

## **Treatment of Posttraumatic Stress Disorder with Relaxation and Biofeedback Training**

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*This study investigated the use of biofeedback and relaxation training on six patients with posttraumatic stress disorder (PTSD) referred routinely for biofeedback treatment in a VA medical center. Subjects received between 8 and 14 sessions of training overall, as well as concurrent individual and group therapy. Measures used to assess treatment outcome include pre- and posttreatment MMPI, State-Trait Anxiety Inventory, Beck Depression Inventory, and Multidimensional Health Locus of Control scores, as well as electromyographic and subjective measures of tension within each session. Additionally, an overall posttreatment clinical rating of change and 1- to 2-year follow-up data were obtained for each subject. Slight to marked improvements were demonstrated for each subject, as evidenced by improvements on the State Anxiety Inventory Scale and the Beck Depression Inventory, a decrease in overall MMPI scores, and lowered EMG and subjective tension ratings for all participants. Possible alternative explanations for improvement (situational demand characteristics, regression toward the mean, lack of independent subject evaluation) are described, along with other study limitations. This preliminary investigation suggests that the use of relaxation training and biofeedback may be a particularly useful component within a comprehensive treatment program for this disorder.*

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**Descriptor Key Words:** posttraumatic stress disorder (PTS); biofeedback; relaxation.

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Posttraumatic stress disorder (PTSD) is a condition characterized by “re-experiencing of the traumatic event; numbing of responsiveness to, or reduced involvement with, the external world; and a variety of autonomic, dysphoric, or cognitive symptoms” (American Psychiatric Association, 1980, p. 236). The symptoms of PTSD may include hyperalertness or exaggerated startle response, sleep disturbance, guilt, difficulty in concentrating, and avoidance of activities that arouse recollection of the traumatic event. Intensification of symptoms may occur with exposure to events that symbolize or resemble the traumatic event.

Treatment of Vietnam veterans suffering from PTSD have included a variety of interventions such as imaginal flooding (Fairbank & Keane, 1982; Keane & Kaloupek, 1982), behavior therapy (Kipper, 1977), systematic desensitization for nightmares (Schindler, 1980), hypnotherapy (Brende & Benedict, 1980), psychotherapy (Haley, 1974), and group psychotherapy (Walker & Nash, 1981). These interventions have presented some optimistic results, particularly regarding several targeted symptoms such as nightmares or intrusive thoughts about traumatic events, as well as reported anxiety reduction.

However, it has been further postulated by some investigators (Kolb & Mutalipassi, 1982) that some patients with PTSD demonstrate physiological hyperactivity in the neuromuscular and cardiovascular systems, suggesting an emotional conditioning to a primitive startle-arousal pattern. Several investigators have found that a number of physiological parameters (i.e., heart rate, systolic blood pressure, and forehead EMG) can correctly differentiate veterans suffering from PTSD from veterans in various control groups, or from nonveteran controls, when exposed to audiotape presentations of combat sounds (Blanchard, Kolb, Pallmeyer, & Gerardi, 1982; Malloy, Fairbanks, & Keane, 1983). Malloy et al. (1983) have proposed a multimethod assessment approach to the diagnosis of PTSD, using behavioral self-report measures and physiological indices. This observation of psychophysiological reactivity has led a number of theoreticians to postulate a variety of biological mechanisms to account for the occurrence of PTSD (De La Pena, 1984; Van Der Kolk, Boyd, Krystal, & Greenberg, 1984). Treatment efforts have consequently been implemented to block the targeted emotional and physiological arousal through the use of psychopharmacological agents, such as propranolol and clonidine (Kolb, Burris, & Griffiths, 1984) and phenelzine (Hogben & Cornfeld, 1981), with encouraging results.

Given the increasing understanding of the behavioral, emotional, cognitive, and physiological factors constituting PTSD, it was thought that an intervention designed to include elements of these factors in a self-regulatory treatment paradigm such as biofeedback and relaxation would be a logical extension of our knowledge to date. This type of intervention would be a nonpharmacological extension of interventions designed to

decrease hyperreactivity to combat cues and to block the suspected sympathetic nervous system arousal found in PTSD (Kolb et al., 1984). To date no known attention has been given in the literature to the use of biofeedback and relaxation training for patients who have PTSD. The present study reports the results of these interventions with six cases of PTSD.

## METHOD

### *Subjects*

Six male patients (mean age = 40.0 years, range = 33–60 years) were referred for treatment in a biofeedback clinic in a Veterans Administration medical center in the northeastern United States. Patients were independently assessed by a licensed clinical psychologist and a board-certified psychiatrist. Each made an independent diagnosis of combat-related PTSD, with 100% agreement of primary diagnosis. Treatment goals for all patients included the reduction of physical arousal and subjective tension/stress as well as increasing the patient's ability to deal effectively with stress. In addition, for two of the subjects, treatment goals included the reduction of headache intensity and frequency. Additional diagnostic and demographic data regarding each patient, as well as other ongoing treatments, are summarized in Table I.

