

# Exposure Therapy with and without Virtual Reality to Treat PTSD while in the Combat Theater: A Parallel Case Series

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## Abstract

Exposure therapy (ET) has been observed to be an effective modality for the treatment of combat-related posttraumatic stress disorder (PTSD). Recently, efforts have been made to use virtual reality (VR) to enhance outcome with modes of ET. How such therapy applies to service members who are facing the reality of a combat deployment has been unknown. This case series documents the first use of VR-based therapy to the treatment of PTSD in a combat theater. Results of therapy are reported from a mental health clinic in Camp Fallujah, Iraq. Combat PTSD constituted a relatively small percentage of overall mental health patients seen. Those who did present with PTSD were offered VR-based ET or traditional ET. Patients who received either treatment modality showed significant gains, and no service member in treatment had to be medically evacuated because of ongoing PTSD symptoms. This demonstrates that ET, with or without the use of VR, can be an effective means of helping service members with mental health issues while they serve in theater.

## Introduction

THE UNITED STATES has been at war since 2001. This has been the longest combat engagement in U.S. history fought without a draft. Whereas the existence of an all-volunteer force has advantages, it also means that the bulk of the fighting falls upon a relative few. Individuals face war, come home, and then go out to the battlefield again. Some of these service members will have experienced traumatic events in their early deployments and be suffering from posttraumatic stress disorder (PTSD).<sup>1</sup>

The U.S. military has been aggressive in developing screening programs to identify PTSD<sup>2</sup> and in funding programs for treatment.<sup>3</sup> Any screening program is only as good as what an individual discloses, however.<sup>4</sup> Both the reality of stigma and the need to minimize it mean that some individuals with PTSD will deploy again. Properly supporting these service members means being able to treat PTSD while in theater.

Treatments for PTSD include both the traditional and the innovative. The modality of therapy that has accumulated the greatest modality of evidence is exposure therapy (ET).<sup>5</sup> In

the last several years, studies have demonstrated attempts to enhance and reformulate modes of ET by using virtual reality (VR) simulations.<sup>6</sup> There are few studies showing its relative efficacy compared to other modes of therapy, but over 18 reports have been published using some form of VR therapy for posttraumatic symptoms (reviewed in Wiederhold and Wiederhold<sup>7</sup>). Although still one of the newer forms of treatment available, VR has entered the mainstream.

Whether VR therapy or other modes of treatment are effective when delivered within a combat theater is still an open question. One study reported positive results of ET performed in Iraq for the prevention of PTSD in theater.<sup>8</sup> There is a long history of treating mental health issues "at the front."<sup>9</sup> For the most part, however, what has been effective in theater has remained unpublished. We do not believe that VR had ever been deployed for the treatment of combat PTSD prior to this report.

In February 2007, two of the authors (RNM and CM) deployed with the First Marine Expeditionary Force to Camp Fallujah in Iraq. They served as the base's Navy psychiatrist and Navy psychologist respectively. Both had been administering ET to service members with PTSD for some time in

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their stateside practices. The senior author (RNM) had also been participating in two trials of VR-based therapy for combat PTSD and using modes of VR therapy in clinical practice for treatment of combat stress. At the time of deployment, one of the collaborators in the stateside research (Virtual Reality Medical Center) donated a portable set of VR machines to take to Iraq. This case series reports on the outcomes seen in service members with PTSD who were treated with VR and traditional ETs while in theater.

## Materials and Methods

### Overview

This article documents a retrospective record review of patients treated for deployment-related PTSD in Camp Fallujah Iraq from February 2008 to November 2008. Specifically, records were reviewed for cases in which service members were treated using either traditional ET<sup>10</sup> or a VR-based therapy<sup>11,12</sup> and in which standardized measures of symptom severity were administered. Available records were reviewed, but due to the nature of record storage in a combat theater, we cannot guarantee that this was a comprehensive sample. Also, procedures were not standardized as they might have been in a research protocol. There was no fixed reasoning behind which patients would receive a particular form of treatment, or for that matter, a fixed way in which treatment was administered. Rather, treatment was always based on clinical judgment, willingness and practicality of a patient participating in a particular modality of therapy, and the availability of resources. What is reported here should therefore be viewed as an amalgamation of clinical experience rather than any form of formally tested evidence meant to support or refute the use of a particular mode of therapy.

