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Trauma management therapy and compressed prolonged exposure therapy for the treatment of posttraumatic stress disorder in an active-duty military sample

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ABSTRACT

Efficacious treatments for PTSD, conducted with primarily veteran samples, include Prolonged Exposure and Trauma Management Therapy, both of which appear effective when delivered in an intensive outpatient protocol (IOP). Both TMT-IOP and compressed prolonged exposure (CPE) are grounded in exposure therapy but TMT includes Virtual Reality (VR) assisted individual exposure therapy, and a group therapy component. The study compared the efficacy of these compressed treatments (TMT-IOP and CPE) in an all active-duty sample ($n = 99$). The results indicated that both interventions were equally effective, with significant decreases on primary measures of PTSD and results were maintained at 6-month follow-up ($ps < .001$ for the CAPS-5 and PCL-5). Remission of PTSD symptoms was achieved by 68% of patients who completed CPE and 67% of patients who completed TMT-IOP, a difference that was not significant ($p > .05$). There were no group differences on measures of anger, general anxiety, depression, and general functioning; both groups demonstrated statistically significant decreases at posttreatment (all $ps < .05$) and maintenance at 6-month follow-up. The results are discussed in terms of the feasibility and efficacy of conducting IOPs at military installations and the necessity of additional interventions for the successful PTSD treatment in military populations.

1. Introduction

Posttraumatic stress disorder (PTSD) among military service members and veterans is common and often debilitating. Estimates of PTSD in service members returning from Iraq and Afghanistan range from 8% to 18% (Kok, Herrell, Thomas, & Hoge, 2012; Richardson, Frueh, & Acierno, 2010; Smith et al., 2008; Tanielian & Jaycox, 2008). However, risk of PTSD in the military is not limited to war zones, as estimates of military sexual trauma (MST) range from 20% to 40% among female military personnel (Hoge et al., 2004; Kelly, Skelton, Patel, & Bradley, 2011; Nichter, Holliday, & Monteith, 2022; Wilson, 2016). Moreover, risk of PTSD related to humanitarian assistance and disaster relief missions is also significant (Cunha, Shen, & Burke, 2018), and non-combat related trauma, accidents, and injuries are common in military environments (Eaton et al., 2011; Foa, Hembree, Rothbaum, & Rauch, 2019). Overall, military-related PTSD imposes significant emotional, functional, and societal costs and is a major public health issue.

Exposure therapy is a well-established gold-standard treatment for PTSD in both civilian and military populations. Prolonged exposure (PE) therapy (Foa et al., 2019) is recommended by all major practice guidelines as a first-line treatment (American Psychological Association [APA], 2025; International Society for Traumatic Stress Studies [ISTSS], 2018; National Institute for Health and Care Excellence [NICE], 2018; U. S. Department of Veteran Affairs [VA], 2017). PE fosters large reductions in PTSD symptoms, remission of diagnosis, and improved functioning and quality of life across trauma contexts and treatment settings (McLean & Foa, 2024; Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010; Rauch, Eftekhari, & Ruzek, 2012). Rooted in emotional processing theory (Foa & Kozak, 1986; Foa et al., n.d.), PE assists patients in identifying and approaching their most distressing traumatic memories and situations. Conducted in session, *imaginal exposures* are followed by processing, or brief discussions allowing patients to make

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meaning and new connections about their trauma, behaviors, and feelings, as they learn to approach rather than avoid the memory. Audio recordings of sessions are assigned for daily reviews between sessions. Likewise, avoided situations and safety behaviors are addressed via *in vivo exposures* assigned as homework. The PE protocol provides a structured platform to guide therapists through these procedures (Foa et al., 2019), with an emphasis on exposure adherence and emotional engagement during exposures as the core treatment components driving successful treatment outcome.

Trauma Management Therapy (TMT) (Frueh, Turner, Beidel, Mirabella, & Jones, 1996; Turner, Beidel, & Frueh, 2005), a similar evidence-based exposure therapy for PTSD, was developed for Vietnam-era veterans, with long term and intractable PTSD. Along with imaginal and in-vivo exposures, TMT includes a group component with skills training to improve interpersonal effectiveness and emotion modulation, which had not seemed to respond to exposure alone. A randomized controlled trial (RCT) with 37 Vietnam-era veterans comparing exposure therapy with and without the additional TMT components demonstrated efficacy in both arms for clinician-rated PTSD symptoms, nightmares, flashbacks, and anger. However, the TMT arm demonstrated an additional positive effect on the number and duration of time spent in social activities (Beidel, Frueh, Uhde, Wong, & Mentrikoski, 2011), providing a preliminary signal that adding programming could translate into additional benefits. Notably, given that effects of exposure therapy on PTSD measures are typically large and appear to generalize to co-occurring mental health issues (Rauch et al., 2012), it has been difficult for the field to demonstrate such augmentation effects on top of standard exposure protocols (Tuerk, 2014).

With respect to TMT, an RCT with 92 veterans and active-duty military personnel compared virtual-reality augmented exposure therapy for PTSD with and without the added TMT group protocol (Beidel et al., 2019). Results indicated that both treatment arms reduced PTSD, depression, anger, and nightmares, but the combined TMT protocol was more effective for improving time spent in social activities.

A revised TMT protocol (TMT-IOP) included virtual reality augmented exposures and group therapy components, including sleep hygiene, behavioral activation, social integration skills, and anger management and was delivered in a compressed (3-week format). A large-scale pilot of TMT-IOP with 112 veterans and active-duty personnel serving in Iraq or Afghanistan demonstrated efficacy for improving PTSD, sleep, anger, depression, and social isolation (Beidel, Frueh, Neer, & Lejuez, 2017).

Together, these two RCTs comparing exposure therapy for PTSD with and without the TMT group components indicated an augmentation effect on social functioning over and above exposure alone. However, these prior studies did not evaluate the TMT protocol against the standard and recommended PE protocol. Previously, direct comparisons would have been complicated by significant differences in the length of treatment, with PE typically delivered in weekly sessions over a few months and TMT typically delivered daily in an IOP model over a few weeks. However, PE has recently been adapted for delivery in daily, massed, or IOP models, facilitating direct comparisons with TMT.

Adaptations of PE for intensive delivery have been validated in several contexts by independent research groups. Massed PE has been shown to be feasible and effective in case studies (Blount, Cigrang, Foa, Ford, & Peterson, 2014; Straud, Blount, & Foa, 2022; Zwetzig, Koch, Blount, Graham, & Peterson, 2022) and in open trials and effectiveness studies (Aosved, Brown, Bell, & Palomo-Burns, 2025; Goetter, Tanev, & Lynch, 2021; Hendriks, de Kleine, Broekman, Hendriks, & van Minnen, 2018; Rauch, Yasinski, & Post, 2021; Yasinski, Watkins, & Maples-Keller, 2022), as well as in large scale high-quality RCTs (Dell et al., 2023; Foa, McLean, & Zang, 2018; Peterson, Blount, & Foa, 2023). Notably, there is no indication that massed treatment is less efficacious than standard delivery and dropout rates for massed conditions are significantly lower than historical rates in both open trials and RCTs: 3.7% (Rauch et al., 2021), 4.4% (Yasinski et al., 2022), 4.8% (Dell et al., 2023), 5% (Hendriks et al., 2018), 5.6% (Goetter et al., 2021), 13.6% (Foa et al., 2018), 19% (Aosved et al., 2025), 23% (Peterson et al., 2023).

Massed exposure protocols or IOP models are especially relevant in military contexts, where rapid treatments may minimize workforce disruptions and facilitate a course of care over one leave period. Rapid treatment models may also reduce stigma, demonstrating that effective treatment can be delivered over a brief timeframe and reinforcing a view of posttraumatic stress (PTS) as an operational injury—akin to physical wounds sustained in service (Beidel et al., 2020). Overall, evidence that individuals recover and return to duty following short-term interventions supports the view that prompt, focused care can restore readiness. Indeed, of the 14 investigations referenced above regarding massed PE or TMT, 12 of them were conducted with active duty or veteran populations. Given the growing interest in these IOP models and the additional time and resources needed for additional IOP programing (i.e., over, and above exposure therapy alone), it is imperative to directly compare the efficacy of these various approaches. Accordingly, the current trial seeks to contribute to this developing knowledge base by comparing a two-week trial of compressed PE (CPE) to a three-week trial of TMT (TMT-IOP) in a sample of active-duty military personnel. The specific hypotheses are as follows:

Hypothesis 1. TMT-IOP and CPE with be equally effective on core PTSD symptoms (as assessed by the CAPS-5 and PCL-5) and results will be maintained at follow-up.

