, (c) fidelity of sessions in terms of percentage of necessary elements administered, and (d) patient satisfaction.

Hypothesis. We expect to consent participants successfully, to complete $\geq 60\%$ of intervention sessions with participants, that fidelity will be $\geq 90\%$, and patients will have high satisfaction ($\geq 80\%$ will rate the treatment as Somewhat or Very Helpful).

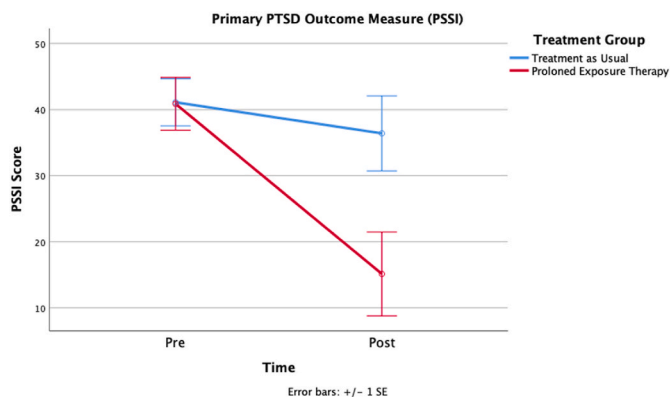


Fig. 1. PTSD scores pre- and post-intervention for both conditions (treatment as usual versus prolonged exposure).

3. Power analysis

To detect a difference between groups on the primary outcome (PSSI-5) with 80% power at 5% significance, we would need to enroll 80 participants per group or 160 participants total. We anticipate a 20% attrition rate based on our previous PE intervention work with this population [41], therefore, we will plan to enroll 200 total participants, with 100 in each group, during the study period.

4. Participant recruitment

Participants will be recruited from those admitted to Baylor Scott and White Institute for Rehabilitation (BSWIR). Following pre-eligibility screening and provision of informed consent, participants will complete baseline assessments and if eligible (Please see Table 1 for criteria) will be randomized to into either the experimental (Brief PE) or control (treatment as usual) condition. Participants will be allocated 1:1 into the Brief PE intervention or treatment as usual control group (see Fig. 2). Randomization will be computer generated by the study biostatistician using a permuted block randomization scheme with a block size of 4 to create equivalent group sizes. The block size will not be known by the research study coordinator or therapist to prevent “guessing” given the small block size. Randomization will be concealed in sealed envelopes

Table 1
Inclusion/Exclusion criteria.

Inclusion Criteria	Rationale
18 years of age or older	Individuals less than 18 years old are excluded as the manualized PE intervention for PTSD has only been tested and validated with adults 18 years of age or older.
Admitted to the inpatient rehabilitation hospital diagnosed with a SCI	As a SCIMS NIDILRR-funded site, we will include both traumatic and non-traumatic SCI patients admitted to the hospital consistent with the new SCIMS change.
Admitted to the hospital after experiencing a DSM-5 defined “Criterion A” trauma	Individuals with “non-traumatic” SCI diagnoses as defined by medical personnel may still meet criteria for experiencing a “Criterion A trauma” (as determined by DSM-5 criteria [11]). Thus, these individuals might still develop PTSD and could benefit from preventative treatment and inclusion in the study.
Exclusion Criteria	
Patient in police custody	Rationale We are unable to enroll patients in police custody due to feasibility and ethical obstacles.
Not fluent in the English language	The Brief PE manual is currently only available in English and has only been tested in English. Thus, its efficacy in other languages is unknown currently.
Severe cognitive impairment	Low cognitive function will be defined as a score <25 on the Orientation Log (O-Log) [65]. This is required so participants can understand and comply with the brief PE and the written program materials.
Patients who are acutely suicidal	Patients who are acutely suicidal may require a higher level of intervention than provided in this trial. Patients who are acutely suicidal will be referred to the BSW psychologists and consult psychiatry as is standard practice. Also, we will follow suicide screening, monitoring, and intervention guidelines as determined by hospital policy.
Patients with active psychosis	Similarly, patients with active psychosis may also require a higher level of intervention than provided in the trial. They also will be referred to the BSW psychologists and consult psychiatry as is standard practice.

only opened at the time of randomization (after completing the baseline assessment).

Participants enrolled in both the treatment and control arms will be compensated up to \$220 for their participation. This includes \$20 to complete the consent and screening, \$50 for the Baseline Assessment, and \$50 each for the 1, 3, and 6-month follow-ups. If participants do not complete all study activities, they will still receive compensation for the activities they have completed up to discontinuation.

