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# THE EFFECTS OF ELECTROMYOGRAPHIC FEEDBACK AND PROGRESSIVE RELAXATION TRAINING ON STRESS REACTIONS IN DENTAL PATIENTS

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APPROVED BY

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# THE EFFECTS OF ELECTROMYOGRAPHIC FEEDBACK AND PROGRESSIVE RELAXATION TRAINING ON STRESS REACTIONS IN DENTAL PATIENTS

## Abstract

This study examined the effects of electromyographic (EMG) feedback and progressive relaxation training on the stress reactions of patients having chronic, negative reactions to dental treatment. Twenty-one subjects were selected from the patient files of one dentist and were randomly assigned to one of three groups: EMG feedback (BF), progressive relaxation (PR), or self-relaxation control (C). Four dependent measures consisting of EMG level, Dental Anxiety Scale (DAS), and State-Trait Anxiety Inventory (STAI-State and STAI-Trait) were collected at actual dental appointments preceding and following ten training or control sessions that spanned a four-week period. Results showed significant decreases in EMG levels across dental appointments for both BF and PR groups, but not for the C group. No difference was found between BF and PR EMG levels. On the DAS and STAI-State measures similar patterns were noted. Significant decreases in all groups, BF, PR, and C, were found. While the decreases shown by the BF and PR groups did not differ significantly from each other, they were both significantly greater than the decreases shown by the C group. STAI-Trait scores

showed a significant decrease only for the BF group. Follow-up data collected approximately one year following the second dental appointment is included.

## Introduction

In recent years much attention has been focused on human reaction to stress (Lazarus & Opton, 1966; McGrath, 1970; Bridges, 1974). One aspect of the stress literature has been the application of principles of stress reduction to subjects confronted with situations or objects perceived as threatening. Cooper, Furst, and Bridger (1969) have pointed out that much of the work in this area has involved college-aged, snake-phobic subjects whose stress reactions have questionable relevance to reactions exhibited in threatening, real-life situations. In addition, Weitz (1970) has observed that our biggest deficiency in knowledge about stress comes from a lack of studies carried out under natural stress-provoking conditions. It would seem that controlled, field-oriented studies are needed in order to better determine the effectiveness of stress reducing psychotherapeutic techniques.

Lazarus (1966) has noted that the dental context provides an excellent area in which to study both physiological and psychological stress. Due to the nature of the procedures involved, stress is often an inherent part of the dental experience. The patient may anticipate possible confrontation with aversive stimuli, but cannot be certain as to when or if it will occur. Further, if the confrontation does occur, the patient generally feels helpless to do anything about it (Corah,

1973). For many dental patients these experiences lead to anxiety stress reactions of disturbing intensity. Other than medication few alternative treatments are available for the relief of these reactions. As a result many patients endure dental treatment with resignation or forego treatment until an emergency arises.

Possible relief for anxious dental patients has been offered by suggestions that anxiety stress reactions may be reduced by relaxation of the body musculature (Jacobson, 1938; Wolpe, 1958; Shultz & Luthe, 1959). In 1938 Jacobson emphasized the important role of relaxation in the treatment of a number of stress related disorders, including anxiety states, and formulated the principle that "to be excited and to be fully relaxed are physiological opposites . . . [which] cannot exist in the same locality at the same time." In accord with this principle Jacobson developed a verbal technique called progressive relaxation which was designed to systematically train individuals to relax. More recently relaxation training using electromyographic (EMG) feedback has been suggested as a means of reducing anxiety stress reactions (Budzynski & Stoyva, 1969; Green, Walters, Green & Murphy, 1969; Green, Green & Walters, 1973). Stoyva and Budzynski (1974) hold that biofeedback techniques produce shifts to "low arousal" conditions which have "physiological effects opposite to those produced by stress."

Techniques designed to reduce anxiety through relaxation rest on the assumption that muscular tension is a necessary part of the anxiety response. While some investigators report low correlations between tension and anxiety (Goldstein, 1964; Lader & Mathews, 1968; Lader & Mathews, 1970) the majority of studies indicate that skeletal

muscle involvement is higher in anxious subjects than in controls (Malmo & Shagass, 1949; David & Malmo, 1951; Jurko, Jost & Hill, 1952; Malmo & Smith, 1955; Malmo, 1957; Balshan, 1962; Newman, 1962; Sainsbury, 1964).

Several studies have dealt with the question as to whether muscular relaxation learned through progressive relaxation training leads to the reduction of anxiety. Comparing the effects of progressive relaxation and hypnosis, Paul (1969) found that anxiety indicators in normal subjects were reduced significantly in the relaxation group in contrast to the hypnosis and control groups. Also comparing the effects of progressive relaxation and hypnosis, McAmmond, Davidson, and Kovitz (1971) found relaxation training to be more effective than hypnosis or control procedures in reducing physiological stress indicators in high anxiety dental patients but not in moderate or low anxiety patients. However, since the McAmmond et al. (1971) study confounded psychological (anticipatory) and physiological (invasive injection) stress factors during measurement of physiological variables, it is difficult to draw parallels between it and other seemingly similar stress studies. Partial substantiation of the relaxation training-anxiety reduction hypothesis was shown in studies by Wilson and Wilson (1970) and Connor (1974). In the former study only the high anxiety relaxation group showed significant decreases in anxiety indicators, while the latter study showed reductions in physiological, but not self-report, stress indicators in the relaxation group. While progressive relaxation has long been held to be an effective treatment for reduction of anxiety stress reactions (Jacobson, 1938; Haugen, Dixon &

Dickel, 1958; Jacobson, 1970), it is evident that little research has been directed toward the empirical validation of this technique as an effective treatment mode.