Hypothesis 2. TMT-IOP will produce significantly greater decreases in depression, anger, and guilt than CPE and differences will be maintained at follow-up.

Hypothesis 3. TMT-IOP will result in significant increase socialization, quality of life and overall functioning than CPE and differences will be maintained at follow-up.

2. Method

The study protocol was registered with ClinicalTrials.gov (NCT02809326). The original study was a three-group comparison of CPE, TMT-IOP, and standard PE (Beidel et al., 2020). However, study delays because of the COVID-19 shutdown and additional precautions to protect military forces (extended delay before resuming "non-essential" research trials) resulted in an inability to complete the original design. Based on (a) emerging data (published after the trial initiation) that demonstrated equivalency between standard PE and CPE (Foa et al., 2018; McLean et al., 2022) and (b) time and financial constraints for the federal contract, a decision was made, in consultation with the funding source, to reduce the scope of the study to a two-group comparison of the two intensive outpatient programs (CPE vs. TMT-IOP).

2.1. Participants

Patients were recruited from three military installations (Dwight D. Eisenhower Army Medical Center, Naval Medical Center Camp Lejeune, and Naval Medical Center Portsmouth). Specifically, study personnel provided information to medical and mental health providers and invited referrals to the study. Informational leaflets were available in reception areas throughout the institutions. Individuals were eligible to participate if they were at least 18 years old, currently active-duty military, and met DSM-5 criteria for a diagnosis of PTSD because of military-related traumatic event. Exclusion criteria included acute cardiac problems, a history of moderate to severe traumatic brain injury, or a diagnosis of current moderate or severe substance use disorder, psychotic disorder, or antisocial personality disorder per DSM-5 criteria.

One hundred ninety-six (196) active-duty military personnel were recruited to the study. The intended sample size was 144, 72 for each group. The final analyzed sample was composed of 99 patients who met

inclusion criteria for the study, began treatment, and were included in the data analyses (see Fig. 1 for CONSORT Chart). Power analysis using G*Power indicated 95% power at $n = 90$ using an effect size of $d = .25$. Demographic information for patients included in the analysis is presented in Table 1.

2.2. Procedure

Study procedures were approved by the IRBs at each site, with Naval Medical Center Portsmouth serving as the IRB of record. Study procedures were consistent across the three sites. Following an initial telephone screen, potential participants completed an in-person eligibility assessment, where they provided written and verbal consent to participate. This assessment also served as the pretreatment assessment for patients who were randomized to the two treatment conditions. Prior to the start of data collection, a random number generator assigned patients in blocks of four to treatment conditions. Block randomization was necessary because the TMT-IOP condition included group therapy. Patients in the CPE condition started treatment immediately after the pretreatment assessment; patients in the TMT-IOP condition began treatment as soon as four eligible patients completed pre-assessment (no patient waited longer than one month after pretreatment assessment).

Posttreatment assessment occurred one week after treatment completion. Follow-up assessments occurred three- and six-months posttreatment completion. These assessment points were selected for two reasons. First, given this all-active-duty sample, there was concern that deployment or change in duty station would provide a significant decrement in sample size for longer follow-up periods. Second, the selected follow-up assessment points were consistent with other RCTs using the same population.

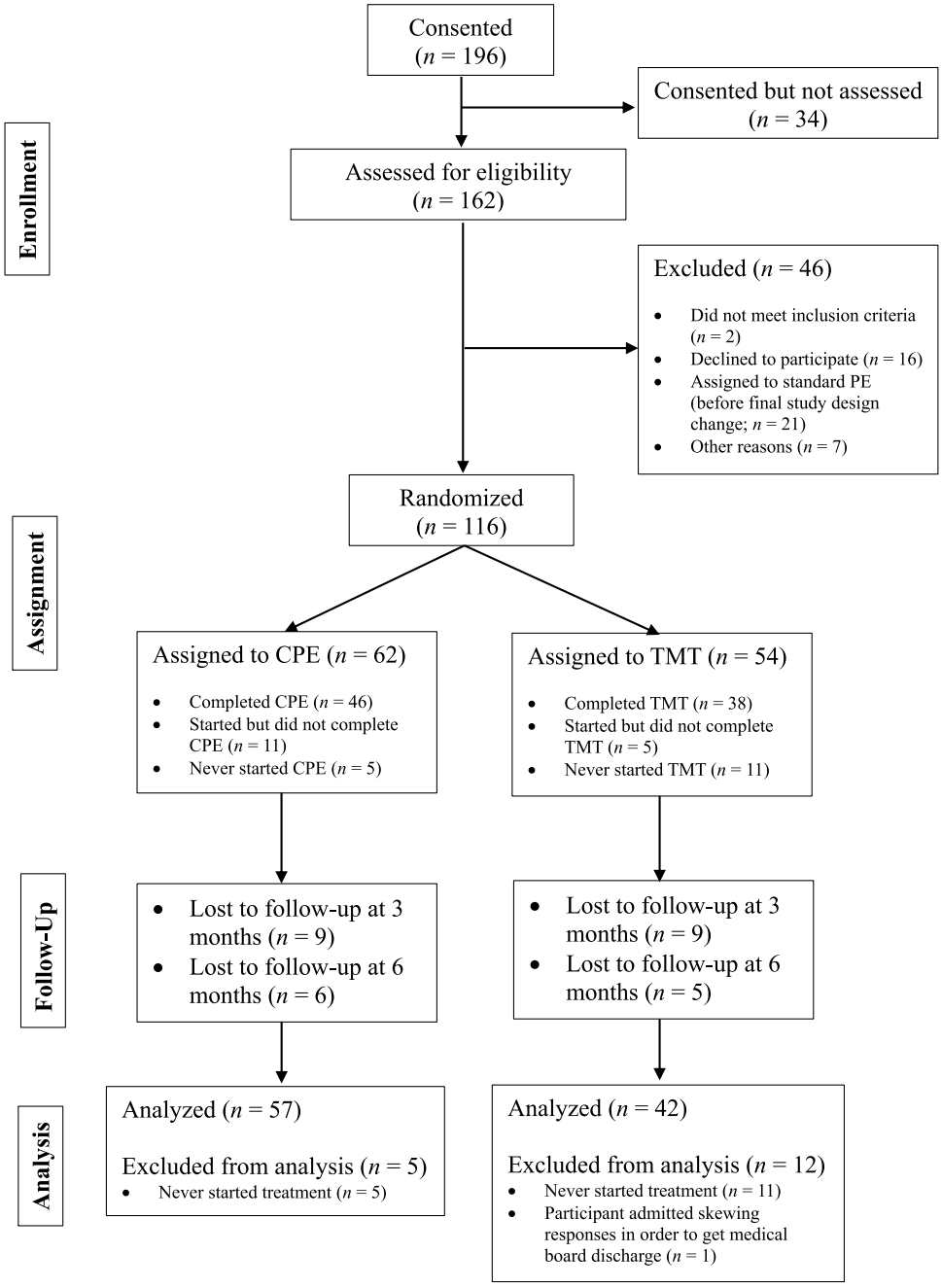


Fig. 1. CONSORT Chart.

Table 1
Sociodemographic Characteristics of Patients.