### Patients and records reviewed

Patients treated in this study were all active-duty service members deployed to Al Anbar Province, Iraq, from February to November 2008. All had sought treatment at the Combat Stress Clinic in Camp Fallujah, Iraq. All patients gave informed consent to mental health treatment. Patients did not specifically give consent to the release of their records; therefore, all individual identifying information is removed from this report, and only amalgamated data is reported. Information was taken from the medical record in regard to diagnosis, mode of therapy, presence or absence of simultaneous medication treatment, age, gender, branch of service, prior deployments, number of therapy sessions received, duration of therapy, and scores on the PTSD Checklist, Military version (PCL-M) at the beginning and end of treatment.

### Location of treatment

Therapy was provided at the Combat Stress Clinic of Fallujah Emergency facility of Camp Fallujah. Camp Fallujah was a Marine base located outside the city of Fallujah, Iraq. It has since been returned to Iraqi national control but, at the time was the headquarters for the First Marine Expeditionary Force, which had military control of Al Anbar Province. The medical facility was set up to stabilize patients on their way to a higher level of care. The Combat Stress Clinic was staffed by a military psychologist and psychiatrist and addressed acute stress issues as well as the greater mental health needs of

service members in the area. Each therapist had an office located within the larger emergency facility. The psychologist (CM) was also assigned to the Regimental Combat Team One (RCT-1) and traveled between Camp Fallujah and outlying bases as part of mental health outreach. Hospital beds could be temporarily assigned to mental health purposes if needed, but symptoms that required more than a short psychiatric hospitalization were medically evacuated out of theater. Service members who were part of the RCT-1 were initially assigned to the psychologist for evaluation, and those in the Combat Logistics Battalion were assigned to the psychiatrist. As a practical matter, service members often saw whomever was available. Most service members seen by the clinic were U.S. Marines or Navy personnel, but the clinic also served other forces in the area, including a substantial number of Army National Guard. Camp Fallujah was a relatively safe place within Iraq at the time. The base came under indirect fire only once during the entire period covered. Combat deaths from improvised explosive devices (IEDs) and other mechanism were still occurring in the surrounding areas, and casualties, both physical and mental, were seen at the Fallujah facility. Psychiatry saw just over 175 patients during the 6-month period and just over 900 patient visits. Psychology saw 330 patients during a 10-month period and just over 1,300 patient visits, with some overlap between the individual patients seen.

### Therapy provided

Therapy was provided as part of regular, clinical practice. Therefore, procedures were not standardized. However, in general, patients who met with one provider (RNM) received VR therapy, and patients who met with the other (CM) received traditional ET.

Traditional ET based on the methods of Foa et al.<sup>10</sup> was administered. In this method, a patient with PTSD respectively recounts his or her trauma narrative to the therapist during sessions (imaginal exposure) and physically faces stimuli related to the trauma (in vivo exposure) between sessions.

VR therapy was administered based on one of two protocols: virtual reality exposure (VRE)<sup>10</sup> or virtual reality exposure with arousal control (VRE-AC).<sup>11</sup> VRE is similar to traditional PE, with the largest difference being that aspects of the trauma are illustrated for the patient within a VR simulator while the patient narrates the trauma experience. VRE-AC uses physiological monitoring to teach arousal control, and then has the patient use this skill to tolerate increasing levels of trauma-related stress in the VR simulator. VRE-AC, unlike VRE, does not require the patient to identify or focus on a particular trauma event. As a practical matter, a blend of the two VR methods was often applied, in which physiological monitoring was used first to allow the patient to build trust and the ability to tolerate the stress of therapy. If the patient could identify a particular trauma, he or she was then asked to recount the narrative within the simulation, as would be performed in VRE.<sup>11</sup>

The nature of the environment required some modifications to the way that both traditional and VR-based therapy would normally be performed. In particular, timing of sessions was dependent on military realities. Normally, therapy would have been scheduled for once or twice a week for 6 to