The assessment of electromyographic (EMG) feedback as a treatment for the reduction of anxiety stress reactions has been the focus of several recent investigations. A single group study by Raskin, Johnson, and Rondestvedt (1973) indicated that EMG feedback is of limited value in the treatment of chronic generalized anxiety. Stoyva and Budzynski (1974), however, report successful use of EMG feedback in the clinical treatment of "several dozen" pervasive anxiety patients. A number of controlled studies comparing the effectiveness of EMG feedback and progressive relaxation training were in general agreement that EMG feedback was superior to progressive relaxation training with regard to speed of learning and depth of relaxation obtained (Coursey, 1975; Coursey & Frankel, 1974; Staples & Coursey, 1975; Haynes, Moseley & McGowan, 1975; Reinking & Kohl, 1975; Reinking, Tamayo & Morgot, 1975). In all of these studies normal subjects who were not involved in a stress situation were used. It is clear that the comparative effectiveness of EMG feedback and progressive relaxation training in reducing stress under natural, stress-provoking circumstances has yet to be determined.

The purpose of this study is two-fold: (a) to ascertain the effects of relaxation training on stress reactions in a dental setting, and (b) to determine the comparative effectiveness of electromyographic (EMG) feedback and progressive relaxation in relieving stress reactions of a relatively circumscribed, though chronic, nature. The following

hypotheses are to be tested:

1. Electromyographic (EMG) feedback and progressive relaxation training will lead to significant decreases in stress reactions as compared to self-relaxation control procedures.
2. Electromyographic (EMG) feedback relaxation training will produce significantly greater stress reduction than will progressive relaxation training.

## Method

### Selection of Subjects

A list of patients classified as prone to stress reactions in a dental setting was compiled by a dentist from his total active file of patients on the basis of the dentist's observations over time and also on patients' verbal reports to him. The patients were contacted by phone by the dentist to determine their interest in participating in a study of treatment techniques aimed at the reduction of stress reactions in dental situations. Those patients who were interested were scheduled for an initial interview which included a brief medical-dental history and a dental examination. Any patient who either was currently using drugs that might affect the results of the study or was being seen regularly by other health service providers was excluded from the study. Those subjects included required dental work of a non-emergency nature entailing at least two separate dental appointments. The final list included 21 subjects (17 females, 4 males). The disproportionate male/female ratio resulted from two factors: (1) twice as many females (N = 28) as males (N = 14) were originally identified by

the dentist as stress prone in a dental setting; (2) the males contacted were more reluctant to participate in the study than were the females. Subjects ranged in age from 21 to 48 years with a mean age of 35 years.

## Apparatus

EMG measures were recorded with an Autogen 1500 Feedback Myograph using standard frontalis placements two inches on either side of center forehead and one inch above each eyebrow (Venables & Martin, 1967). A ground electrode was secured to the forehead midway between the other electrodes.

Connected to the Autogen unit were stereophonic headphones through which subjects in the EMG feedback group received auditory feedback of ongoing muscular tension. This feedback was presented in the form of clicks which were logarithmically proportional to the level of EMG activity being monitored. All meter readings were based on average integral microvolts.

## Procedures and Measures

During the first phase of the initial dental appointment in which actual dental work occurred, baseline frontalis EMG readings were taken. After a three-minute adaptation period, while the patient was seated in the dental chair, the baseline EMG readings were recorded once every ten seconds for a three-minute period and averaged to obtain a single score. After removal of the electrodes each subject completed a set of self-report measures including the Dental Anxiety Scale (DAS)

(Corah, 1969) and the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch & Lushene, 1970). Upon completion of these measures the scheduled dental treatment was initiated. At the conclusion of the initial dental appointment, all subjects were scheduled for ten training or control sessions to extend over a four-week period. Both dental appointments and all training sessions for each subject were scheduled at approximately the same time of day with a maximum deviation of two hours for any one subject. Subjects were then randomly assigned to one of three groups (N = 7 each): EMG feedback training (BF), progressive relaxation training (PR), or self-relaxation control (C).

Subjects in the progressive relaxation group received ten training sessions of from 40 to 10 minutes in length in the manner standardized by Bernstein and Borkovec (1973). The longer time periods were necessary for completion of training during the first three sessions, with session length decreasing as the training progressed. The progressive relaxation training was "live," rather than prerecorded on tape, as Paul and Trimble (1970) have shown the latter method to be significantly less effective in reducing stress responses. In the EMG feedback group subjects also received ten training sessions. Each session was a uniform length of 20 mintues (Budzynski & Stoyva, 1969). As with subjects in the treatment groups, control subjects met with the experimenter for ten sessions. No training was given this group, but the subjects were asked to relax themselves while in a reclining position for 20 minutes. Each subject was encouraged to practice relaxing at home in the same way they had during office sessions for two 15-minute periods each day.

Treatment and control sessions were conducted in the physical therapy room of a physician's office adjacent to the office of the participating dentist. The room was well insulated from sound on all sides. During relaxation sessions subjects reclined on a hospital bed with the experimenter seated in a nearby chair.

In all cases, the second dental appointment was scheduled within two weeks after completion of the ten relaxation sessions. EMG recordings of muscle tension levels and self-report data were collected in an identical manner as that collected during the first dental appointment. The dentist recording EMG levels was unaware of the experimental group to which each patient was assigned.

Routine dental check-up notices were mailed to all subjects approximately one year after their second experimental dental appointment. Those subjects who responded to this call for check-up appointments and who upon examination required dental treatment other than routine cleaning were scheduled for a follow-up appointment. EMG levels and self-report data were collected in the same manner as in the first and second dental appointments.

## Results

### EMG Levels--Training Sessions

The mean EMG levels in microvolts for all groups, BF, PR, and C, were determined for each of the ten training or control sessions that occurred during the five to seven week period between dental appointments. Figure 1 shows the EMG trends for each group across these ten sessions. If it is assumed that learning to relax is