Characteristic	CPE (n = 57)		TMT-IOP (n = 42)		Combined Sample (n = 99)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age (years)	33.65	7.58	35.33	9.14	34.36	8.27
Number of Deployments	2.18	1.63	1.70	1.43	1.95	1.55
	n	%	*n*	%	*n*	%
Biological Sex						
Female	19	33.3	13	31.0	32	32.3
Male	38	66.7	29	69.0	67	67.7
Relationship Status						
Single	11	19.3	7	16.7	18	18.1
In a Relationship	6	10.5	2	4.8	8	8.1
Living with Partner	2	3.5	3	7.1	5	5.1
Married	30	52.6	25	60.0	55	55.5
Engaged	3	5.3	0	0.0	3	3.0
Divorced	3	5.3	5	11.9	8	8.1
Separated	2	3.5	0	0.0	2	2.0
Highest Level of Education Completed						
High School	11	19.3	6	14.3	17	17.2
Some College	18	31.6	18	42.9	36	36.4
Associate's Degree	11	19.3	6	14.3	17	17.2
Bachelor's Degree	10	17.5	7	16.7	17	17.2
Master's Degree	7	12.3	5	11.9	12	12.1
Race/Ethnicity						
White	25	43.9	16	38.1	41	41.4
Black or African American	21	36.9	12	28.6	33	33.3
Hispanic or Latino/a/x	7	12.3	9	21.4	16	16.2
Asian	0	0.0	3	7.1	3	3.0
Native Hawaiian or Pacific Islander	1	1.8	0	0.0	1	1.0
American Indian or Alaska Native	0	0.0	1	2.4	1	1.0
Other	3	5.3	1	2.4	4	4.0
Military Branch						
U.S. Army	33	57.9	32	76.2	65	65.7
U.S. Navy	8	14.0	5	11.9	13	13.1
U.S. Marine Corps	14	24.6	4	9.5	18	18.2
U.S. Air Force	1	1.8	1	2.4	2	2.0
U.S. Coast Guard	1	1.8	0	0.0	1	1.0

2.3. Measures

See Table 2 for a list of assessments and time points when they were administered.

2.3.1. PTSD Symptoms, and Other Trauma-Related Symptoms

2.3.1.1. Clinician Administered PTSD Scale for DSM-5 (CAPS-5; Weathers et al., 2013). This semi-structured interview assesses frequency and intensity of DSM-5 PTSD symptoms, with a composite rating assigned for each symptom. In a sample of military veterans, the CAPS-5 had high interrater reliability for both PTSD diagnosis (κ =.78–1.00) and total severity score (ICC =.91), good test-retest reliability for both PTSD diagnostic status (κ =.83) and severity score (ICC =.78), good internal consistency for the severity items (α =.88; Weathers et al., 2018), and good convergent and discriminant validity (Weathers et al., 2018).

Clinicians completed the online Veterans Affairs CAPS-5 training prior to administering any CAPS-5 interviews. The index trauma was determined by the patient's presenting complaint. In cases where multiple traumatic events had occurred, the event that produced the most frequent and severe symptoms, and identified by the patient as the most distressing, was used as the index trauma. Twenty percent of the interviews (across all assessment points) were rated by a masked CAPS-5 trained clinician to determine inter-rater reliability, with a resultant intra-class correlation of 0.90. The CAPS-5 was administered at all four assessment timepoints.

Table 2
Schedule of Assessments.

Measure	Pre-Tx	3rd Tx Session	Post-Tx	3 mo. Follow-up	6 Mo. Follow-up
CAPS-5	X		X	X	X
PCL-5	X		X	X	X
TRGI	X		X	X	X
PTCI	X		X	X	X
MIES	X		X	X	X
SCID for DSM-5	X				
SCID-5-PD	X				
PHQ-9	X		X	X	X
GAD-7	X		X	X	X
DAR-5	X		X	X	X
Tx Expectancy		X			

2.3.1.2. PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013). This self-report measure assesses how much the patient has been "bothered by" each of the 20 DSM-5 PTSD symptoms, with ratings on a scale from (0) not at all to (4) extremely. The total score ranges from 0 to 80. In a study with veterans, PCL-5 scores had excellent internal consistency (α =.96) and good test-retest reliability (r = .84), and good convergent and discriminant validity (Bovin et al., 2016). Internal consistency for this active-duty sample across all time points was α = .95. This questionnaire was administered at all four assessment timepoints.

2.3.1.3. Trauma-Related Guilt Inventory (TRGI; Kubany et al., 1996). This 32-item measure assesses three aspects of trauma-related guilt cognitions (global guilt, distress, and guilt cognitions). Each item is rated from 0 to 4 with response anchors varying by item. In a sample of veterans, internal consistency estimates were excellent (α =.90–.94), and test-retest reliability correlations were good (r = .84–.86; Kubany et al., 1996). Internal consistency for this active-duty sample across all time points was α = .91. This questionnaire was administered at all four assessment timepoints.

2.3.1.4. Posttraumatic Cognitions Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999). This 36-item measure assesses three domains: negative cognitions about self, negative cognitions about the world, and self-blame. Each item is rated on a 1 (*totally disagree*) to 7 (*totally agree*) scale. In a sample of adult volunteers, internal consistency for the total score was excellent (α =.97), test-retest reliability over one- and three-week periods was good, and convergent and discriminant validity were demonstrated (Foa et al., 1999). Internal consistency for this active-duty sample across all timepoints was α = .91. This measure was administered at all four assessment timepoints.

2.3.1.5. Moral Injury Event Scale (MIES; Nash et al., 2013). This 9-point item self-report measure assesses psychological distress associated with violations of moral standards. Each item is rated from 1 (*strongly disagree*) to 6 (*strongly agree*). A total score is computed by summing across all items. The scale has good internal consistency (α =.90), temporal stability, and construct validity using a sample of Marines (Nash et al., 2013). Internal consistency for this active-duty sample across all timepoints was α = .89. This measure was administered at all four assessment timepoints.

2.3.2. Symptoms of Other Mental Health Conditions

2.3.2.1. Structured Clinical Interview for DSM-5, Clinician Version (SCID-5-CV; First, Williams, Karg, & Spitzer, 2015). This structured clinical interview assesses symptoms of depressive, bipolar, anxiety, obsessive-compulsive, and psychotic disorders. Previous research has demonstrated good reliability and high specificity of diagnoses from the

SCID-5-CV (Osório et al., 2019). This interview was administered only at pretreatment to identify co-morbid diagnoses, and no inter-rater reliability evaluation was conducted.

2.3.2.2. Structured Clinical Interview for DSM-5, Personality Disorders (SCID-5-PD; First, Williams, Benjamin, & Spitzer, 2016). The antisocial personality disorder module of the SCID-5-PD was administered at pretreatment only to establish study eligibility.

2.3.2.3. Patient Health Questionnaire-9 (PHQ-9; Kroenke & Spitzer, 2002). This 9-item self-report measure assesses depressive symptoms. Each item rated on a 0 (*not at all*) to 3 (*nearly every day*) scale, and a total score is computed. PHQ-9 scores were reported to be reliable and valid (Kroenke & Spitzer, 2002; Titov et al., 2011), including in a sample of veterans (Ahmadi et al., 2023). Internal consistency for this active-duty sample across all timepoints was α = .90. This measure was administered at all four assessment timepoints.

2.3.2.4. Generalized Anxiety Disorder Scale-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). On this 7-item general anxiety scale, each item is rated from 0 (*not at all*) to 3 (*nearly every day*); responses are summed to compute a total score. Reliability and validity of the GAD-7 have been established (Spitzer et al., 2006; Löwe et al., 2008), including in a sample of veterans (Ahmadi et al., 2023). Internal consistency for this active-duty sample across all timepoints was α = .92. This measure was administered at all four assessment timepoints.

2.3.2.5. Dimensions of Anger Reactions-5 (DAR-5; Forbes et al., 2014). On this 5-item measure of anger, each item is rated from 1 (*none or almost none of the time*) to 5 (*all or almost all the time*); responses are summed to compute a total score. The reliability and validity of the DAR-5 have been established in university, trauma-exposed, and veteran samples (Forbes, Alkemade, Mitchell, et al., 2014; Forbes, Alkemade, Hopcraft, et al., 2014). Internal consistency for this active-duty sample across all timepoints was α = .91. This measure was administered at all four assessment timepoints.

2.3.3. Social and occupational functioning

2.3.3.1. World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0; Üstün et al., 2010). On this 36-item measure, patients rate their health difficulties on a scale from 1 (*none*) to 5 (*extreme or cannot do*). The scale assesses impairment in six domains: cognition, mobility, self-care, having a good relationship with people, life activities (at home and work), and participation in society. It has good internal consistency, excellent test-retest reliability at the domain level, and good concurrent validity (Üstün et al., 2010). Internal consistency for this active-duty sample across all timepoints was α = .96. This measure was administered at all four assessment timepoints.