### *Apparatus*

Biofeedback equipment included a Cyborg P303 Electromyographic machine and a Cyborg BL 900 EMG Dual Processor Integrator. For those subjects who required thermal biofeedback, a Cyborg J42 temperature unit was utilized.

### *Procedure*

Prior to receiving treatment, each subject completed a diagnostic interview and psychological testing, which included the Minnesota Multiphasic Personality Inventory (MMPI, Dahlstrom & Welsh, 1960), the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the Multidimensional Health Locus of Control (MHLC; Wallston,

Table 1. Diagnostic and Demographic Data on Each Patient

Case No.	Diagnosis	Employment status	Age	Marital status	Service separation date	Other treatments	Medication	Inpatient/out-patient status
1	PTSD	Self-employed	33	S	1970	Individual psychotherapy	None	Outpatient
2	PTSD	Self-employed	41	M	1967	Group therapy Individual psychotherapy	None	Outpatient
3	Tinnitus PTSD Substance abuse Antisocial personality Chronic L/B pain	Unemployed	36	M	1969	Group therapy Individual Psychotherapy Group therapy	Tylox Xanax Naproxin Inderal	Inpatient
4	PTSD Dysthymic disorder	Employed	36	M	1970	Individual psychotherapy Group therapy	Norpramine Ludiomil Inderal	Inpatient <sup>a</sup>
5	PTSD Diabetes mellitus S/P myocardial infraction	Disabled	60	M	1946	Individual psychotherapy	Insulin Isordil Nitroglycerin Inderal	Outpatient <sup>b</sup>
6	PTSD Polysubstance abuse (in remission))	Student	37	S	1968	Individual psychotherapy Group therapy	None	Outpatient

<sup>a</sup>Patient received 10 sessions while an inpatient and 1 session as an outpatient.

<sup>b</sup>Patient received 1 treatment session while an inpatient and 7 sessions as an outpatient.

Wallston, & DeVellis, 1978). Additionally, patients who presented with a pain complaint were requested to complete a 1-week baseline of daily pain ratings.

All treatment sessions were conducted by a female psychology aide, certified in biofeedback therapy. The initial 2 to 3 sessions consisted of audiotaped progressive muscle relaxation (PMR) training, based largely on the procedures outlined in Bernstein and Borkovec (1973), with the goal being to develop a deep sense of muscular relaxation. Electromyographic biofeedback (EMG) was simultaneously provided, using both auditory and visual feedback from a frontalis muscle electrode placement. Each subject received between 7 and 14 relaxation/EMG training sessions over a period of 8 to 16 weeks. Sessions subsequent to the PMR training involved use of autogenic phrases (Schultz & Luthe, 1969) and the development of a cue-conditioned relaxation response. Each subject was encouraged to practice relaxation on a daily basis. Two subjects received additional training in thermal biofeedback following the relaxation/EMG training in an effort to relieve complaints of vascular headaches. Each patient was also requested to rate his subjective feeling of tension at the beginning and end of each session (0 = no tension, 10 = worst imaginable tension).

At the conclusion of the final biofeedback session, each subject completed posttreatment psychological testing consisting of the same measures outlined above. As part of routine clinic practice each subject was also given a consensual rating on his overall clinical progress by the supervising psychologist and aide jointly, using a 7-point Likert scale of progress (-3 = markedly worse, -2 = moderately worse, -1 = slightly worse, 0 = no change, +1 = slight improvement, +2 = moderate improvement, +3 = markedly improved).

Follow-up data were obtained on five of the six subjects through a phone contact conducted by the biofeedback technician. The sixth subject was not able to be contacted for follow-up evaluation, having moved out of state.