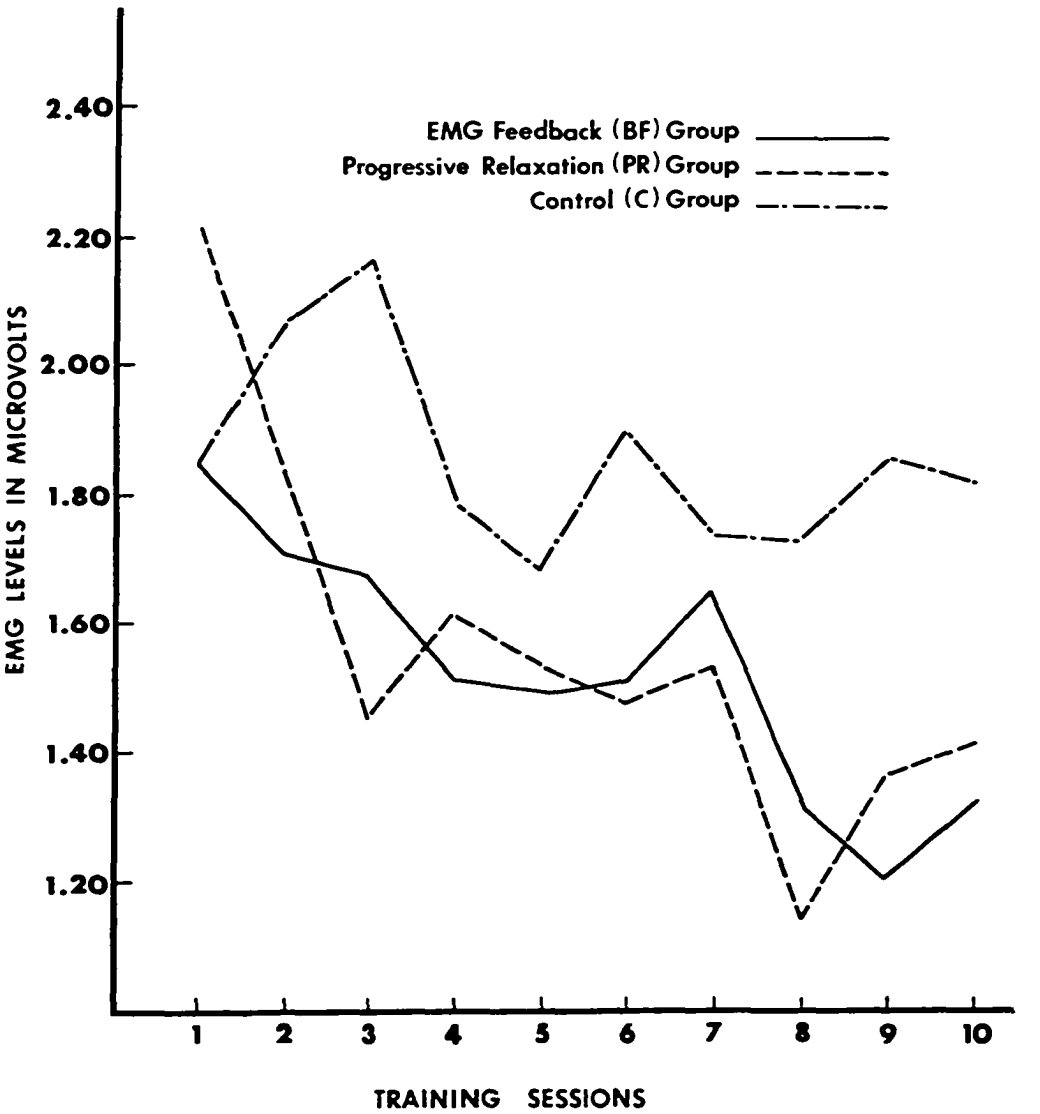


Figure 1. Trends for training session EMG levels

accompanied by progressively lower EMG levels across sessions, significant linear trends for each group would be one indicator that learning had occurred. Separate tests for trends across the ten training sessions for each group showed significant linear trends for the progressive relaxation ($F = 8.93$, $p < .01$) and the EMG feedback ($F = 6.31$, $p < .05$) groups but not for the control group ($F = 0.46$). Further analysis of the data was accomplished through the use of a 3 x 10 (groups x training sessions) ANOVA with the results being presented in Table 1. Of particular interest is the groups by training session interaction which indicates significant differences in trends among groups. While a significant difference among linear trends would be an expedient way of showing differential learning among groups, it can be seen from Table 1 that this linear trend difference was not significant. As a result trends other than linear must be considered in order to account for the significant groups by training session interaction. Therefore, although significant differences among linear trends were not shown, the PR and BF groups did show significant linear decreases in EMG levels while the control group did not.

EMG Levels--Dental Appointments

The mean EMG levels in microvolts for each group across dental appointments are presented in Table 2, as are the results of a 3 x 2 (groups x appointments) ANOVA. A significant decrease in EMG level across dental appointments was found. A planned analysis of the data through an ANOVA for simple main effects showed that the decreases in EMG levels from the first to the second dental appointment occurred in

TABLE 1

ANALYSIS OF VARIANCE OF THE EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION AND SELF-RELAXATION ON TRAINING SESSION EMG LEVELS WITH PLANNED TREND COMPARISONS

| Source | df | MS | F |
|---|---|---|---|
| Groups (G) | 2 | 2.07 | 0.52 |
| Error (within groups) | 18 | 3.98 | |
| Training Sessions (T) | 9 | 0.63 | 5.73** |
| Linear Trend | 1 | 4.54 | 34.92*** |
| G x T | 18 | 0.19 | 1.73* |
| Differences in Linear Trends | 2 | 0.30 | 2.31 |
| Error (T x S/G) | 162 | 0.11 | |
| Linear Error | 18 | 0.13 | |

*$p < .05$.

**$p < .01$.

***$p < .001$.

TABLE 2

ANALYSIS OF VARIANCE OF THE EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION AND SELF-RELAXATION ON DENTAL APPOINTMENT EMG LEVELS

| Source | df | MS | F | | Appointment Means 1 | 2 |
|---|---|---|---|---|---|---|
| Groups (G) | 2 | .71 | .23 | BF | 3.50 | 2.03 |
| Error (within groups) | 18 | 2.56 | | | | |
| Appointments (A) | 1 | 12.27 | 8.13* | PR | 3.70 | 1.86 |
| G x A | 2 | 3.58 | 2.37 | | | |
| Error (A x S/G) | 18 | 1.51 | | C | 2.35 | 2.43 |

*$p < .05$.

the EMG feedback ($p < .05$) and the progressive relaxation ($p < .05$) groups. A slight nonsignificant increase in EMG level between dental appointments was noted in the self-relaxation control group. No significant differences were shown in EMG levels of the three groups at the post dental appointment. Therefore, while EMG levels for both BF and PR groups were reduced significantly across dental appointments, these decreases were not significantly different from each other.