2.3.3.2. The Quality of Life Scale (QOLS; Burckhardt & Anderson, 2003). This 16-item measure assesses subjective quality of life across 6 domains: independence, recreation, personal development/fulfillment, material/physical well-being, relationships with others, and community/civic involvement. Satisfaction is rated from 1 (*terrible*) to 7 (*delighted*), and a total score is the sum of the items. The scale had good psychometric properties (see Burckhardt & Anderson, 2003). Internal consistency for this active-duty sample was α = .91. This measure was administered at all four assessment timepoints.

2.4. Treatment

Master's level therapists provided treatment for both conditions. TMT-IOP training was provided by a developer of TMT-IOP (Beidel), and training in CPE was conducted by a certified PE trainer (Tuerk). Each training course consisted of one 2- to 3-day workshop that included didactic instruction and role-play practice sessions, with observation and feedback. Treatment manuals were provided to all therapists, and weekly supervision sessions were held with the trainer of the assigned treatment (TMT-IOP – Beidel; CPE – Tuerk).

To assess treatment integrity, independent raters evaluated the content of audio-recorded therapy session, marking the presence of key therapeutic strategies via an inclusive checklist derived from key elements of each treatment condition. All therapy sessions were recorded, and therapists were unaware of which sessions were evaluated. Twenty percent of the sessions were randomly selected for evaluation of treatment integrity. Results indicated treatment adherence rates of 91% for CPE and 95% for TMT-IOP. In all cases, non-adherence resulted from treatment elements that should have been included in the treatment session but were not. There were no instances of non-adherence resulting from cross-treatment contamination.

To assess outcome expectancy, each participant completed the Credibility/Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000) at the third treatment session. Three items from the CEQ addressing how logical the treatment seems, how confident patients are about treatment, and whether they would recommend the treatment to another person suffering from the same condition were used in this investigation. Items are rated on a 9-point scale, with higher ratings indicating greater credibility. Overall, both treatments were rated as (a) very logical (*M*=6.9 [CPE], *M*=7.1 [TMT-IOP]) and (b) somewhat to very useful (*M*=6.0 [CPE], *M*=7.0 [TMT-IOP]). Both groups reported feeling very confident recommending the treatment to a friend (*M*=7.0 [CPE], *M*=8.0 [TMT-IOP]) with no difference between groups.

2.4.1. Trama management therapy intensive outpatient program (TMT-IOP)

TMT (Turner et al., 2005) is a multicomponent behavioral treatment targeting various aspects of chronic PTSD – reducing emotional and physiological reactivity to traumatic cues, reducing intrusive symptoms and avoidance, improving interpersonal skills and emotion modulation (e.g., anger control), and increasing the range of enjoyable social activities. In this study, TMT-IOP included virtual-reality augmented exposure therapy, therapist-accompanied in vivo exposure, assigned in vivo exposure activities outside of sessions, and group therapy to address sleep (2 sessions of sleep hygiene and CBT-I), anger (4 sessions of anger management), depression (4 sessions of behavioral activation), and social isolation (3 sessions of social reintegration). One additional session was devoted to relapse prevention. TMT-IOP consists of 40 treatment hours.

In TMT-IOP, each participant received virtual-reality assisted exposure therapy to their index trauma in the morning (5 days per week) followed by in vivo exposure and group therapy each afternoon. Unlike in CPE (see below) where exposure sessions are conducted for a specific period of time, exposure therapy in TMT-IOP is continued until within sessions habituation is achieved. Early sessions are longer (75–90 min) and later sessions are shorter (20–30 min). Initially targeted at 4–6 patients per group, the referral rate for the current trial supported groups consisting of 4 patients.

2.4.2. Compressed Prolonged Exposure Therapy (CPE)

CPE consists of psychoeducation, imaginal exposure to the memory of the patient's index trauma, in vivo exposure to situations that are avoided due to their association with the trauma, and emotional processing. The standard protocol consists of 10 sessions delivered over consecutive weekdays and consists of 36 total treatment hours. Session 1 consists of the treatment rationale, gathering information about trauma-history, and identification of the most currently disturbing trauma. Session 2 includes education about trauma-related symptoms, construction of an in-vivo hierarchy, and the rationale for and initial assignment of in-vivo exposure activities. Individuals begin confronting items lower on the hierarchy, and as they are successful, they confront

the more feared items. Imaginal exposure begins in session 3, in which the patient recounts the trauma aloud for 45–60 min. Beginning with session 4 and continuing throughout the remaining sessions, the procedure includes review of homework, imaginal exposure for 30–45 min, a discussion of the imaginal exposure (emotional processing), and the assignment of homework to be completed between sessions. All sessions are audio recorded and patients are instructed to listen to the recordings between sessions. The CPE protocol used has been previously described (Beidel et al., 2020; Dell et al., 2021) and validated in a military treatment context (Dell et al., 2023) with the same parameters and trainer (Tuerk).

The current protocol is materially consistent with other compressed PE protocols (i.e., Foa et al., 2018; Peterson et al., 2023; Rauch et al., 2021), except for minor scheduling specifications intended to maximize opportunities for patient-directed in vivo exposures within the compressed format. First, the current 10-day protocol specifies that Session 1 does not commence on a Monday, thereby allowing two full weekends of in vivo homework practice and generalization during the truncated course of care. Second, the protocol presumes that sessions are scheduled in the morning to provide patients sufficient time to complete in vivo assignments later in the day. Neither the Foa et al. 10-day protocol nor the Peterson et al. 12-15-day protocol specify these procedures. In the latter case, however, the longer treatment duration potentially minimizes the assumed benefits of these protections. Likewise, the Rauch et al. (2021) protocol is imbedded within a broader intensive outpatient program (IOP) that includes structured group-based and therapist-assisted in vivo practice, again reducing the potential need to optimize out-of-session patient time for self-directed in vivo practice. Finally, for patients who have not responded adequately by Session 10, the current protocol permits assignment of additional in vivo homework at Session 10 together with a follow-up telephone call one week later.

3. Results

3.1. Pretreatment Attrition

Four patients dropped out of CPE after randomization but before the first treatment session, as did 11 patients from TMT-IOP, a difference that was significantly different, X^2 (1, N= 115) = 4.82, p<.05. For CPE, 2 patients (50%) were diagnosed with medical conditions (immediately after assessment but before treatment) that resulted in study exclusion and 2 (50%) did not give a reason. For TMT-IOP, 3 patients (27%) did not give a reason, whereas 1 (9%) developed a medical condition necessitating intensive treatment, 1 (9%) changed their mind about participation, and 1 (9%) was deployed prior to starting treatment. Five (45%) reported that they would be unable to commit to a treatment schedule that encompassed a complete day for three contiguous weeks (see Discussion).

3.2. Treatment Dropouts

Among those who attended at least one treatment session, 11 (23.9%) dropped out from CPE and 5 (13.2%) from TMT-IOP, a result that was not significantly different, X^2 (1, N=100) =1.07, p > .05. Five CPE dropouts (45%) did not give a reason, 2 (18%) indicated that therapy took too much time, 1 (9%) stated that therapy was too stressful, 1 (9%) developed unrelated legal issues, 1 (9%) developed an unrelated medical condition requiring immediate treatment, and 1 (9%) cancelled so many appointments that treatment completion within the two-week protocol could not occur. For TMT-IOP, 4 patients (80%) did not give a reason, whereas 1 (20%) indicated insufficient time for therapy. These results suggest that most reasons for non-participation (either prior to treatment or early discontinuation) had to do with the time necessary to participate in these IOPs.

3.3. Iatrogenic effects of treatment

There were no iatrogenic effects – no instances of suicidal ideation or attempts, increased substance use or depression as assessed by weekly AUDIT or PHQ-9 scores.

3.4. Data analytic strategy

Data were analyzed using Linear Mixed Effects Regression Models with the Jamovi GAMLJ module. All results were analyzed using all participants who completed at least one treatment session, except for one participant who was eliminated for admitted malingering. All analyses used Random Effects Maximum Likelihood estimation. See Table 3 for means and standard deviations for all measures.

3.5. Primary Outcome Measures

According to the study protocol, treatment groups had to show a statistically significant reduction in CAPS-5 or PCL-5 scores at

Table 3
Means and standard deviations of study measures.

