EMG BIOFEEDBACK I: TREATMENT OUTCOME IN ANXIETY NEUROSIS

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SUMMARY

36 subjects were included in a study on the efficacy of EMG biofeedback training in the management of anxiety neurosis. The outcome measures included a physiological stress profile and measures of anxiety symptoms, frontalis muscle tension, skin temperature and electrodermal activity. The data analysis indicated that the subjects were able to maintain reduced levels of frontalis muscle tension at rest and during the stress condition without concomitant changes in skin temperature or in electrodermal activity. This pattern of results supported the prediction of the motor skills learning model of EMG biofeedback. The clinical benefits of the training were manifested in the decreased anxiety symptom scores.

EMG biofeedback as a relaxation technique is the logical outcome of research evidence that biofeedback techniques can effectively modify autonomic nervous system and other bodily responses typically associated with anxiety states (Miller, 1969).

As the sole method of treatment EMG biofeedback is moderately efficacious while in comparison to other relaxation procedures it may/may not be as effective or to have a singular advantage. In combination with other techniques its effects may be additive, non-contributory or unique (Qualls and Sheehan, 1981; Tarler Benlolo, 1978). The evidence does not convincingly demonstrate the specific value of frontalis EMG training with anxiety disorders (Rice and Blanchard, 1982) largely because of the methodological deficiencies in the existing research (Keeiman and Roberts, 1983).

A proper evaluation of treatment effectiveness would require the use of a particular modality of feedback for the treatment of a particular disorder, in a particular patient population. Trained therapists would need to administer the treatment for a sufficient length of time, at least 8-25 hours, with the goal of achieving a certain criterion level of the response (Steiner & Dince, 1981).

Keeping in view the inconclusive evidence and the paucity of research on biofeedback in India, the authors sought to evaluate the efficacy of EMG biofeedback therapy in anxiety neurosis, using the treatment package strategy (Kazdin, 1980).

Material and Methods

Sample:

Subjects with anxiety symptoms were referred to the Behaviour Therapy and Biofeedback Unit, Department of Clinical Psychology at the National Institute of Mental Health and Neuro Sciences (NIMHANS), from the Psychiatry Out-patient centers of NIMHANS and Victoria Hospital, Bangalore. 36 subjects with a diagnosis of anxiety neurosis (300.0, ICD-9, 1978), completed the twenty-session EMG biofeedback therapy program. They were literate, without an associated medical illness or an additional/alternative psychiatric diagnosis.

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Assessment Measures:

(a) Psychological:
State trait Anxiety Inventory- Form Y1 (STAI-Y1) (Spielberger et al., 1983).
Symptom Rating Scale (SRS) (Sargunarat and Kumaraiah, 1989).
Hamilton’s Anxiety Rating Scale (HARS) (Hamilton, 1959; Lader and Marks, 1971).

(b) Physiological:
Feedback myograph (Instruction manual, Autogen 1700).
Feedback thermometer (Instruction manual, Autogen 2000 b).
Feedback dermograph (Instruction manual, Autogen 3400).
Physiological stress profile (Budzynski et al., 1980).

Following a 5 minutes adaptation period, the therapist recorded the levels of frontalis muscle tension (EMG), skin temperature (TEMP), skin conductance level (SCL) and response (SCR) during the 14 min of relaxation, 6 min of stress (substracting serial sevens from 700) and 10 min of recovery.

FIG. 1. AVERAGE EMG VALUES(±SEM) DURING THERAPY SESSIONS

Procedure:
Each subject was assessed prior to the intervention (pre-therapy), after the initial ten training sessions (mid-therapy), and after the next ten training sessions (post-therapy) with the STAI-Y1, SRS & HARS. Following a 5 minutes adaptation period, the therapist recorded resting levels of EMG, TEMP, SCL and SCR at 50 seconds intervals during the 30 minutes sessions. The physiological stress profile was assessed before and after the therapy program.

The EMG biofeedback therapy program was designed to teach the subject awareness and control of frontalis muscle tension and generalisation of tension reduction. The program was flexible enough to allow for individual differences in learning but at the end of 20 sessions all subjects had passed through the three stages.

At the post-therapy clinical interview, each subject was interviewed to ascertain whether alternate treatments had been utilised during this period. Following this, each subject was advised to continue the practice of relaxation at home and to return to the clinic a month later.
Results

Preliminary analysis:

12 subjects stated that they had used chemotherapy (betablockers/benzodiazepines/antidepressants) as a treatment adjunct.

To determine whether this had influenced the outcome measures, the sample of subjects with and without medication was compared using an analysis of covariance (ANCOVA) (Garrett, 1981).

As shown in Table I, the non-significant F values indicate that the pre-therapy differences within the sample did not influence the post-therapy values.