12 weeks. In this case, patients were seen as often as possible, which sometimes was more than twice a week but more often was more spread out. Therapy went on anywhere from 10 days to 13 weeks (see Table 1). Some individual therapy sessions also had to be interrupted by medical emergencies; during such times the providers were assigned to the larger, medical staff of the facility. Also, ET usually requires the patient to listen to recordings of the session between visits. Voice recorders were not always available. Finally, the largest difference between therapy reported here and that described in many manuals<sup>10,13</sup> is that all patients were, by necessity, receiving a form of in vivo therapy. They were all in Iraq and facing trauma-related cues every day. As some of these cues involved a realistic threat of being retraumatized, homework assignments involved asking patients to face more socially related trauma cues, such as eating with others or calling loved ones.

*Virtual reality apparatus*

VR machinery and software was donated to the U.S. Navy by Virtual Reality Medical Center. Hardware and software used here was similar to that described elsewhere<sup>12</sup> except that laptop rather than desktop computers were used. Patients were initially taught arousal control and received physiologic monitoring by use of a J&J Engineering biofeedback system. When connections to the biofeedback system failed early into the deployment, portable biofeedback units (StressErasers), donated by Helicore Inc., were substituted. VR simulation of situations from Iraq and Afghanistan were provided by means of a two-computer system. The client computer provided 3D images of wartime situations viewed through a head-mounted display (HMD). Movement of the HMD and a joystick controller allowed the participant to move and interact with the simulated world. The second computer served as controller and was used by the therapist to control sights and sounds within the simulation to re-create situations such as a base camp, battlefield, Iraqi marketplace, or military convoy coming under attack.

*Measure of PTSD severity*

Symptom severity was tracked using the PCL-M,<sup>14</sup> a self-report scale in which a patient rates the severity of the 17 DSM-IV symptoms of PTSD on a scale from 1 (*no symptoms*) to 5 (*extreme problems*) over the past month. Scores on the PCL-M range from 17 to 85. Because the scale's lower end is 17 and not 0, percentage of improvement on the scale is reported after subtracting 17 from all scores. To meet criteria for PTSD according to the PCL-M, a respondent must rate as moderate (3) at least one criteria B symptom, three criteria C symptoms, and two criteria D symptoms corresponding with a DSM diagnosis of PTSD. A respondent is considered to meet criteria for PTSD if clinical criteria are met and total severity score is 50 or higher.<sup>14</sup> Previous studies have found that the PCL-M has a high correlation with the CAPS and is an accurate reflection of PTSD symptom severity.<sup>14</sup> The PCL-M was used as part of standard procedures in first-time interviews in the Combat Stress clinic and was readministered periodically during treatment.

*Additional measures*

Some patients also received standardized measures of depression and anxiety. These were used consistently in patients who were receiving VR therapy but only intermittently in those receiving traditional ET. Therefore' data was gathered on these measures only for those patients in VR treatment. The Patient Health Questionnaire (PHQ-9) was used as the measure of depressive symptoms.<sup>15</sup> The PHQ-9 is a self-report measure asking frequency of symptoms corresponding to the nine DSM-IV symptoms for major depressive disorder over the past 2 weeks. The PHQ-9 is part of the Primary Care Evaluation of Mental Disorders (PRIME-MD) and has been well validated in assessing depressive symptoms.<sup>15</sup> The Beck Anxiety Inventory (BAI) was used to quantify anxiety symptoms. It is a well-validated, extensively used<sup>16</sup> self-report measure developed to assess anxiety symptoms as separate from those of depression.<sup>17</sup>

TABLE 1. DEMOGRAPHIC VARIABLES, AMOUNT OF TREATMENT, AND CHANGES IN PTSD SEVERITY ON THE PCL-M IN PATIENTS WHO RECEIVED VR THERAPY AND TRADITIONAL ET

	VR		Traditional	
	Mean	Range	Mean	Range
<i>n</i>	6		4	
Age	26.5	21–37	24.5	22–29
Male gender	100%		100%	
USMC	33%	(50% Army)	75%	
Enlisted	100%		100%	
Prior Dx/Tx	83%		25%	
On medication	67%		25%	
Months of Sx	29.8	6–48+	5.8	5–6+
Prior deployments	1.7	0–3	1.0	0–1
No. sessions	6.5	3–10	9	5–16
Length of Tx	6.4	10 d–13 wk	10	7–12 wk
Pre-PCL-M	54.8 ± 3.7	45–66	48.8 ± 4.2	42–61
Post-PCL-M	29.5 ± 3.0	23–43	25.8 ± 5.0	17–39
PCL-M change	25.3 ± 3.8	12–37	23.0 ± 3.4	22–29

USMC, United States Marine Corps; Dx, diagnosis; Tx, treatment; Sx, symptoms; PCL-M, PTSD Checklist–M.