Measure	TMT-IOP *M* (*SD*)	CPE *M* (*SD*)	Omnibus Test Results
CAPS-5			
Pre	38.70 (10.56)	39.60 (10.65)	G (p > .05)
Post	22.30 (10.72)	21.40 (10.37)	T (p < .05)
3-month f/u	25.20 (10.24)	20.70 (10.40)	G x T (p < .05)
6-month f/u	25.70 (9.95)	20.30 (9.91)	
PCL-5			
Pre	50.60 (15.61)	51.60 (15.86)	G (p > .05)
Post	31.50 (15.83)	31.00 (15.46)	T (p < .05)
3-month f/u	33.30 (15.25)	29.80 (15.02)	G x T (p > .05)
6-month f/u	34.20 (14.55)	27.90 (14.54)	
TRGI			
Pre	60.30 (22.30)	62.80 (22.65)	G (p > .05)
Post	43.50 (22.36)	50.60 (21.90)	T (p < .05)
3-month f/u	45.00 (21.34)	48.10 (20.98)	G x T (p > .05)
6-month f/u	43.70 (20.27)	44.70 (20.22)	
PTCI			
Pre	137.00 (36.54)	136.00 (37.15)	G (p > .05)
Post	110.00 (37.21)	113.00 (36.41)	T (p < .05)
3-month f/u	116.00 (36.06)	110.00 (35.57)	G x T (p > .05)
6-month f/u	112.00 (34.54)	103.00 (34.48)	
MIES			
Pre	33.00 (11.15)	30.30 (11.33)	G (p > .05)
Post	34.90 (11.27)	35.00 (11.05)	T (p < .05)
3-month f/u	33.40 (10.88)	33.30 (10.71)	G x T (p > .05)
6-month f/u	33.20 (10.39)	36.50 (10.35)	
PHQ-9			
Pre	14.80 (5.64)	15.29 (5.74)	G (p > .05)
Post	10.99 (5.06)	10.54 (5.55	T (p < .05)
3-month f/u	12.01 (5.44)	10.13 (5.35)	G x T (p > .05)
6-month f/u	11.40 (5.17)	9.51 (5.16)	
GAD-7			
Pre	14.13 (5.46)	14.23 (5.55)	G (p > .05)
Post	10.65 (5.47)	9.63 (5.35)	T (p < .05)
3-month f/u	11.12 (5.22)	10.14 (5.13)	G x T (p > .05)
6-month f/u	11.23 (4.95)	8.34 (4.94)	
DAR-5			
Pre	13.69 (4.80)	14.05 (4.88)	G (p > .05)
Post	10.88 (4.86)	9.42 (4.76)	T (p < .05)
3-month f/u	11.34 (4.69)	10.09 (4.62)	G x T (p > .05)
6-month f/u	11.91 (4.48)	9.44 (4.47)	
WHODAS			
Pre	53.40 (14.63)	52.90 (14.87)	G (p > .05)
Post	46.30 (14.60)	46.80 (14.31)	T (p < .05)
3-month f/u	49.70 (13.91)	45.80 (13.68)	G x T (p > .05)
6-month f/u	49.60 (13.23)	43.80 (13.15)	
QOL			
Pre	63.80 (15.81)	61.70 (16.08)	G (p > .05)
Post	65.50 (15.89)	67.60 (15.53)	T (p < .05)
3-month f/u	68.80 (15.20)	71.60 (14.96)	G x T (p < .05)
6-month f/u	65.40 (14.46)	73.60 (14.43)	

posttreatment before other outcomes could be analyzed.

3.5.1. CAPS-5

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), session (pre, post, 3-month, 6-month), and their interaction, with random intercepts for patients (N=99; total observations = 303). The model converged successfully and showed good fit, with conditional $R^2 = .70$ and marginal $R^2 = .35$. The main effect of treatment was not statistically significant, $F(1, 103) = 1.48$, $p = .226$, whereas the main effect of time was significant, $F(3, 214) = 97.99$, $p < .001$. The interaction between treatment and time was also significant, $F(3, 214) = 2.71$, $p = .046$.

Parameter estimates indicated significant decreases in CAPS scores at post-session ($b = -17.23$, $SE = 1.10$, $p < .001$), 3-month ($b = -16.43$, $SE = 1.22$, $p < .001$), and 6-month sessions ($b = -16.03$, $SE = 1.29$, $p < .001$) relative to pre-treatment. Significant interaction effects suggested that the CPE group experienced a greater decline in CAPS scores at 3 months ($b = 5.01$, $SE = 2.44$, $p = .041$) and 6 months ($b = 6.67$, $SE = 2.58$, $p = .010$) compared to TMT-IOP. Random intercept variance for patients was 60.0 ($SD = 7.75$, $ICC = .52$), with residual variance of 55.3 ($SD = 7.44$). Model fit indices supported the model (AIC = 2380, BIC = 2418). The pre-post treatment effect sizes were very large for both TMT-IOP and CPE, $d = 1.54$ and 1.73, respectively.

3.5.2. PCL-5

A similar analysis examined the effects of treatment (TMT-IOP - CPE), session (pre, post, 3-month, 6-month), and their interaction on PCL-5 scores, with random intercepts for patientid (N=99; total observations = 305). The model showed good fit with conditional $R^2 = .69$, $df = 8$, and marginal $R^2 = .27$, $df = 7$ (both $p < .001$). Model fit indices were AIC = 2380 and BIC = 2418.

Omnibus tests revealed no significant main effect of treatment, $F(1, 109) = 0.29$, $p = .593$. The main effect of time was significant, $F(3, 211) = 66.94$, $p < .001$, but the treatment × time interaction was not significant, $F(3, 211) = 1.61$, $p = .188$.

Fixed effects (reference: pre) included an intercept of $b = 36.18$, $SE = 1.35$, 95% CI [33.51, 38.84], $t(123) = 26.71$, $p < .001$. The TMT-IOP - CPE effect was $b = 1.43$, $SE = 2.67$, 95% CI [–3.82, 6.67], $t(133) = 0.54$, $p = .593$.

Time effects (vs. pre) showed declines: post $b = –19.95$, $SE = 1.57$, 95% CI [–23.05, –16.86], $t(228) = –12.69$, $p < .001$, $d = -.84$; 3-month $b = –19.55$, $SE = 1.75$, 95% CI [–22.99, –16.11], $t(230) = –11.19$, $p < .001$, $d = -.74$; 6-month $b = –19.98$, $SE = 1.85$, 95% CI [–23.61, –16.35], $t(229) = –10.82$, $p < .001$, $d = -.71$.

Interaction effects were nonsignificant at post, $b = 2.02$, $SE = 3.15$, 95% CI [–4.16, 8.21], $t(228) = 0.64$, $p = .521$; and 3 months, $b = 5.18$, $SE = 3.50$, 95% CI [–1.71, 12.07], $t(230) = 1.48$, $p = .140$; but significant at 6 months, $b = 8.22$, $SE = 3.69$, 95% CI [0.96, 15.49], $t(229) = 2.23$, $p = .027$. Random intercept variance for patient id was 153 ($SD = 12.4$, ICC =.58), and residual variance was 112 ($SD = 10.6$).

3.5.3. PTSD Diagnosis at Posttreatment

Based on the CAPS-5, 68% of patients who completed CPE treatment and 67% of patients who completed TMT-IOP treatment no longer met diagnostic criteria for PTSD at posttreatment, a difference that was not significant, $X^2(2, N=55) = 0.93$, $p > .05$. At six-month follow-up, 5 patients in the TMT-IOP group and 2 in the CPE group met criteria for relapse (i.e., no diagnosis of PTSD at posttreatment but met criteria at follow-up), a difference that was not significant (Fisher's Exact Test, $p > .05$).

3.6. Secondary Outcome Measures - Additional Measures of PTSD Symptoms

3.6.1. PTCI

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction on secondary outcome scores, with random intercepts for patientid (N=99; total observations = 327). All mixed effect models converged successfully with good fit indices.

Omnibus tests indicated no significant main effect of treatment, $F(1, 107) = 0.23$, $p = .66$. The main effect of time was significant, $F(3, 212) = 19.05$, $p < .001$, but the treatment × time interaction was not significant, $F(3, 212) = 0.97$, $p = .407$.