## RESULTS

Table II summarizes changes in the subjective measures of tension and EMG microvolt decreases. As a group, all subjects reported lower tension ratings from the beginning to the end of sessions,  $F(1, 5) = 27.20, p < .004$ . They also reported significantly less tension as treatment progressed,  $F(1, 5) = 17.39, p < .009$ . A concomitant decrease of EMG readings was found within,  $F(1, 5) = 38.21, p < .002$ , and across sessions,  $F(1, 5) = 22.58, p < .005$ , with every subject demonstrating the ability to learn to lower his frontalis readings. Measures used for comparison of both the subjective and microvolt ratings across treatment consisted of averages of measures during the first three and last three EMG/or treatment sessions except as noted in

**Table II.** Mean Subjective Rating and EMG Changes Within Sessions and Across Treatment

Number and type of bio-feedback sessions	Case														Group Means for all subjects	
	1		2		3		4		5		6		6			
	10 EMG	7 EMG Thermal	5 Start of Tx	5 End of Tx	10 EMG	3 Start of Tx	3 End of Tx	8 EMG Thermal	8 Start of Tx	8 End of Tx	14 EMG	14 Start of Tx	14 End of Tx	Start of Tx		
Subjective ratings <sup>d</sup> Before session	4.33	5.50	4.33	7.33	6.67	2.17	1.33	4.17	1.83	5.67	4.83	5.39	3.88			
After session	4.00	3.67	2.00	5.67	5.33	1.17	0.67	2.33	1.33	3.67	1.67	3.42	2.08			
uV ratings Before session	1.65 <sup>a</sup> <sub>uV</sub>	1.53 <sub>uV</sub>	1.67 <sub>uV</sub>	1.30 <sub>uV</sub>	1.83 <sub>uV</sub>	1.57 <sub>uV</sub>	1.67 <sub>uV</sub>	1.47 <sub>uV</sub>	1.67 <sub>uV</sub>	1.43 <sub>uV</sub>	2.07 <sub>uV</sub>	1.47 <sub>uV</sub>	1.76 <sub>uV</sub>	1.46 <sub>uV</sub>		
After session	1.30 <sub>uV</sub>	1.20 <sub>uV</sub>	1.27 <sub>uV</sub>	1.07 <sup>b</sup> <sub>uV</sub>	1.40 <sub>uV</sub>	1.10 <sub>uV</sub>	1.03 <sub>uV</sub>	.87 <sup>c</sup> <sub>uV</sub>	1.50 <sub>uV</sub>	1.27 <sub>uV</sub>	1.53 <sub>uV</sub>	1.10 <sub>uV</sub>	1.34 <sub>uV</sub>	1.10 <sub>uV</sub>		
Clinical ratings of improvement	Moderate	Slight	Slight	Slight	Moderate	Marked	Marked	Marked	Marked	Marked	Marked	Marked	Marked	Marked		

<sup>a</sup>Owing to missing data, only first and third sessions derive the mean scores for Case 1.

<sup>b</sup>Mean is derived for last three EMG readings (sessions 5, 6, and 7).

<sup>c</sup>Last three session EMG scores were for sessions 6, 8, and 11.

<sup>d</sup>First three and last three sessions used for comparison across treatment.

Table II. This average was used for comparison in an effort to control for expected change fluctuations between individual biofeedback sessions.

The consensual clinical ratings of the psychologist and the biofeedback technician did not seem positively related to lower EMG readings, but more marked or moderate improvements were noted to occur consistently with lower subjective ratings of overall tension.

Pre- and posttreatment scores on these measures were examined using multiple one-tailed *t*-test comparisons. Using the Bonferroni correction, alpha was adjusted from .05 to .007. All of the five subjects who completed the BDI showed improvement on this measure,  $t(4) = 5.80, p < .005$ . Of the five subjects completing the STAI, all showed improvement in State anxiety, with the pre/post mean differences showing a trend toward significance,  $t(4) = 3.74, p < .025$ . For Trait anxiety, all but one of the five subjects improved, and again there was a trend toward significant mean differences,  $t(4) = 2.80, p < .05$ . In general, MMPI elevations dropped for all six subjects, suggesting clinical improvement, and a significant difference was observed between the mean of the 10 clinical scale scores across treatment (pretreatment mean = 80.67, posttreatment mean = 75.03,  $t(5) = 6.09, p < .002$ ). No readily discernable pattern of MHLC scores was noted, nor did BDI scores positively correlate with MMPI scale 2 (depression) scores. A complete listing of all test scores may be found in Table III. Finally, clinical ratings of improvement did not consistently agree with psychological test scores.

Spontaneous comments from subjects spoke to the increased sense of control and accomplishment gained in the experience of biofeedback treatment. Additionally, for one subject the ability to reduce tension levels without the need for medication was important to him, given his past history of drug abuse.

Subjects were contacted for follow-up evaluation (time since completion of training varied from 12 to 25 months), with five of the six subjects responding. All subjects stated they would recommend biofeedback/relaxation training to patients with similar problems. Four of the subjects had continued with regular home practice, with the mean rating when asked on a 10-point scale how much it had helped (0 = not at all, 10 = a great deal) being 4.75. These subjects rated it a useful procedure for dealing with their current stressors ( $M = 6.0$ , range of 4 to 10 on a 0-to-10 scale). One subject—our oldest, and a WW II-era PTSD—did not continue with home practice and subsequently did not rate this as a useful procedure for him. However, he did report that it might be helpful for others with similar problems.