5. Conditions

Intervention Group – Brief Prolonged Exposure Therapy (Brief PE): In addition to the standard clinical treatment received by all SCI patients at BSWIR (treatment as usual), participants randomized to the intervention condition will also receive 3 60-min sessions of Brief PE distributed 1–7 days apart. The treatment is manualized [43,59,60] and has been successfully implemented and evaluated in other challenging environments (i.e. Emergency Department) [61,62]. Brief PE includes education about common reactions to trauma, breathing retraining, prolonged (repeated) imaginal exposure to trauma memories, repeated in vivo/behavioral exposure to situations that participants are avoiding due to trauma-related fear, and discussion of thoughts and feelings related to exposure exercises. This discussion addresses patients’ unrealistic beliefs about themselves and the world. In addition, patients are given homework to complete between each session (breathing practice, listening to the session recording, and completing behavioral exposures). See Table 2 for session content. Session 1 will begin immediately after the baseline assessment and assignment to the Brief PE condition. To ensure patients receive adequate PE treatment, missed sessions will be made up by scheduling multiple sessions in subsequent weeks. If a patient is discharged before completing all 3 sessions, the balance will be provided via telehealth.

Control Group: Treatment as Usual (TAU): Participants in the control group will complete the same baseline assessments but will not receive the Brief PE therapy. Instead, they will receive standard clinical treatment for by all SCI patients at BSWIR. This includes an evaluation by a licensed psychologist and continued follow-up psychotherapy as needed. This therapy does not consist of trauma-focused therapy and will be summarized in the analysis.

6. Assessment

All participants in this study will complete questionnaires and assessments at the following time points: baseline, 1 month, 3 months, and 6 months post-enrollment. All study-related assessments will be completed at these times and recorded for analysis. Please see Table 3 for schedule of measures.

All follow ups will be completed via phone if patient is no longer admitted at BSWIR. Follow-up phone calls will be conducted within a four-week window around the participants’ due date (i.e., two weeks prior and two weeks after the date). Participants will be contacted using the information they provided during the first data collection period at the time of their hospitalization. During the window of time that participants are eligible for follow-up, we will attempt to contact the participant by phone until reached, with a maximum attempt of twelve separate contacts.

7. Measures

7.1. Screening and eligibility measures

“Traumatic” event: The Criterion A screening items from the Clinician-Administered PTSD Scale for DSM-5 [63,64] (CAPS-5) will be used to determine whether individuals have experienced a traumatic event which meets diagnostic requirements for the first criteria for PTSD, this includes 1) directly experiencing the event, 2) witnessing the