Fixed effects (reference: pre) included an intercept of $b = 116.16$, $SE = 3.13$, 95% CI [110.01, 122.30], $t(120) = 37.17$, $p < .001$. The effect of TMT-IOP - CPE treatment was $b = 1.21$, $SE = 6.17$, 95% CI [−10.93, 13.30], $t(106) = 0.20$, $p = .845$.

Time effects relative to pre-treatment showed significant decreases: post $b = -25.21$, $SE = 3.91$, 95% CI [−32.90, −17.50], $t(211) = -6.45$, $p < .001$, $d = -.43$; 3-month $b = -22.85$, $SE = 4.34$, 95% CI [−31.39, −14.30], $t(216) = -5.27$, $p < .001$, d = -.35; 6-month $b = -28.06$, $SE = 4.58$, 95% CI [−37.08, −19.00], $t(211) = -6.12$, $p < .001$.

Interaction effects were not statistically significant at post $b = -2.78$, $SE = 7.81$, 95% CI [−18.15, 12.60], $t(211) = -0.36$, $p = .722$; 3-month $b = 7.82$, $SE = 8.70$, 95% CI [−9.30, 24.90], $t(216) = 0.90$, $p = .370$; or 6-month $b = 11.13$, $SE = 9.17$, 95% CI [−6.92, 29.20], $t(219) = 1.21$, $p = .226$.

Random intercept variance for patientid was 767 ($SD = 27.7$, ICC =.52), and residual variance was 695 ($SD = 26.4$).

3.6.2. MIES

The same analysis was conducted using the MIES as the dependent variable. Omnibus tests revealed no significant main effect of treatment, $F(1, 111) = 0.03$, $p = .864$. The main effect of time was significant, $F(3, 213) = 3.15$, $p = .03$. The treatment × time interaction was not statistically significant, $F(3, 213) = 1.78$, $p = .151$.

Fixed effects (reference group: pre) indicated a significant intercept predicting mean MIES scores, $b = 33.56$, $SE = 0.96$, 95% CI [31.67, 35.45], $t(102) = 34.95$, $p < .001$. The treatment effect was not statistically significant, $b = -0.33$, $SE = 1.89$, 95% CI [−4.04, 3.39], $t(111) = -0.17$, $p = .864$.

Time effects showed significant increases relative to pre-treatment at post ($b = 3.21$, $SE = 1.13$, 95% CI [0.99, 5.42], $t(121) = 2.85$, $p = .005$, $d = .19$) and 6 months ($b = 3.28$, $SE = 1.32$, 95% CI [0.68, 5.88], $t(216) = 2.48$, $p = .014$, $d = .16$), but not at 3 months ($b = 1.94$, $SE = 1.25$, 95% CI [−0.52, 4.40], $t(219) = 1.55$, $p = .123$).

The treatment × time interaction was significant only at 6 months, $b = -5.93$, $SE = 2.65$, 95% CI [−11.14, −0.73], $t(219) = -2.24$, $p = .026$, indicating that the increase in MIES scores at 6 months was less pronounced for the TMT-IOP group relative to CPE. Interactions at post and 3 months were not significant.

3.6.3. TRGI

A linear mixed-effects model examined the effect of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction. Omnibus tests revealed no significant main effect of treatment, $F(1, 116) = 0.33$, $p = .552$. The main effect of time was significant, $F(3, 212) = 24.96$, $p < .001$, but the treatment × time interaction was not significant, $F(3, 212) = 0.66$, $p = .577$.

Fixed effects (reference: pre) included an intercept of $b = 49.74$, $SE = 2.01$, 95% CI [45.79, 53.68], $t(103) = 24.80$, $p < .001$. The TMT-IOP - CPE effect was nonsignificant, $b = -4.53$, $SE = 3.93$, 95% CI [-12.26, 3.19], $t(116) = -0.59$, $p = .55$.

Time effects relative to pre showed significant declines: post $b = -14.50$, $SE = 2.09$, 95% CI [-18.63, −10.38], $t(212) = -6.92$, $p < .001$,

d = -.46; 3-month $b = -14.81$, $SE = 2.33$, 95% CI [-19.40, −10.23], $t(215) = -6.36$, $p < .001, d = -.42$; 6-month $b = -17.08$, $SE = 2.46$, 95% CI [-21.92, −12.24], $t(217) = -6.94$, $p < .001, d = -.46$.

Interaction effects were nonsignificant across time: post $b = -4.18$, $SE = 4.19$, 95% CI [-12.42, 4.06], $t(212) = -1.00$, $p = .319$; 3-month $b = 0.10$, $SE = 4.67$, 95% CI [-9.08, 9.28], $t(215) = 0.02$, $p = .983$; 6-month $b = 2.33$, $SE = 4.92$, 95% CI [-7.35, 12.01], $t(217) = 0.47$, $p = .636$.

3.7. Secondary outcome measures - additional measures of psychological distress

3.7.1. DAR-5

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction. Omnibus tests revealed no significant main effect of treatment, $F(1, 116) = 1.98$, $p = .162$. The main effect of time was significant, $F(3, 208) = 23.06$, $p < .001$, but the treatment × time interaction was not significant $F(3, 208) = 2.31$, $p = .078$.

Fixed effects (reference: pre) included an intercept of $b = 11.40$, $SE = 0.43$, 95% CI [10.56, 12.24], $t(98) = 26.77$, $p < .001$. The TMT-IOP - CPE effect was nonsignificant, $b = 0.98$, $SE = 0.84$, 95% CI [-0.67, 2.63], $t(108) = 1.17$, $p = .245$.

Time effects relative to pre showed significant declines: post $b = -3.77$, $SE = 0.49$, 95% CI [-4.74, −2.81], $t(210) = -7.70$, $p < .001, d = -.52$; 3-month $b = -3.14$, $SE = 0.54$, 95% CI [-4.21, −2.07], $t(214) = -5.77$, $p < .001, d = -.38$; 6-month $b = -3.21$, $SE = 0.58$, 95% CI [-4.34, −2.08], $t(217) = -5.58$, $p < .001, d = -.37$.

Interaction effects indicated were not significant at post, $b = 1.93$, $SE = 0.98$, 95% CI [-0.001, 3.85], $t(210) = 1.97$, $p = .050$; nonsignificant at 3 months, $b = 1.85$, $SE = 1.09$, 95% CI [-0.29, 4.00], $t(215) = 1.70$, $p = .091$; but significant at 6 months, $b = 2.83$, $SE = 1.15$, 95% CI [0.57, 5.08], $t(215) = 2.45$, $p = .015$.

3.7.2. GAD-7

The same linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction. Omnibus tests revealed no significant main effect of treatment, $F(1, 111) = 1.11$, $p = .289$. The main effect of time was significant, $F(3, 206)$ 28.16, $p < .001$, and the treatment × time interaction was not significant, $F(3, 206) = 2.09$, $p = .102$.

Fixed effects (reference: pre) included an intercept of $b = 11.22$, $SE = 0.49$, 95% CI [10.25, 12.19], $t(98) = 20.85$, $p < .001$. The TMT-IOP - CPE effect was nonsignificant, $b = 0.83$, $SE = 0.97$, 95% CI [-1.07, 2.73], $t(111) = 0.86$, $p = .389$.

Time effects relative to pre showed significant declines: post $b = -4.11$, $SE = 0.50$, 95% CI [-5.09, −3.13], $t(207) = -8.24$, $p < .001$, d = -.55; 3-month $b = -3.56$, $SE = 0.56$, 95% CI [-4.65, −2.47], $t(210) = -6.42$, $p < .001$, d = -.43; 6-month $b = -4.38$, $SE = 0.59$, 95% CI [-5.54, −3.23], $t(210) = -7.48$, $p < .001, d = -.50$.

Interaction effects were nonsignificant at post, $b = 1.20$, $SE = 1.00$, 95% CI [-0.77, 3.16], $t(207) = 1.20$, $p = .232$, and 3 months, $b = 1.27$, $SE = 1.11$, 95% CI [-0.91, 3.46], $t(210) = 1.15$, $p = .253$, but significant at 6 months, $b = 3.22$, $SE = 1.17$, 95% CI [0.92, 5.53], $t(211) = 2.75$, $p = .006$.