### Statistics

Demographic statistics were gathered for descriptive purposes. Means, standard errors, percentages, and ranges are reported. Scores on the PCL-M were compared before and after treatment in either VR or traditional ET. Repeated measures ANOVA was used to compare the effect of treatment (between pre and post) and treatment type on PCL-M score.

For patients who received VR treatment before, scores on the PHQ-9 and BAI were compared before and after treatment by paired *t* tests.

### Results

Six patients with chronic PTSD were treated with VR. Four patients were treated with traditional ET. Demographics for these patients are given in Table 1. Mean scores on the PCL-M before and after treatment, grouped according to the treatment type, are shown along with standard errors in Figure 1. All patients treated had chronic PTSD, and the majority had symptoms that had existed long before this deployment and often had failed to respond to treatment performed stateside.

Of the six patients in VR, all showed improvements in their PCL-M scores. Five of six showed improvements to the point that they would no longer meet DSM criteria for PTSD by the end of treatment. The one patient who still met criteria for PTSD had been in therapy for only 10 days before re-deploying home. He was returned because he had reached the end of his tour. No patient in this group was medically evacuated out of theater. Likewise, no patient in VR suffered adverse events related to the therapy. There were adverse events during the course of therapy. Two patients had new, life-threatening, and potentially traumatic events. One experienced a new IED blast, and another was involved in a mass casualty event that placed his life directly in peril. Neither patient was physically injured. Also, at least two sessions of therapy had to be cut short because of mass casualty events that were coming to the hospital. Despite these events, no patient decompensated in the therapy or showed significant worsening of symptoms. On average, patients in VR therapy experienced a 67% decrease in PTSD symptoms as measured on the PCL-M. In the five out of six patients who no longer met criteria, the mean change was 74%, whereas the one remaining individual experienced only a 32% drop. Overall, the

six patients who received VR therapy experienced both clinically meaningful and statistically significant ( $p < 0.001$ ) drops in their PCL-M scores.

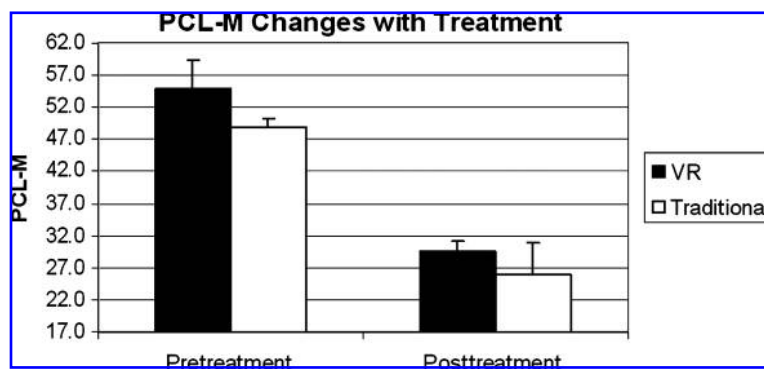
Of the four patients treated with traditional ET, all showed improvements in their PTSD symptoms severity, and all no longer met DSM criteria for PTSD by the end of treatment. The mean change in symptoms was numerically but not statistically lower in traditional ET patients than in VR patients, largely because the patients in ET did not start off with scores that were quite as bad (Table 1). Percentage of symptom changes were almost identical, with traditional ET patients undergoing a mean 74% drop in symptoms. One patient in the traditional ET group was reporting no PTSD symptoms at all by the end of treatment (17 on PCL-M), and the smallest improvement anyone in this group saw was 50%. There were no adverse events in the group that received ET. Like those in VR therapy, patients in traditional ET showed clinically and statistically significant changes in their scores on the PCL-M (Fig. 1).