Dental Anxiety Scale

Table 3 consists of the mean score on the DAS for each group across dental appointments and the results of a 3 x 2 (groups x appointments) ANOVA. A significant decrease in DAS scores occurred between dental appointments as demonstrated by the significant main effect. Further, a significant interaction between groups and dental appointments was also shown. A planned ANOVA for simple main effects accounted for the interaction effect by demonstrating that, first, all groups evidenced a significant decrease in scores across appointments (BF, $p < .001$; PR, $p < .001$; C, $p < .05$) and, second, the groups' scores, while not differing on the first dental appointment, did differ significantly on the second ($p < .05$). Individual comparisons indicated that while there was no significant difference between the EMG feedback and progressive relaxation scores at the second dental appointment, the mean of these scores differed significantly ($p < .05$) from that of the control group. A t-test on the difference scores between appointments for the BF and PR groups was not significant. Thus, DAS scores in all groups, BF, PR, and C, showed significant reductions; however, the

TABLE 3

ANALYSIS OF VARIANCE OF THE EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION AND SELF-RELAXATION ON DENTAL ANXIETY SCALE SCORES

| Source | df | MS | F | | Appointment Means 1 | 2 |
|---|---|---|---|---|---|---|
| Groups (G) | 2 | 23.74 | 3.05 | BF | 14.00 | 8.00 |
| Error (within groups) | 18 | 7.79 | | | | |
| Appointments (A) | 1 | 201.53 | 70.20*** | PR | 12.43 | 7.71 |
| G x A | 2 | 11.45 | 3.99* | | | |
| Error (A x S/G) | 18 | 2.87 | | C | 13.86 | 11.43 |

*$p < .05$.

***$p < .001$.

reductions shown by the BF and PR groups, while not differing significantly from each other, were significantly lower than those in the C group.

STAI-State

In Table 4 the mean STAI-State scores for each group and the results obtained from a 3 x 2 (groups x appointments) ANOVA are presented. Main effects for groups ($p < .05$) and appointments ($p < .001$) and the interaction effect ($p < .001$) are shown to be significant. A planned ANOVA for simple main effects revealed significance for groups at both levels of appointments and for appointments at all levels of groups. Individual comparisons showed that at the first appointment the score of the PR group was significantly lower than that of the BF group ($p < .05$); however, the score of neither the PR group nor the BF group differed significantly from that of the C group. At the second dental appointment the score of the BF group did not differ significantly from that of the PR group, although the scores of both the BF group ($p < .01$) and the PR group ($p < .01$) differed significantly from that of the control group. A t-test of difference scores between appointments for the BF and PR groups was not significant. Thus, all groups showed significant decreases in STAI-State scores; however, while the reductions shown by the BF and PR groups did not differ significantly from each other, they were both significantly greater than the decreases shown by the C group.

TABLE 4

ANALYSIS OF VARIANCE OF THE EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION AND SELF-RELAXATION ON STAI-STATE SCORES

| Source | df | MS | F | | Appointment Means 1 | 2 |
|---|---|---|---|---|---|---|
| Groups (G) | 2 | 848.86 | 5.77* | BF | 55.43 | 30.57 |
| Error (within groups) | 18 | 147.14 | | | | |
| Appointments (A) | 1 | 2288.09 | 2138.40*** | PR | 43.43 | 27.43 |
| G x A | 2 | 405.82 | 379.27*** | | | |
| Error (A x S/G) | 18 | 1.07 | | C | 52.71 | 49.29 |

*$p < .05$.

***$p < .001$.

STAI-Trait

Table 5 includes mean STAI-Trait scores for all groups across dental appointments and the results of a 3 x 2 (groups x appointments) ANOVA. A significant difference was shown between scores on the first and second dental appointments. Further analysis with an ANOVA for simple main effects indicated that there was a significant decrease in BF scores ($p < .05$) between appointments. No difference was found on scores between dental appointments in either the PR or the C groups. Also, there were shown to be no differences among the scores of the three groups on either the first or the second dental appointments. Therefore, while STAI-Trait scores showed significant reductions across dental appointments for the BF group, no such reductions were apparent in the PR or the C groups.

Follow-up

Approximately one year following the second dental appointment all subjects were mailed dental check-up notices. Three subjects did not respond, while two others indicated that they no longer resided in the area. Five of the sixteen subjects who did return for check-ups required dental treatment other than routine cleaning. Three of these five subjects were in the EMG feedback training group, one in the progressive relaxation group, and one in the self-relaxation control group.

Figure 2 illustrates the EMG levels of the follow-up subjects from first through third appointments. It can be seen that the mean EMG level of the feedback subjects at the follow-up appointment decreased from their mean level at the second dental appointment a year

TABLE 5

ANALYSIS OF VARIANCE OF THE EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION AND SELF-RELAXATION ON STAI-TRAIT SCORES

| Source | df | MS | F | | Appointment Means 1 | 2 |
|---|---|---|---|---|---|---|
| Groups (G) | 2 | 88.10 | .54 | BF | 35.71 | 31.00 |
| Error (within groups) | 18 | 159.88 | | | | |
| Appointments (A) | 1 | 77.36 | 5.49* | PR | 36.29 | 34.71 |
| G x A | 2 | 10.57 | .75 | | | |
| Error (A x S/G) | 18 | 14.08 | | C | 39.29 | 37.43 |

*$p < .05$.