3.7.3. PHQ-9

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction. Omnibus tests revealed no significant main effect of treatment, $F(1, 107) = 0.23$, $p = .636$. The main effect of time was significant, $F(3, 205) = 29.27$, $p < .001$, and the treatment × time interaction was not significant, $F(3, 205) = 2.21$, $p = .088$.

Fixed effects (reference: pre-control) included an intercept of $b = 11.81$, $SE = 0.51$, 95% CI [10.80, 12.81], $t(95) = 23.20$, $p < .001$. The TMT-IOP - CPE effect was nonsignificant, $b = 0.47$, $SE = 1.00$, 95% CI [-1.49, 2.44], $t(107) = 0.48$, $p = .636$.

Time effects relative to pre showed significant declines: post $b = -4.34$, $SE = 0.54$, 95% CI [-5.41, −3.27], $t(206) = -8.01$, $p < .001, d = -.54$; 3-month $b = -4.03$, $SE = 0.60$, 95% CI [-5.22, −2.85], $t(209) = -6.70$, $p < .001, d = -.45$; 6-month $b = -4.48$, $SE = 0.64$, 95% CI [-5.73, −3.23], $t(210) = -7.05$, $p < .001, d = -.48$.

Interaction effects were nonsignificant at post, $b = 1.03$, $SE = 1.08$, 95% CI [-1.10, 3.16], $t(206) = 0.95$, $p = .342$, but significant at 3 months, $b = 2.48$, $SE = 1.21$, 95% CI [0.11, 4.86], $t(210) = 2.06$, $p = .041$, and 6 months, $b = 2.82$, $SE = 1.27$, 95% CI [0.32, 5.32], $t(210) = 2.22$, $p = .028$.

3.8. Secondary outcome measures – social, familial, and functional impairment

3.8.1. QOL

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction on QOL scores. Omnibus tests revealed no significant main effect of treatment, $F(1, 10) = 0.63$, $p = .386$. The main effect of time was significant, $F(3, 210) = 7.92$, $p < .001$, and the treatment × time interaction was significant, $F(3, 210) = 2.83$, $p = .039$.

Fixed effects (reference: pre-treatment control) included an intercept of $b = 67.48$, $SE = 1.42$, 95% CI [64.69, 70.26], $t(99) = 47.68$, $p < .001$. The TMT-IOP - CPE treatment effect was not significant, $b = -2.42$, $SE = 2.78$, 95% CI [-7.88, 3.05], $t(110) = -0.87$, $p = .386$.

Time effects showed significant increases relative to pre-treatment at post ($b = 3.46$, $SE = 1.55$, 95% CI [0.41, 6.50], $t(210) = 2.23$, $p = .027$, $d = .15$), 3 months ($b = 7.53$, $SE = 1.72$, 95% CI [4.15, 10.91], $t(214) = 4.38$, $p < .001, d = .49$), and 6 months ($b = 6.76$, $SE = 1.82$, 95% CI [3.19, 10.34], $t(214) = 3.72$, $p < .001$, d = .25).

Interactions indicated the TMT-IOP group experienced less increase in QOL compared to CPE at 6 months, $b = -10.44$, $SE = 3.63$, 95% CI [-17.59, −3.29], $t(215) = -2.87$, $p = .004, d = .19$; interactions at post and 3 months were not significant.

3.8.2. WHODAS

A linear mixed-effects model examined the effects of treatment (TMT-IOP - CPE), time (pre, post, 3-month, 6-month), and their interaction on WHODAS scores. Omnibus tests revealed no significant main effect of treatment, $F(1, 111) = 0.40$, $p = .653$. The main effect of time was significant, $F(3, 208) = 10.28$, $p < .001$, while the treatment × time interaction was not significant, $F(3, 208) = 1.89$, $p = .132$.

Fixed effects (reference: pre) indicated an intercept of $b = 48.25$, $SE = 1.32$, 95% CI [45.66, 50.84], $t(99) = 36.66$, $p < .001$. The treatment effect was nonsignificant, $b = 1.33$, $SE = 2.58$, 95% CI [-3.74, 6.40], $t(111) = 0.52$, $p = .606$.

Time effects showed significant decreases relative to pre: post $b = -6.82$, $SE = 1.36$, 95% CI [-9.50, −4.15], $t(208) = -5.02$, $p < .001, d = -.34$; 3-month $b = -5.44$, $SE = 1.51$, 95% CI [-8.41, −2.46], $t(212) = -3.60$, $p < .001 d = -.24$; 6-month $b = -6.41$, $SE = 1.60$, 95% CI [-9.55, −3.27], $t(212) = -4.01$, $p < .001$, d = -.27.

Interaction effects were nonsignificant at post, $b = -1.05$, $SE = 2.72$, 95% CI [-6.40, 4.30], $t(208) = -0.39$, $p = .700$, 3 months, $b = 3.78$, $SE = 3.03$, 95% CI [-2.18, 9.74], $t(212) = 1.25$, $p = .214$, and 6 months, $b = 5.70$, $SE = 3.19$, 95% CI [-0.58, 11.98], $t(212) = 1.79$, $p = .076$.

Random intercept variance for patientid was 155.8 ($SD = 12.48$, ICC =.65), with residual variance of 82.4 ($SD = 9.08$).

4. Discussion

This investigation revealed that both CPE and TMT-IOP were effective treatments for active-duty military personnel with PTSD. Both treatments were judged to be equally credible by the patients.

Furthermore, both treatments significantly decreased primary PTSD symptoms, with reductions maintained at six-month follow-up. At the three- and six-month follow-up, the CPE group had significantly lower scores on the CAPS-5 than the TMT-IOP group. The reason for this difference is unclear but may have to do with the treatment protocols, where the CPE group had additional exposure therapy sessions (via listening to digital recordings of their therapist led exposure sessions) whereas skills- based trainings were the focus of the TMT-IOP group sessions. It should be noted that the significant group difference in CAPS-5 scores at follow-up was not replicated for the PCL-5, which may reflect differences in assessment strategy (i.e., clinician-rated vs self-report).

Based on the CAPS-5 data, 68% of patients treated with CPE and 67% of patients treated with TMT-IOP no longer met diagnostic criteria for PTSD at posttreatment, and few patients had relapsed at 6-month follow-up, with no significant difference in relapse based on treatment group. Overall, these results are consistent with previous trials of TMT and TMT-IOP with primarily veteran samples (Beidel et al., 2017, 2019) and previous trials of CPE with veterans and active-duty personnel (Dell et al., 2023; Foa et al., 2018; Peterson et al., 2023), suggesting that both of these intensive treatment protocols produce substantial and lasting impact on PTSD symptoms.

After documenting significant improvement on the PTSD primary measures (CAPS-5 and PCL-5), further analyses revealed that both interventions significantly decreased posttraumatic cognitions and trauma-related guilt, with benefits maintained at follow-up. CPE, like traditional PE, includes a processing component within each treatment session, where patients are queried directly about their thoughts and feelings and therapists assist patients in making meaning out of any changes over time (Foa et al., 2019). TMT-IOP does not include this component, yet both groups had equivalent decreases on these variables. These results suggest that specific processing of trauma-related cognitions within treatment sessions may not be necessary for efficacious exposure therapy, although it may be helpful for a particular patient.

In contrast, neither treatment had a significant effect on moral injury, as assessed by the MIES. Whereas scores of the CPE group appeared to worsen from pretreatment to 6-month follow-up, scores for the TMT-IOP group at 6-month follow-up returned to baseline. Since this study's initiation, MIES scores are more commonly interpreted as correlates of psychopathology (e.g., PTSD symptoms, suicidal ideation) rather than as a treatment outcome measure (e.g., Jordan, Eisen, Bolton, Nash, & Litz, 2017; Maguen et al., 2023; Wisco et al., 2016), and interpretation of treatment outcome must be considered in light of that revised conceptualization. In general, there is a need for further research on this important element of military trauma. Psychometric data from moral injury assessment measures (Coady, Hawkins, Chartoff, Litz, & Frankfurt, 2021), and a review of moral distress/injury noted that these assessments, including the MIES (Maguen et al., 2023), frequently confound experiences of potentially morally injurious events with distress related to these events (Houle et al., 2024).