Statistically, there was a significant effect between pretreatment and posttreatment ( $p < 0.001$ ) but no statistically significant effect of treatment group (VR vs. traditional ET) and no significant treatment by treatment group interaction.

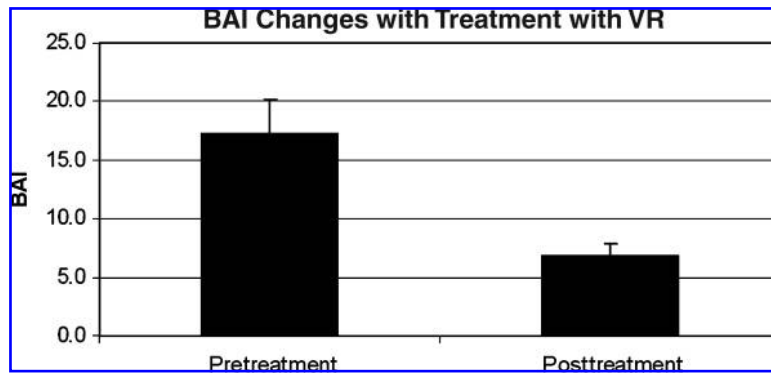
Depression and anxiety symptom scores for the patients in VR therapy also improved throughout treatment (see figures 2 and 3). This was seen in terms of changes in PCL-M and BAI scores in those who received VR therapy (Table 1) and was a statistically significant change for BAI ( $p < 0.05$ ) and PHQ-9 ( $p < 0.005$ ). Clinically, patients in traditional ET also appeared to improve in terms of anxiety and depression. For the patients in whom measures were used, these improved also (data not shown). The measures of depression and anxiety were not used consistently in these patients, however, so the statistical effect cannot be reported. Patients improved regardless in which form of therapy they engaged.

### Discussion

This work shows that patients with combat PTSD can be successfully treated with ETs while in a combat theater. It is the first published report on treatment in this setting and documents what we believe is the first use of VR-based therapy for PTSD performed in a combat theater. It is also the first report to show side-by-side comparisons of outcomes for



**FIG. 1.** PTSD Checklist–Military changes across time in patients who received virtual reality therapy and traditional exposure therapy. Overall effect of treatment was significant ( $p < 0.001$ ), but no effect of treatment type was seen. Mean scores are shown with error bars representing standard error of the mean.



**FIG. 2.** Beck Anxiety Inventory changes across time in patients who received VR therapy. Overall effect of treatment was significant ( $p < 0.05$ ). Mean scores are shown with error bars representing standard error of the mean.

VR-based therapy and traditional ET from PTSD related to combat in Iraq and Afghanistan.

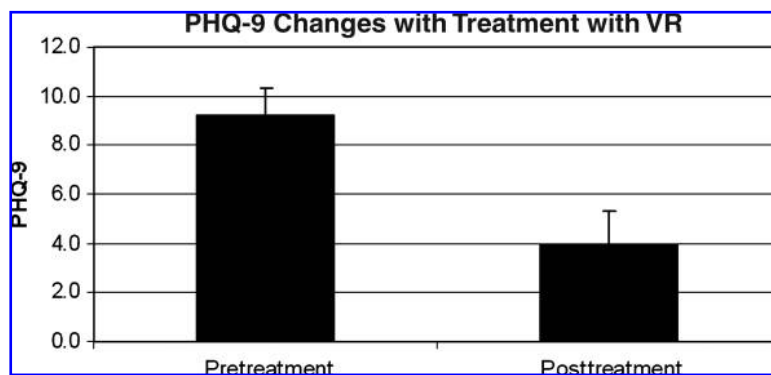
Overall, both VR-based and traditional therapy were found to be safe and effective in theater. Patients showed a rather startling degree of recovery. This is particularly impressive considering that many had previously been through extensive therapy prior to deployment and were, at the time of therapy, experiencing considerable ongoing stress from the deployment itself. Some patients even experienced life-threatening events during the course of therapy. Despite the new and ongoing stress and the unusual demands of the therapy environment, none of the patients with PTSD decompensated, dropped out of the therapy, or had to be medically evacuated before completing their tour. Symptoms of PTSD, depression, and anxiety all improved. In short, those who came to therapy did very well.