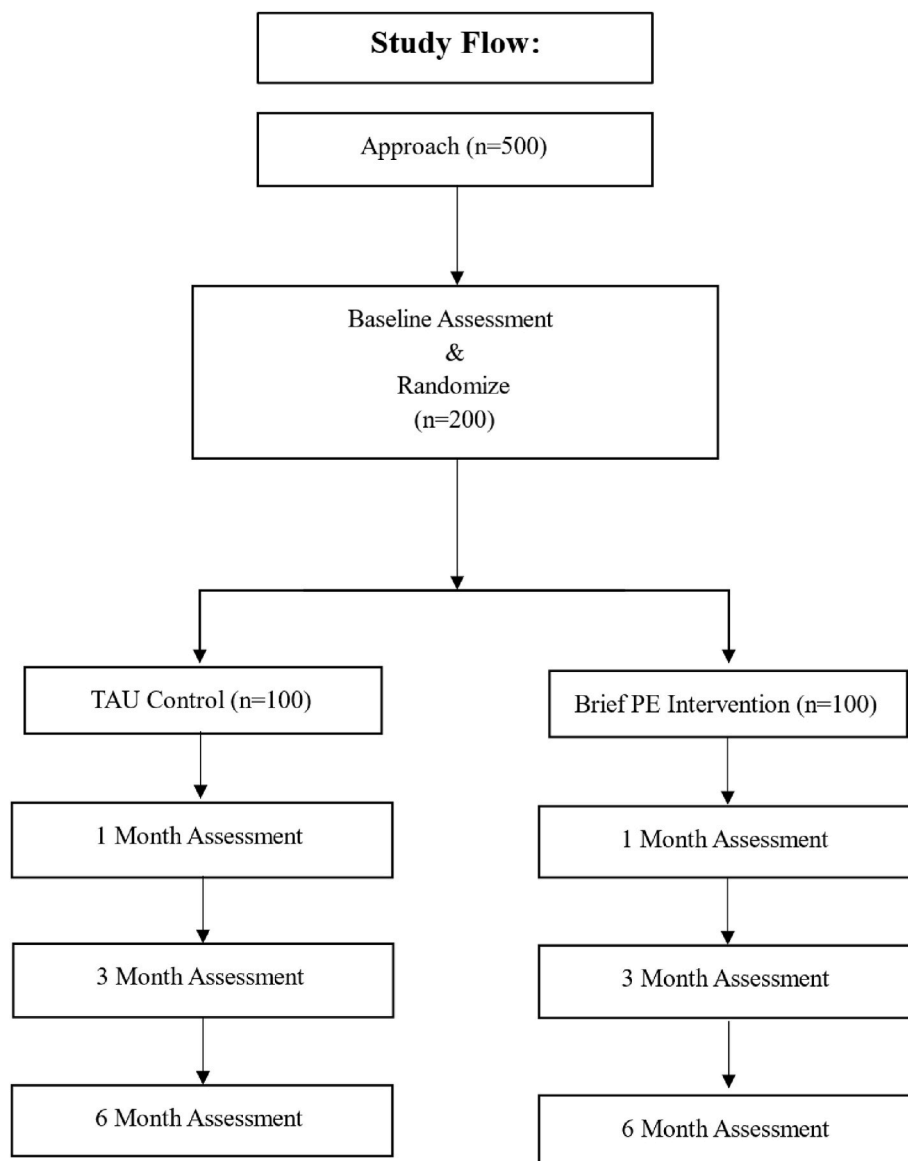


Fig. 2. Flow diagram for the 1:1 allocation of participants to TAU or Brief PE Intervention.

event in person, 3) learning an event happened to close family member or friend, or 4) experiencing repeated or extreme exposure to aversive details of the event (e.g. first responders).

Cognitive status: The Orientation-Log (O-Log) [65] will be used to screen for severe cognitive impairment to ensure that participants are able to understand and comply with the brief PE intervention. Severe cognitive impairment will be defined as less than a score of 25 on the O-Log, which is consistent with recommendations made for other rehabilitation populations [66].

7.2. Primary outcome measure (Aim 1)

PTSD Symptoms: The PTSD Symptom Scale – Interview for DSM-5 (PSSI-5) [45] is a 24-item, semi-structured interview that assesses PTSD symptoms in the past month, and makes a diagnostic determination based on the DSM-5 criteria. For this study, the index trauma will always be set as the spinal cord injury as done in the pilot trial [43]. Questions assess for PTSD symptoms corresponding to the 4 DSM-5 clusters of re-experiencing, avoidance, changes in mood and cognition, and arousal and hyperactivity, in addition to interference, distress, and duration of symptoms. The interviewer rates participant responses

to symptom questions on a 5-point scale of frequency and severity, from 0 (“Not at all”) to 4 (“6 or more times a week/severe”). This measure has been used in our ongoing studies [41,67–70] and will be conducted by a trained independent evaluator.

7.3. Secondary outcome measures (Aim 2)

Depression: The Patient Health Questionnaire 9-Item (PHQ-9) [46, 47] is a brief self-report measure of major depressive disorder (Kroenke et al., 2001). The PHQ-9 is a valid measure of depression for population-based studies and clinical populations with a cut off score of equal to or greater than 10 as the diagnostic for current depression.

Anxiety: Generalized Anxiety Disorder 7-Item (GAD-7) [48,49] is a 7-item questionnaire that measures severity of anxiety. Response options are “not at all,” “several days,” “more than half the days,” and “nearly every day,” scored as 0, 1, 2, and 3, respectively. Therefore, GAD-7 scores range from 0 to 21, with scores of 5, 10, and 15 representing mild, moderate, and severe anxiety symptom levels, respectively.

Pain: The Numeric Rating Scale (NRS) [50,51] is a commonly used validated measure of pain intensity.^{52,53} This 11-point rating scale

Table 2
Brief PE session content.

Session	Task (times are approximate)
1	<ul style="list-style-type: none"> • Introduce the intervention (5 min) • Imaginal exposure (30 min) • Process the imaginal exposure (10 min) • Identify behavioral exposure(s) for the coming week (5 min) • Explain normal reactions to trauma and identify self-care tasks for the coming week (5 min) • Breathing retraining (3 min) • Schedule next session (2 min)
2	<ul style="list-style-type: none"> • Review homework check-in (5 min) • Imaginal exposure (30 min) • Process the imaginal exposure (10 min) • Identify behavioral exposure(s) for the coming week (5 min) • Identify self-care tasks for the coming week (3 min) • Schedule next session (2 min)
3	<ul style="list-style-type: none"> • Review Homework (5 min) • Imaginal exposure (30 min) • Process the imaginal exposure (10 min) • Identify behavioral exposure(s) to continue working on after treatment ends (4 min) • Identify self-care tasks to continue prioritizing in the coming weeks/months (4 min) • Remind the patient to attend the 1, 3, and 6-month assessments (2 min)

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 [71] as a core outcome measure in clinical trials of chronic pain and is specifically recommended for SCI-related pain [52,53]. Participants will be asked to rate their worst pain over the past four weeks. Additionally, a second item asks about pain interference using a Likert-type scale ranging from “not at all” to “extremely”.