TMT and TMT-IOP developed because exposure therapy alone appeared less effective for Vietnam veterans with a 30-year history of PTSD (Turner et al., 2005). Since then, highly standardized exposure therapy protocols have reduced this concern (Goodson, Lefkowitz, Helstrom, & Gawrysiak, 2013; Yoder et al., 2012; Yoder et al., 2013). In the current investigation with all active-duty personnel, both TMT-IOP and CPE were equally effective in decreasing anger and depression and in improving general functioning. These results could suggest that there is no need for the group component in TMT, and by extension, potentially the group components in other exposure therapy protocols as well. Such conclusions, if replicated, must be tempered by two considerations. First, it may be that some associated emotions (e.g., depression, anger) become entrenched as the chronicity increases. When trauma is more recent, specific attention to these additional variables may not be necessary. This conclusion would be consistent with a recent pilot study where the individual component of VR assisted exposure therapy alone successfully treated first responders recently diagnosed with PTSD (Beidel et al., 2024).

A second consideration is the difference in the trauma types and context for this investigation and previous studies of TMT in both formats. As noted above, all previous investigations were limited to combat trauma. In this investigation, trauma type was expanded to include any traumatic event that occurred during military service (e.g., military sexual trauma, training accidents, witnessing the impact of drone operations). Although the sample size did not allow us to examine the groups separately by type of trauma, recent outcomes and a meta-analysis (Straud, Siev, Messer, & Zalta, 2019) typically do not find a difference in treatment efficacy for PTSD by trauma type (assault vs combat), in spite of earlier signals to the contrary (Turner et al., 2005). Although trauma type and duration may not be consistent predictors of exposure therapy outcome, the context of trauma, an individual's service experiences, personal preferences, openness to group support, and method of study recruitment (all largely under-examined as predictors of treatment outcome) may yet play significant roles in discovering who does and who does not benefit from adding a group component to a gold-standard exposure therapy. Thus, firm conclusions regarding when and with whom group components added to other exposure therapies are necessary will await further investigations.

This investigation provides evidence that treating active-duty military personnel in an IOP format is well-accepted, efficacious, and despite the short program length or perhaps because of it, does not result in high rates of relapse. One area where treatment group differences did emerge was the rate of pretreatment attrition, where significantly more individuals assigned to TMT-IOP decided not to participate, primarily due to the extensive daily time commitment. It is important to point out that the initial TMT-IOP trial (Beidel et al., 2017) required all patients to travel to Orlando, FL where the intervention was delivered at a specialty clinic and active-duty personnel were considered to be on temporary duty status (TDY). Therefore, one question surrounding TMT-IOP's efficacy was the impact of receiving treatment in a place other than one's official duty station. In this investigation, once patients were informed of the treatment condition, significantly more people assigned to TMT-IOP dropped out of treatment due to time constraints, when compared to CPE. Patients expressed the belief that despite command assurances, staffing shortages meant no one could backfill their assignment and they would have to complete their work before or after time spent in the treatment program. To address this challenge and be able to offer the interventions at their duty station, one alternative may be to break up the components of TMT-IOP, providing the exposure therapy first and then offering the elements of group treatment only to those who demonstrate a need, and perhaps on a weekly, rather than daily schedule. Beyond this potential logistic tweak to TMT-IOP, the field in general is still awaiting data to inform the relative impact of PTSD IOP services delivered locally versus delivered to those who travel for treatment and are thus insulated from daily stresses.

As with any RCT, this study has several limitations. First, although sufficiently powered, the sample size was smaller than originally proposed. Participant recruitment had just started when COVID-19 shutdowns resulted in the program's suspension for several months and, on one site, for almost a year. We were unable to recoup the lost funding and lost time, resulting in a smaller than proposed sample. Second, as discussed above, the perception by some individuals that they could not participate because of staffing shortages prevented patients from receiving care that could be beneficial for their overall wellness. Third, the outcomes reported in this investigation are clinician ratings and self-report measures of anxiety, depression, and social interaction were assessed by self-report. The original protocol included blood samples and sputum, which were objective measures designed to examine biomarker predictors of treatment and genetic markers of individuals more likely to benefit from treatment. Although the samples were collected, funding cuts at the federal level resulted, to date, in an

inability to analyze the samples. The importance of inclusion of objective measures is further supported by a separate paper, which assessed sleep variables using sleep actigraphy, which found that at six month follow-up, TMT-IOP (and most likely the specific inclusion of cognitive-behavioral strategies to address sleep difficulties within the group treatment) demonstrated improvement in sleep efficiency and sleep quality and also decreased frequency of awakenings after sleep onset when compared to CPE (Cifre et al., 2026). Although self-report may remain the only viable option to assess treatment outcome in many instances, it is important to acknowledge that different outcomes may emerge based on assessment methodology.

Another limitation of this trial also serves as a marker of robustness for the treatment modalities; the project therapists engaged and trained for this project, none of whom had prior CBT experience, were also impacted by COVID in their own lives and by administrative onboarding issues within the DoD related to COVID disruptions, leading to therapist attrition. Accordingly, the trial used a fair number of novice CBT therapists who did not benefit from the experience of providing the treatments over longer periods of time. Although a more stable workforce may have translated into larger effect sizes, the team was still able to produce positive treatment outcomes.

Finally, it is important to point out that TMT-IOP includes the use of virtual reality as part of the exposure therapy. Once quite expensive, the cost of using virtual reality has decreased over the past decade. Sophisticated hardware has become less expensive and advances in AI have lessened the time needed to develop the VR scenarios needed for exposure therapy. Nevertheless, there are additional costs when incorporating VR including the upfront cost of purchasing the hardware and software, as well as learning to use and maintain all the elements of the system. Furthermore, pre-existing VR scenarios may not always cover the myriad of traumatic events experienced by military personnel, which can sometimes lead to less-than-optimal immersive experiences, and therapeutic efficacy, for some participants.

With respect to the clinical impact of IOP programs, it is important to recognize that the provision of exposure therapy for veterans with PTSD has been the subject of numerous clinical trials, whereas there have been fewer clinical trials with samples restricted to all active-duty personnel. In addition to the well-stablished evidence-base for the efficacy of massed exposure, the provision of intensive treatment programs for PTSD allows military personnel to quickly return to their duty station. The IOP treatment format may also reduce the stigma that PTSD treatment will always require years of treatment. In fact, IOP formats are similar to the provision of medical care for physically injured patients; like physical therapy, PTSD can be treated efficiently and effectively in a short period of time. Yet, some patients dropped out of the research study after treatment assignment but before beginning treatment and the most common reason was that they could not devote so much time to treatment as there was no one to back fill their job. Thus, the most optima strategy of IOP treatment for active-duty personnel may be a temporary duty assignment to a different military installation where there are no explicit or implicit demands that they return to their job after a full day of treatment.

In summary, both CPE and TMT are efficacious when delivered in an IOP format for active-duty personnel with military trauma. Both treatments resulted in significant decreases in primary and secondary outcome variables and high rates of diagnostic remission. The group intervention component of TMT-IOP did not produce any added benefits for depression, anger, or social/general functioning, with both groups demonstrating significant improvement on these variables. Finally, all groups maintained their treatment gains through follow-up. The results suggest that these interventions are portable to military installations and capable of dissemination throughout the behavioral health programs in the military.

CRediT authorship contribution statement

Deborah C. Beidel: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Peter W. Tuerk:** Writing – review & editing, Writing – original draft, Supervision, Investigation, Conceptualization. **Clint A. Bowers:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Amie R. Newins:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition. **Christine Seaver:** Writing – review & editing, Project administration, Data curation. **Shawna Grover:** Writing – review & editing, Supervision, Project administration. **Michael J. Franks:** Writing – review & editing, Supervision, Project administration.

Ethics

The study had Naval Medical Center Portsmouth IRB approval.

CIP statement

Research data derived from an approved Naval Medical Center, Portsmouth, Virginia IRB, protocol.

Disclaimer

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IRB approval statement

The study protocol was approved by the Naval Medical Center Portsmouth Institutional Review Board in compliance with all applicable Federal regulations governing the protection of human subjects.

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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.

Data availability

The data in this investigation, even in a deidentified format, are considered by the Department of Defense to be Confidential Unclassified Information (CUI). As such, they are not accessible to the general public.

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