It should be noted that the treatment samples were very small in this case series. This says something about the nature of Iraq at the time: events were getting more peaceful. Interpersonal difficulties and depression were far more common complaints among service members than was PTSD. The low number of PTSD patients likely also reflected the nature of the screening process for service members coming to Iraq. Most individuals with preexisting PTSD were probably prevented from coming on this deployment. The patients who did continue into theater likely constituted a highly motivated subset of the overall population with PTSD. This high degree of motivation likely was reflected in their commitment to therapy and success therein. Simply by coming back to Iraq,

the patients here had already taken on the avoidance characteristic of PTSD and which ET seeks to overcome. In effect, all patients who came into treatment were already participating in a “real reality” form of exposure treatment.

The ubiquitous nature of exposure cues may also explain why it was difficult to see differences in treatment response between those who received VR-based therapy and those who received traditional ET. Note that what is reported here is a case series. It was not set up as a randomized or head-to-head trial. Each therapist provided different therapy, and no effort was made to control for this therapist effect, for simultaneous medication treatment, or for different frequency or lengths of therapy. Even if one outcome with one form of therapy had proven statistically superior to the other, it would have been difficult to attribute the differences to the treatment modality. Formal, randomized trials are needed to determine if there really are particular aspects of VR that can enhance treatment in theater.

The case series reported here is also limited in that it followed the patients only while they were in theater. It is possible that the nature of the environment, although it would seem to be stressful, was actually the essential part of their doing well. It is worth noting, however, that before they entered therapy, all the patients reported on here were still symptomatic while in theater. The exposure to the combat theater itself had not seemed to solve their problems. Likewise, for many of them, other, nonexposure-based therapy at home had not seemed to be effective. It was only when therapy was combined with real-life confrontation of their



**FIG. 3.** PTSD Checklist–Military changes across time in patients who received VR therapy. Overall effect of treatment was significant ( $p < 0.005$ ). Mean scores are shown with error bars representing standard error of the mean.

fears that recovery happened. If such recovery persists in the face of returning home remains to be seen. Long-term follow-up of "recovered" PTSD patients from multiple forms of therapy is clearly needed.

One of the most unusual aspects of the cases reported on here was that VR was involved. Regardless of the presence or absence of VR in the treatment, PTSD patients got better. If the treatments were roughly equivalent in theater, the question may legitimately be asked, Why provide something like VR in this situation? Even in portable form, the equipment is cumbersome and subject to damage or failure.

The very presence of VR in the clinic did bring attention to the Combat Stress Clinic, however, and may have made certain individuals aware of services that could be provided. The simulator also provided an amount of face validity to a mental health provider's thoughts about how a patient with PTSD might do in combat situations. That after treatment a patient is able to go through a simulated combat event and perform well may give the therapist, patient, and commander confidence in returning that individual to regular duty. As demonstrated here, some individuals are clearly capable of such recovery and performance. Finally, a small case series such as this can show only that some patients can benefit from therapy. It does not say who will benefit from what treatment. Having a wide variety of therapy available will ensure that service members get the treatment they deserve.

One final comment should be made on future research. Data are clearly needed to determine if VR therapy is superior to ET within traditional clinics. Based on the results observed here, it would be easy to infer that there is little difference between VR therapy and traditional ET. Power analysis reveals that, based on the PCL-M scores and standard deviations seen here, to have an 80% chance of detecting a statistically significant difference between treatments would require a sample size of 155 per group. Even if such a statistical difference were found, however, a difference of 2 points on the PCL-M would not be considered clinically significant. The circumstances here were unusual, however. Everyone was involved in "real reality" exposure by virtue of being in Iraq. One hundred percent of the traditional ET patients experienced a clinically significant improvement. Most stateside studies of ET put the improvement rate closer to 50%.<sup>18</sup> The overall effect of VR on stateside treatment may be different and will require further study.

### Disclosure Statement

Mark Wiederhold and Brenda Wiederhold are owners of Virtual Reality Medical Center, which manufactures and sells the VR equipment used in this study. Robert McLay and Colleen McBrien have no competing financial interests.

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