## DISCUSSION

The results of this (uncontrolled) investigation suggest that the use of relaxation training and biofeedback has a positive role to play in the treat-

Table III. Psychological Test Scores Before and After Treatment

Subject	1		2		3		4		5		6		Group means	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
BDI	33	28	27	19	38	27	N/A <sup>a</sup>	22	4	0	21	13	24.6 <sup>b</sup>	18.2
STAI (%ile)	92	88	75	48	99	90	N/A	52	28	5	70	43	72.8 <sup>b</sup>	54.3
State	88	90	72	45	98	89	N/A	70	48	33	72	51	75.6 <sup>b</sup>	63.0
Trait														
MHLC ( <i>T</i> scores)														
Internality	50	45	46	42	52	41	31	48	25	32	53	68	42.8	46.0
Powerful others	45	50	56	55	44	43	30	46	49	67	48	43	45.3	50.7
Chance	49	59	61	52	73	66	51	58	55	60	37	40	54.3	55.8
MMPI ( <i>T</i> scores)														
L	60	63	43	47	43	43	53	57	50	53	43	47	48.7	51.7
F	68	78	88	76	112	104	96	84	58	55	70	60	82.0	76.2
K	51	38	31	36	40	48	36	38	66	64	44	46	44.7	45.0
Hs	103	95	85	95	93	90	90	88	80	77	62	57	85.5	83.7
D	118	113	87	77	108	96	115	113	96	72	87	87	101.8	93.0
HY	89	85	85	80	85	75	85	85	78	76	71	67	82.2	78.0
Pd	81	69	67	55	102	97	78	69	78	69	83	76	81.5	72.5
Mf	71	74	55	55	65	65	61	61	63	57	78	69	65.5	63.5
Pa	59	59	70	67	82	73	88	70	53	59	82	62	72.3	65.0
Pt	95	87	85	75	103	93	95	83	62	52	79	64	86.5	75.7
Sc	80	94	109	88	122	117	119	99	69	53	82	67	96.8	86.3
Ma	64	66	61	59	79	81	74	76	46	44	66	71	65.0	66.2
Si	75	79	77	67	64	66	78	70	52	54	71	63	69.5	66.2
Mean <i>T</i> score	83.5	82.1	78.1	71.8	90.3	85.3	88.3	81.4	67.7	61.3	76.1	68.3	80.66	75.04

<sup>a</sup>N/A = not available.

<sup>b</sup>These means are based on five cases.



ment of PTSD. Improvements were noted on a wide range of measures, including psychological test scores, subject ratings, EMG readings, and clinical ratings.

It is important to note that even though all subjects showed a drop in tension ratings, none reported total elimination of unwanted tension. One can reasonably speculate that if these interventions were targeted more closely to the known psychophysiological responsiveness of the PTSD patient (i.e., changes in heart rate, BP, and EMG) as part of a systematic desensitization program for arousing stimuli, more effective symptom alleviation might be realized. There is definitely a need for more controlled investigations that would examine the impact of relaxation training alone, the combination of traditional psychotherapy with biofeedback, and the potential relationship between the severity of the PTSD and the emotional underpinnings of the psychophysiological responsiveness.

Results of the present study need to be viewed in the context of the limitations of the present design. First, patients were certainly subject to the situational demands associated with providing multiple pre- and posttreatment tension ratings, and they may have unconsciously lowered their ratings following treatment. In addition, clinical ratings of improvement were not independently validated, and experimenter bias could therefore have been present. In fact, clinical ratings at times showed disagreement with psychological test scores. This was felt to reflect in part the fact that many factors contributed to the consensual ratings of improvement, such as patient report, ability to alter levels of subjective and objective measures of tension, and clinical presentation. Posttesting was not a part of this process but rather was used for follow-up meetings with the patient. Thus, many intangible variables are reflected in this measure, even with the agreement reached between raters on each patient. Third, clinical improvement, as reflected by the lowering of overall profiles on most of the psychological test data, could have been due to a regression toward the population mean effect rather than as a specific result of the treatment intervention. Moreover, all patients were receiving concurrent individual and group therapy. Further, the nature of a routine referral suggests that some screening was made in selection for those patients believed to be potentially able to profit from biofeedback by the referring physician.

Finally, the present study was conducted on a small number of subjects, again making generalizations of these results hazardous at best. However, while these patients were seen as only one part of an overall comprehensive treatment package (i.e., individual, group, and/or milieu), the consistent results of this initial study appear quite positive, since all participants made positive changes over the course of treatment with relaxation and biofeedback intervention.

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