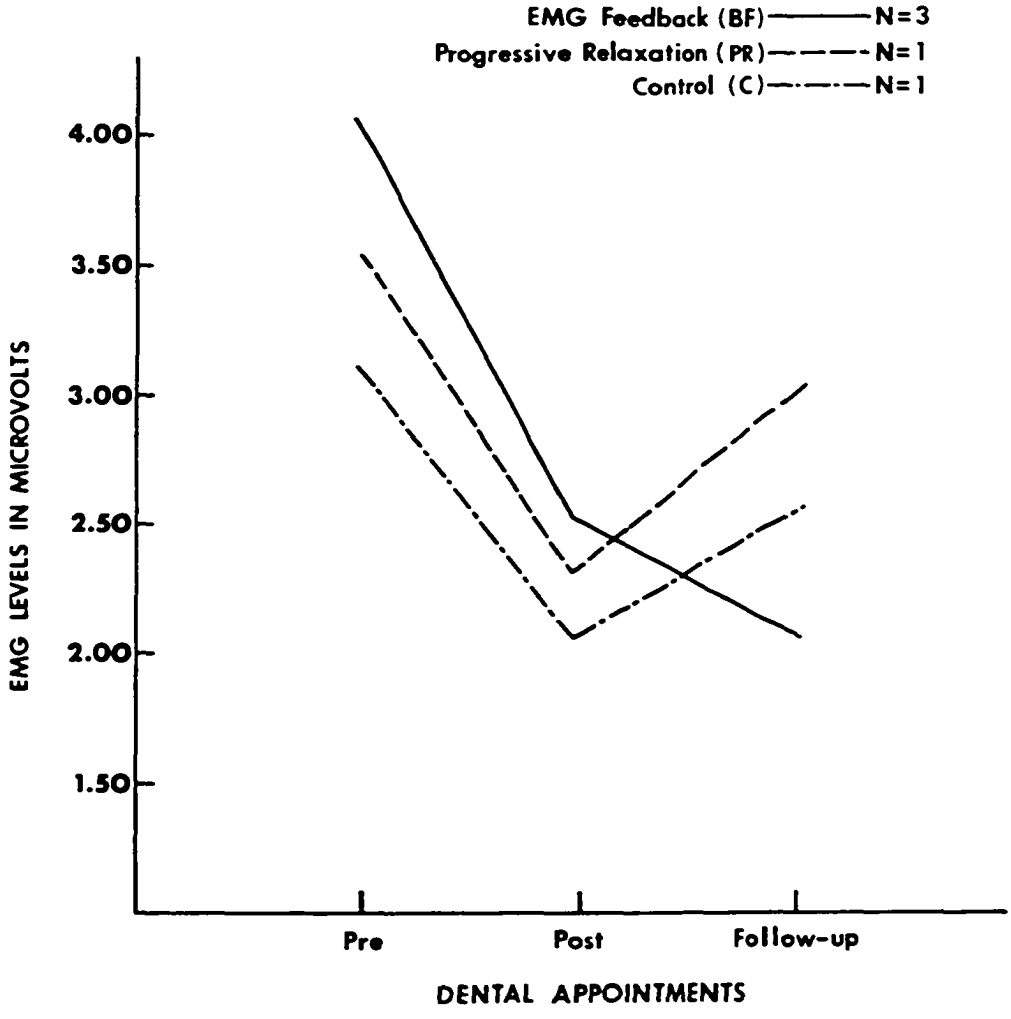


Figure 2. EMG levels of follow-up subjects at pre, post, and follow-up dental appointments

earlier. Conversely, the EMG levels of both the progressive relaxation and control subjects showed increases from second to follow-up appointments. It should be noted that the marked decrease of EMG level between first and second appointments shown by the control subject was highly atypical of that group and may represent a placebo effect stemming from that subject's perception that the self-relaxation procedure was the primary treatment under investigation.

With the exception of the progressive relaxation patient's increased STAI-State score, all other state anxiety scores (DAS and STAI-State) showed no change or decreased from the second to the follow-up dental appointments. However, on the STAI-Trait measure a different pattern was observed. The mean STAI-Trait scores of the EMG feedback subjects showed a slight decrease (1 percent) from second to follow-up appointments, while substantial increases were evident in the scores of the progressive relaxation (66 percent) and control (12 percent) subjects.

## Discussion

Both the training session data and the pre-post appointment data lend support to the first hypothesis which contends that EMG feedback and progressive relaxation training will lead to significant reductions in stress reactions as compared to self-relaxation control procedures. The second hypothesis which holds that EMG feedback relaxation training will produce significantly greater stress reduction than progressive relaxation training finds partial support in that a reduction in general, day-to-day stress was reported by the EMG

feedback group but not by the progressive relaxation or control groups. Both treatment groups, however, were equally effective in reducing transitory, situational stress such as found in the dental setting.

While the results of this study are necessarily limited by the nature of the subjects involved, i.e., by the high female to male ratio and by their volunteer-subject status, a review of the data suggests that patients having chronic negative stress reactions in dental settings may obtain a significant degree of relief from relaxation training with either EMG feedback or progressive relaxation techniques. The EMG levels of both the feedback and the progressive relaxation groups showed significant decreasing linear trends across training sessions suggestive of learning. No such trend, however, was observed in the control group. Also, from the first to the second dental appointments the feedback and the progressive relaxation groups showed significant decreases in scores on three of four dependent measures (EMG, DAS, STAI-State). While significant decreases were also shown by the control group on the latter two measures, these decreases were significantly less than those shown by the EMG feedback and progressive relaxation groups. No indication of a clear-cut superiority of one type of relaxation training over the other was shown on the EMG, DAS, or STAI-State measures. Rather, on the basis of this evidence, it would seem that patients in both groups were more comfortable, physiologically and psychologically, when exposed to dental stimuli after receiving relaxation training.

However, STAI-Trait scores did differentiate between the EMG feedback and progressive relaxation groups. Here, the score of the EMG

feedback training group was significantly lowered, while the scores of the progressive relaxation and self-relaxation control groups were not. This suggests that the effects of the EMG feedback training reached beyond the dental situation. The patients in this group reported fewer day-to-day stress reactions after EMG feedback training. This phenomenon was noted with some surprise, for STAI-Trait scores had been expected to remain constant for all groups across appointments, in line with Spielberger's hypothesis (1966) that trait anxiety refers to a relatively stable personality trait denoting individual differences in anxiety-proneness.

Assuming that the reduction in anxiety-proneness reported by the EMG feedback group resulted from differences in the experimental treatments, the key distinction between EMG feedback and progressive relaxation techniques may lie in the self-taught versus therapist-taught aspects of the two procedures. More specifically, EMG feedback training requires that the patient learn for himself how to reduce his muscular tension level, while progressive relaxation training involves the learning of muscular relaxation through an intermediary, i.e., the therapist. The self-training aspect of the EMG feedback procedure may aid in the internalization of learned control over muscular tension which may, in turn, serve to decrease general anxiety levels. Strassberg (1973) has demonstrated that persons with internal controls are significantly less anxious than are those having external controls. If the contentions outlined above are correct, patients in the EMG feedback group would be expected to retain the benefits derived from relaxation training for a longer time period than would patients in the

progressive relaxation group. The efficacy of this hypothesis was evaluated through follow-up data collected approximately one year following the second experimental dental appointment.