Quality of Life: Spinal Cord Injury Quality of Life (SCI-QOL) Positive Affect & Well-Being – Short Form [54,55] is a 10- item, self-report measure that assesses participants’ positive affect and well-being (e.g., “I thought positively about my future”) in the past 7 days on a Likert scale of 1–5, with 1 representing “never” and 5 representing “always.” The SCI-QOL is a product of the SCIMS program and was featured in the

Table 3
Schedule of measures.

Outcomes	Instrument	Baseline	BPE 1	BPE 2	BPE 3	Post-Int.	Follow Up	
		Omo				1mo	3mo	6mo
Aim 1								
PTSD	PSSI-5	X				X	X	X
Aim 2								
Depression	PHQ-9	X	X	X	X	X	X	X
Anxiety	GAD-7	X				X	X	X
Pain	NRS	X				X	X	X
QOL	SCI-QOL	X				X	X	X
Aim 3								
Feasibility (a)	Number of participants enrolled	X						
Feasibility (b)	Number of sessions completed					X		
Feasibility (c)	Fidelity of sessions					X		
Feasibility (d)	Patient satisfaction					X	X	X
Other Measures								
Trauma Symptoms	PDS-5	X	X	X	X	X	X	X
Sleep	PROMIS SDS	X				X	X	X
Resilience	CD-RISC	X				X	X	X
Demographics	Self-report & Medical Record	X						
Mental Status	O-Log	X						
Alcohol Use	AUDIT-C	X						
Drug Use	DAST-10	X						
Injury Data	Medical Record	X						
Suicide Assessment	C-SSRS*	X						

AUDIT-C: Alcohol Use Disorders Identification Test, concise version (AUDIT-C); Connor-Davidson Resilience Scale (CD-RISC); C-SSRS: Columbia – Suicide Severity Rating Scale; DAST-10: Drug Abuse Screening Test, 10-item; GAD-7: General Anxiety Disorder 7-item; NRS: Numeric Rating Scale of pain intensity; PDS-5: Post-traumatic Diagnostic Scale for DSM-5; PHQ-9: Patient Health Questionnaire 9-item; Orientation-Log (O-Log); PROMIS Sleep Disturbance Scale (PROMIS SDS); PSSI-5: PTSD Symptom Scale – Interview for DSM-5; SCI-QOL: Spinal Cord Injury – Quality of Life. *C-SSRS will also be administered as needed for safety reasons if participant endorses suicidal ideation.

2015 Journal of Spinal Cord Medicine. It has been demonstrated as a robust psychometric measurement tool [54,55].

Sleep Disturbance: The PROMIS Sleep Disturbance Scale [56] is a Common Data Elements measure [57] consisting of 8 items which assesses underlying sleep conditions over the past 7 days. It has been validated to assess sleep health broadly by converting raw scores to T-scores for interpretation (M = 50, SD = 10).

Resilience: Connor-Davidson Resilience Scale (CD-RISC) 10-item version [58] has been developed and tested as (i) a measure of degree of resilience, (ii) as a predictor of outcome to treatment with medication or psychotherapy, stress management and resilience-building; (iii) as a marker of progress during treatment (iv) as a marker of biological (i.e. physical); changes in the brain. The scale also has promise as a method to screen people for high, intermediate, or low resilience.

7.4. Feasibility and fidelity (Aim 3)

To assess the feasibility of delivering the modified brief PE intervention to people with SCI in the rehabilitation setting we will examine: (a) the number of participants who meet the inclusion criteria and agree to participate versus the total number of traumatic SCI admissions to the BSWIR, (b) the number of sessions completed by each participant randomized to the intervention condition, (c) fidelity of sessions in terms of percentage of necessary elements administered measured by therapist checklist and verified by expert review of session recordings (7 elements for session 1, 6 elements for session 2, and 6 elements for session 3), and (d) patient satisfaction measured by a two item questionnaire. The two patient satisfaction questions administered at 1, 3, and 6-months include: 1) How difficult was the treatment? (0 = Very Difficult, 1 = Somewhat Difficult, 2 = Neutral, 3 = Somewhat Easy, 4 = Very Easy), and 2) How helpful was the treatment? (0 = Very Unhelpful, 1 = Somewhat Unhelpful, 2 = Neutral, 3 = Somewhat Helpful, 4 = Very Helpful).