Pre, mid and post-therapy comparison of the psychological and physiological assessment measures:

Each clients' score on the STAI-Form Y1, the SRS and the HARS, was used to calculate average values for the group on the respective measures. The frontalis muscle tension values recorded during the pre-therapy assessment session were averaged for each subject and across subjects to provide a group mean value. Similarly, group mean values were obtained for the mid- and post-therapy assessment intervals. The data on skin temperature, skin conductance level and response were treated in

| Variables | Pre-therapy | Post-therapy | Corrected | Mean | S.D. | Mean | S.D. | Mean | S.D. | F(2, 70) |
|-----------|-------------|--------------|-----------|------|------|------|------|------|------|---------|
| STAI-Y1   | I           | 43.71        | 32.38     | 33.82 | 0.10 |
|           | II          | 48.50        | 35.42     | 34.49 |      |
| SRS       | I           | 427.33       | 263.79    | 235.99 |      |
|           | II          | 343.08       | 156.17    | 186.98 | 1.33 |
| HARS      | I           | 333.25       | 102.88    | 110.40 | 1.56 |
|           | II          | 377.50       | 83.00     | 73.48  |      |
| EMG       | I           | 2.18         | 1.36      | 1.43  | 0.33 |
|           | II          | 3.24         | 1.36      | 1.31  |      |
| TEMP      | I           | 90.99        | 90.05     | 90.10 | 0.05 |
|           | II          | 91.17        | 89.78     | 89.73 |      |
| SCL       | I           | 23.29        | 19.11     | 18.84 | 0.15 |
|           | II          | 21.91        | 16.41     | 15.68 |      |
| SCR       | I           | 0.19         | 0.19      | 0.19  | 0.75 |
|           | II          | 0.19         | 0.30      | 0.30  |      |

Table II Group Mean Values and F Ratios for the Psychological and Physiological Variables Across Assessments
the same manner. Table II indicates the group mean values and the F ratios obtained on all the measures using the repeated measures analysis of variance (ANOVA-R) (Winer, 1971).

The change across the three assessments was significantly linear for state anxiety (F = 54.43, p < .01), self-report of symptoms (F = 70.94, p < .01), therapist's rating (F = 188.45, p < .01) and frontalis muscle tension (F = 36.16, p < .01) while the change was not significant for skin temperature (F = 1.89, NS), skin conductance level (F = 2.52, NS) and response (F = 0.12, NS).

Pre-and post-therapy comparison of the physiological stress profile:

On each physiological variable, for each subject for the phases of relaxation, stress and recovery, a mean value was calculated for each phase. The mean values of each phase were averaged across clients to provide group mean values.

The pre-and post-therapy group mean values on each variable were compared with ANCOVA. The data is presented in Table III.

During the pre-therapy stress phase clients manifest an increase in muscle tension, skin conductance level and response and a reduction in temperature indicating that the cognitive task was adequately stressful.

After therapy, there was a significant change in the frontalis muscle tension values from the relaxation to the stress phases (t = 4.6, p < .01) and from the stress to the recovery phases (t = 3.1, p < .01). The change from the relaxation to the recovery phase was non-significant (t = 1.5, NS).

The clients hence manifest a lower baseline EMG, a diminished reactivity to stress and a recovery to baseline EMG levels. The changes in skin temperature, skin conductance level and response were not significant.

**Discussion**

It is possible that the use of pharmacological substances could complicate the learning of physiological self-regulation either by artificially altering natural baselines or by interfering with the normal range of a particular response system or by

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**Table III Pre-Post comparison on the Physiological Stress Profile**

|                | Pre-Therapy | Post-Therapy | F(2,104) |
|----------------|-------------|--------------|----------|
|                | Relaxation  | Stress       | Recovery | Relaxation  | Stress       | Recovery |          |
| EMG            | 2.32        | 2.56         |          | 1.32        | 2.24         | 1.62     | 10.79*    |
| TEMP           | 90.91       | 89.88        | 90.08    | 90.14       | 89.83        | 89.52    | 0.12      |
| SCL            | 22.71       | 31.29        | 31.79    | 19.64       | 23.65        | 24.40    | 1.22      |
| SCR            | 0.18        | 0.61         | -0.43    | 0.19        | 0.65         | 0.21     | 1.68      |

p < .01
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fostering learning of self-regulation that does not generalise to a drug-free state (De Good & Mohr, 1984). The present findings indicate that medication usage did not significantly influence the post-therapy values.

The subjects were able to maintain lowered levels of EMG activity at rest during the mid-and post-therapy assessment sessions. The linear decrease in EMG levels was not accompanied by concomitant changes in skin temperature, skin conductance level and response. This is consistent with the research indicating that the effect of EMG biofeedback training is remarkably specific with limited crossmodality generalisation effects (Carlson et al., 1983).

The specificity of the training effect was reflected in the pre-post therapy changes on the physiological stress profile. A finding which conforms to the results reported in the literature (Diaz and Carlson, 1984).

This pattern of results concurs with the prediction from the motor skills learning model (Alexander, 1975; Fridlund et al., 1980) that biofeedback reinforces discriminative responding to produce “muscular change of a highly specific nature” (Glaus & Kotses, 1979). This specificity has been observed in the earlier studies by the authors (Sargunaraj et al., 1987, a & b).

The reduction in frontalis muscle tension was accompanied by a reduction in state anxiety. This implies that EMG biofeedback therapy is associated with changes in the subjects “subjective consciously perceived feelings of tension, apprehension, nervousness and worry” (Spielberger, 1985).

Further, the linear decrease in anxiety symptom scores as rated by the client and the therapist are indicative of the clinical benefits of EMG biofeedback training.

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