Since only five of the sixteen patients who responded to a call for yearly check-ups required dental treatment, it is not possible to draw definite conclusions about treatment effects over time. However, the data collected does tend to support the contention that patients who received EMG feedback relaxation training would retain the benefits of that treatment to a greater extent than would the progressive relaxation and control patients. At the follow-up appointment further decreases in mean EMG levels and STAI-Trait scores were noted for the EMG feedback patients, while the progressive relaxation and control patients showed increases on corresponding measures.

Chronic high levels of stress have been suggested as a contributing factor in a number of psychophysiological disorders (Seyle, 1956). If the STAI-Trait measure reflects anxiety-proneness or, in effect, an individual's usual stress level, then a procedure capable of reducing this and other stress indicators may prove to be of far-reaching therapeutic value. As the follow-up patients receiving EMG relaxation training in this study maintained decreases over time in EMG levels, state anxiety scores, and trait anxiety scores, further investigation of this aspect of EMG feedback relaxation training is warranted.

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# APPENDIX A

# PROSPECTUS

# PROSPECTUS

## I. Introduction

### A. Objectives

The objectives of the proposed study are (1) to determine the effectiveness of muscular relaxation treatment as applied to patients exhibiting stress reactions in a dental setting, and (2) to compare the effects of electromyographic (EMG) feedback training with those of progressive relaxation training in the reduction of stress reactions in dental patients.

### B. Background

In recent years psychologists and psychiatrists have focused much attention on human reaction to stress (Lazarus & Opton, 1966; McGrath, 1970; Bridges, 1974). One facet of this type of study has been the application of principles of stress reduction to subjects confronted with situations or objects perceived as threatening. Cooper, Furst, and Bridger (1969) have pointed out that much of the work in this area has involved college-aged, snake-phobic subjects whose stress reactions have questionable relevance to reactions exhibited in threatening, real-life situations. In addition, Weitz (1970) has observed that ". . . one of the biggest deficiencies in our knowledge about stress stems from the paucity of studies of stress under natural, or what may be called field,

conditions." It would seem that controlled, field-oriented studies are needed in order to better determine the effectiveness of stress reducing psychotherapeutic techniques.

Lazarus (1966) has noted that the dental context provides an excellent area in which to study both physiological and psychological stress. Due to the nature of the procedures involved, stress is often an inherent part of the dental experience. The patient may anticipate possible confrontation with aversive stimuli, but he cannot be certain as to when or if it will occur. Further, if the confrontation does occur the patient generally feels helpless to do anything about it (Corah, 1973). It is within this context that the proposed study will examine two psychotherapeutic techniques, EMG feedback and progressive relaxation, with regard to their effectiveness in reducing stress reactions in dental patients.

Biofeedback has been defined as "the immediate ongoing presentation of information to a person concerning his own physiological processes" (Green, Green & Walters, 1973). More specifically, EMG feedback involves the presentation of information, through auditory or visual means, about current levels of muscular tension. The use of EMG feedback as a relaxation technique has recently been suggested to be an effective treatment for the reduction of anxiety stress reactions (Budzynski & Stoyva, 1969; Green, Green & Walters, 1973). Following a wave of clinical enthusiasm greeting this new technique, Miller (1974) has called for rigorous tests of biofeedback therapy, preferably by

comparing its results to those of the best alternative treatments.

One such treatment known as progressive relaxation was developed by Jacobson in the late 1930s. This treatment involved the systematic tensing and relaxing of major muscle groups for the purpose of increasing discriminative control of muscular tension levels. Jacobson's program was intensive, requiring from fifty to one hundred hours or more of guided practice. It was also an extensive therapy program, for Jacobson (1938) used progressive relaxation as the only treatment for neuroses and a number of psychosomatic disorders. Progressive relaxation treatment has particularly been recommended for patients exhibiting symptoms of anxiety stress reactions (Haugen, Dixon & Dickel, 1958). A recent refinement of the Jacobson treatment (Bernstein & Borkovec, 1973) has resulted in a relatively brief, standardized progressive relaxation program more suitable for research purposes than the original lengthy version.

A review of current literature has revealed a few controlled studies which compare the effectiveness of EMG feedback with that of progressive relaxation in reducing muscular tension levels (Coursey & Frankel, 1974; Reinking, Tamayo & Morgot, 1975; Staples & Coursey, 1975). The results of these studies were in general agreement that EMG feedback is superior to progressive relaxation training with regard to the speed of learning and the depth of relaxation obtained. In all of the aforementioned studies, however, the subjects employed were classified as normal, i.e., they did not exhibit undue stress reactions under the

experimental conditions. No studies were found in which the comparative effectiveness of these two relaxation treatments were examined with regard to the reduction of stress reactions under natural, stress-provoking circumstances.

C. Rationale

Given the above considerations, it would seem that the proposed study may aid in answering questions which are both pertinent and appropriate to the present state of knowledge concerning the use of relaxation training as a means of reducing stress reactions in real-life situations.

The basic premise underlying the proposed study is that through relaxation of muscular tension, stress reactions can be reduced. Although experimental evidence tends to support such a view (Jacobson, 1939; Paul, 1969a; Paul, 1969b; Garrett & Silver, 1972; Coursey & Frankel, 1974; Reinking, Tamayo & Morgot, 1975), some conflicting evidence is reported (Wilson & Wilson, 1970; Connor, 1974; Davidson & Neufeld, 1974). On the basis of evidence presented above (see Section I., B.), this study further hypothesizes that EMG feedback will be superior to progressive relaxation in reducing stress reactions in dental patients. It would seem valuable to investigate these proposed hypotheses on the grounds that the training measures involved offer the possibility of control over uncomfortable, if not harmful symptoms.