7.5. Additional measures

Demographic Data: Participant demographic variables will be

obtained through a standard self-report form and the patient's medical record at baseline and will include age, race, ethnicity, marital status, education level, employment, income, insurance status, veteran status, premorbid psychiatric history, and history of substance use.

Injury-related Data: Patient injury-related variables from the SCI will be obtained from the hospital trauma registry (TraumaBase CDM, Conifer, CO), maintained as a criterion for Level 1 trauma center designation by the American College of Surgeons-Committee on Trauma for the National Trauma Data Bank, for patients admitting to BSWIR. Variables will include Paraplegic vs tetraplegic – injury level (cervical, thoracic, lumbar) and level 1–12 as well as admit ASIA Impairment Scale (AIS).

History of Traumas and PTSD at Baseline: The Posttraumatic Diagnostic Scale for DSM-5 (PDS-5) [72] is a 24-item, self-report measure that assesses history of traumas and PTSD symptom severity over the last month according to the DSM-5 criteria [11]. Twenty questions assess the presence and severity of the PTSD symptoms in relation to the index trauma; symptom questions are based on the DSM-5 symptom clusters of re-experiencing (items 1–5), avoidance (6 and 7), changes in mood and cognition (8–14), and arousal and hyper-reactivity (15–20). 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”). An additional 4 items ask about distress and interference caused by PTSD symptoms, as well as onset and duration of symptoms. In this study, the PDS-5 will be used for the same purpose as in Rothbaum et al. (2012) [43] to document pre-existing traumas and PTSD from any Criterion A trauma at Baseline before the intervention begins.

7.6. Suicide assessment: Columbia – Suicide Severity Rating Scale (C-SSRS)

The Columbia Suicide Severity Rating Scale (C-SSRS) [73] will be administered to assess for suicidal ideation, intent, and behavior as well as self-injurious non-suicidal behaviors. The C-SSRS demonstrates good reliability and validity [73,74]. If participants are found to be at risk, assessors or therapists will complete the empirically validated Safety Plan worksheet with the participant [75].

7.7. Statistical methods

Analysis for Aim 1 will be based on total score of the PSSI-5 at each time point and a hierarchical linear model (HLM) will be used to evaluate the effectiveness of the PE intervention on PTSD symptoms across time. HLM will allow us to specify a time effect for each patient and has the added benefit of not removing a patient who misses a follow-up. 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 [76], 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. A reliable change index 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 [27,77], we will examine whether severity of injury, female gender, and pre-morbid mental health issues affect treatment. As such, each variable will be addressed in the HLM analysis as a covariate.

Analysis for Aim 2 will also be performed using HLM for each secondary outcome and separate models will be used to examine the effectiveness of the PE intervention on depression, anxiety, pain, quality of life, sleep disturbance, and resilience across time. Covariate analysis will follow the statistical plan from Aim 1.

Analysis for Aim 3 will include descriptive statistics on (a) percentage of participants who met criteria and agreed to participate relative to the number screened, (b) number of sessions completed by those

randomized to the intervention condition, (c) fidelity of sessions in terms of percentage of necessary elements administered at each session to those randomized to the intervention condition, (d) patient satisfaction - average scores for the difficulty and helpfulness of the intervention scales.

8. Discussion

Individuals with SCI may be at an increased risk for developing PTSD and related comorbidities following their spinal cord injury. Prior to our most recent clinical trial, no evidenced-based PTSD treatment had been tested among this population. PTSD treatment, and particularly prevention, remains insufficiently studied for individuals with SCI. We aim to conduct the first trial of brief PE (and only second trial of any evidence-based PTSD treatment) a brief version of the most research evidence-based psychotherapy for PTSD. The results of the proposed study could have implications for reducing or preventing posttraumatic symptoms and related secondary impact for individuals following acute rehabilitation after SCI.

Several design considerations deserve comment. First, we chose to not exclude patients post SCI with comorbid traumatic brain injury (TBI) or with comorbid chronic pain. This makes the data more generalizable to rehabilitation centers and is consistent with studying this early intervention among patients with the common polytrauma clinical triad (PTSD, TBI, chronic pain). This also gives us the ability to look at these different presentations through moderation analyses. Second, although not unique to this population, we will examine which part of the trauma and sequelae are most difficult.

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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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