II. Specific Aims

The specific aims of this proposal are (1) to train subjects to obtain levels of deep relaxation through EMG feedback and

progressive relaxation techniques; (2) to provide an adequate control group by holding constant all variables except the experimental treatments; (3) to evaluate the effectiveness of the relaxation training in reducing stress reactions by comparing the treatment groups with the control group; and (4) to assess the effectiveness of EMG feedback in comparison to progressive relaxation with regard to the reduction of stress reactions in a real-life situation.

III. Method

A. Selection of Subjects

A list of patients classified as highly prone to stress reactions in a dental setting will be compiled by a dentist from his total file of patients on the basis of the dentist's observations over time and also on patients' verbal reports to him. The patients will be contacted by phone by the dentist to determine their interest in participating in a study of treatment techniques aimed at the reduction of stress reactions in dental situations. Those patients interested will be scheduled for a brief initial interview and dental examination. Any patient currently using drugs or being seen regularly by other health service providers will be excluded from the study. Those included must require dental work of a non-emergency nature entailing at least two separate dental appointments. The final list will include 21 subjects who will be randomly assigned to one of three groups (N = 7 each): EMG feedback training, progressive relaxation training, or self-relaxation control.

B. Measures

The following dependent measures will be used to determine the effectiveness of relaxation training in reducing the stress reactions of dental patients: electromyographic (EMG) recordings of muscle potential based on average integral microvolts; the Dental Anxiety Scale (DAS) (Corah, 1969); and the State-Trait Anxiety Inventory (STAI-State and STAI-Trait) (Spielberger, Gorsuch & Lushene, 1970).

The reliability of the Dental Anxiety Scale was estimated for both internal consistency and stability over time (Corah, 1969). A correlation coefficient of 0.86 was obtained from a sample of students completing the DAS. A test-retest coefficient of 0.82 was found after administering the DAS twice, with three months intervening between testing. The validity of the DAS was estimated by correlating dentist ratings of the anxiety levels of patients to the DAS scores of those same patients, with a coefficient of 0.42 ($p < 0.01$) being obtained.

Estimates of the reliability and validity of the State-Trait Anxiety Inventory have been reported by Spielberger, Gorsuch, and Lushene (1970). The internal consistency of both the STAI-State and the STAI-Trait scales were shown to be comparable in tests of high school and college students, with correlation coefficients ranging from 0.83 to 0.92. The test-retest reliability of the STAI-trait scale was found to be relatively high after a 104 day test interval ($r = 0.77$ for females; $r = 0.73$ for males), while the reliability for the STAI-State scale for the same subjects

tended to be low (r = 0.31 for females; r = 0.33 for males). Concurrent validity was checked by correlating the STAI-Trait scale with the IPAT Anxiety Scale (Cattell & Scheier, 1963) and the Taylor (1953) Manifest Anxiety Scale (TMAS). The correlations for psychiatric patients were found to be 0.77 (STAI-Trait vs. IPAT) and 0.83 (STAI-Trait vs. TMAS). The construct validity of the STAI-State scale was supported by group means which progressively increased from 32.70 to 50.03 under four conditions ranging from nonstressful to highly stressful.

B. Experimental Procedure

During the first portion of the initial dental appointment in which actual dental work will occur, baseline frontalis EMG readings will be taken. After a three-minute adaptation period, while the patient is seated in the dental chair, the baseline EMG readings will be recorded once every ten seconds for a three-minute period and averaged to obtain a single score. After removal of the electrodes each subject will complete a set of self-report measures including the Dental Anxiety Scale (DAS) (Corah, 1969) and the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch & Lushene, 1970). At the conclusion of the initial dental appointment all subjects in each of the three groups will be scheduled for ten training or control sessions to extend over a four-week period. Sessions will be scheduled with at least one day intervening between sessions.

Subjects in the progressive relaxation group will receive ten training sessions of from 40 to 10 minutes in length in the

manner standardized by Bernstein and Borkovec (1973). The longer time periods will be necessary for completion of training during the first three sessions with session length decreasing as the training progresses. Each subject will be encouraged to practice relaxation at home in the same way they had during training sessions for two 15-minute periods each day. Data sheets for recording home practice information will be provided each subject and will include four items: (1) the length of session, (2) the time of occurrence, (3) a 5 point rating scale evaluating the depth of relaxation obtained, and (4) a space for comments.

Subjects in the EMG feedback group will also receive ten training sessions. Each session will be a uniform length of 20 minutes (Budzynski & Stoyva, 1969). As in the other treatment group, subjects will be encouraged to practice relaxation at home in a reclining position and will be asked to record this information. Instructions for home practice in relaxation will correspond to those instructions given to the progressive relaxation group, i.e., they will be asked to relax in the same way as they had during training sessions but without the aid of instrumentation.

As with subjects in the treatment groups, control subjects will meet with the experimenter for ten sessions. No training will be given, but the subjects will be asked to relax themselves while reclining for a 20-minute period. Home relaxation instructions will correspond to those of the other two groups. Material

for home practice information will also be identical with that given the other groups.

In all three groups muscle potential level will be recorded at five equally spaced 20-second intervals throughout each session. Five separate EMG readings will be taken during each 20-second interval. In the progressive relaxation group recordings will be made only during those periods when the subjects have been instructed to relax.

Treatment and control sessions will be conducted in the physical therapy room of a physician's office immediately adjacent to the office of the participating dentist. The room is well insulated from sound on all sides. During relaxation sessions subjects will recline on a hospital-type bed with the experimenter seated in a nearby chair. The experimenter will have a clear view of both the subject and the electromyograph. The myograph, however, will be screened from view of the subjects.

Where possible, the second dental appointment will be scheduled within two weeks after completion of the ten relaxation sessions. EMG recordings of muscle potential levels and self-report data will be collected in an identical manner as that collected during the first dental appointment.

EMG measures will be recorded from an Autogen 1500 Feedback Myograph using standard frontalis placements two inches on either side of center forehead and one inch above each eyebrow (Venables

& Martin, 1967). A ground electrode will be taped to the forehead midway between the other two electrodes.

Subjects in the EMG feedback group will receive auditory feedback of their current ongoing level of muscular tension via stereophonic headphones. This feedback will be given to the subjects in the form of clicks which are logarithmically proportional to the level of EMG activity being monitored. All meter readings will be based on average integral microvolts.

C. Human Experimentation Considerations

1. Electrical recording. The recording of physiological measures will employ non-invasive techniques, i.e., there will be no puncture of the skin and no devices will be introduced into body apertures. In rare instances electrode application has caused some discomfort and irritation to the skin. These effects are minimal and disappear within a few hours after the electrodes are removed. An occasional subject may have skin irritation due to the cleansing procedures necessary for the proper electrode contact or may have an allergic reaction to the electrode paste. With the occurrence of any unusual skin response, the subject will be terminated.

2. Psychological tests, etc. All information gained regarding individual subjects will be held in strict confidence. Subjects will be assigned a code number and only this number will be used to identify subjects on psychological tests, personal histoties, etc. The key to the code numbers will be kept in a secure location under the control of the experimenter.

3. Informed consent. Before entering the study, subjects will read and sign a consent form. Any questions regarding the procedures or purposes of the study will be fully explained to the subject. Only information regarding psychological test scores will be withheld.

IV. Statistical Analysis of Data

A. EMG Data from Training and Control Sessions

Data collected during the training and control sessions will be averaged for each subject over each of the ten sessions yielding ten scores expressed in average microvolts per session. This data will be analyzed through an analysis of variance using a repeated measures design. Individual comparisons will be used in order to determine which treatment groups differ significantly. Linear tests for trends will be computed to indicate if learning has occurred across sessions.

B. EMG Data from Dental Appointments

The EMG data collected will be averaged separately for each of the two dental appointments yielding two scores expressed in average microvolts per appointment. The data will be analyzed with a 3 x 2 (treatment x appointment) analysis of variance. Individual comparisons will be made.

C. The Dental Anxiety Scale and the State-Trait Anxiety Inventory

The data collected from these measures will be analyzed separately, but in the same manner, using a 3 x 2 (treatment x appointment) analysis of variance. Again individual comparisons

will be made to determine more specifically where significant differences are occurring.

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# APPENDIX B

## RESPONSE FORM FOR INITIAL INTERVIEW

BRIEF DENTAL AND MEDICAL HISTORY

Name _____ Date _____

Address _____ Phone _____

Age ___ Occupation _____ Marital Status _____

Please mark the answer(s) which most closely apply to you.

1. At what age did you have your first dental appointment?

   a. Between 1 to 5 years of age.
   b. Between 6 to 10 years of age.
   c. Between 11 to 15 years of age.
   d. Between 16 to 20 years of age.
   e. After age 20.

2. By age 18 approximately how many teeth did you have that were filled?

   a. None.
   b. 1 to 5.
   c. 6 to 10.
   d. 11 to 15.
   e. 16 or more.

3. By age 18 how many permanent teeth had been extracted because of decay?

   a. None.
   b. 1.
   c. 2.
   d. 3.
   e. 4 or more.

4. Is "going to the dentist" a difficult experience for any of the members of your family?

   a. Mother.

   b. Father.

   c. Sister.

   d. Brother.

   e. Wife or husband.

   f. Daughter.

   g. Son.

   h. Other (please specify) _____.

5. Rank order those events you find to be the most disturbing parts of the dental experience. (Rank these events from 1, the most disturbing, to 5 or 6, the least disturbing.)

   ___ a. Sitting in the waiting room.

   ___ b. Sitting in the dental chair before the dentist begins work.

   ___ c. Injection of the anesthetic.

   ___ d. Noise of the drill.

   ___ e. The dental procedure itself.

   ___ f. Other (please specify) _____.

6. Are you currently under the care of

   a. a physician.

   b. a psychiatrist.

   c. a psychologist.

   d. none of the above.

7. Do you regularly use any medication or drugs?

   a. Yes (please specify) _____.

   b. No.

8. Briefly describe any memorable dental experience you have had during your life time. (Use the back of this page, if necessary.)

9. Has the distress you have experienced in the dental setting ever kept you from seeing the dentist regularly? (If your answer is "yes" please go into more detail.)

# APPENDIX C

# CONSENT FORM

CONSENT FORM

I, _____, voluntarily consent to participate in the investigation entitled: "The Effects of EMG Feedback and Progressive Relaxation Training on the Reduction of Stress Reactions in Dental Patients," the purpose of which has been explained to me by Dr. Terry P. Miller. I thereby authorize Martha P. Miller, and such assistants as she may designate, to conduct the foregoing investigation in which I will serve as a subject.

Benefits

Although no assurance can be made that the experiment will benefit me with regard to the reduction of stress reactions in a dental setting (since results from investigational studies cannot be predicted), I realize that the information gained may contribute to an understanding of the effects of EMG feedback and progressive relaxation on stress reactions.

It is my understanding that, if I complete my training and dental appointments as a subject, I will receive a twenty-five percent discount on all dental services performed during the study. Further, I understand that no charges will be made for the initial dental examination or for the relaxation training program.

Risks

The risks involved are minimal and specifically include: (1) possible skin irritation due to cleansing procedures necessary for proper electrode contact; and (2) possible allergic reaction to electrode paste.

I understand that the investigators and their assistants will take every precaution consistent with the best dental practice and experimental procedures.

I also understand that:

1. By signing the consent form I have not waived any of my legal rights or released the investigators from liability for negligence. I may revoke my consent and withdraw from this study at any time.

2. Psychological tests (the Dental Anxiety and the State-Trait Anxiety Inventory) administered to me will be treated as confidential and will receive a code number so that they will remain anonymous when filed. In no case will any use be made of these tests other than their application to experimental analysis.

I voluntarily agree to participate in these studies, and I understand that I am free to withdraw this consent and to discontinue my participation at any time.

| | |
|---|---|
| (Dentist's Signature as Responsible Investigator) | (Participant's Signature) |
| (Principal Investigator's Signature) | (Witness' Signature) |
| (Identification Number) | (Date) |

# APPENDIX D

## RESPONSE FORMS FOR DENTAL APPOINTMENTS

Identification Number _____

DENTAL QUESTIONNAIRE
(DAS)

Please place a check mark before the answer which most closely applies to you.

1. As you wait for your dental appointment to begin, how do you feel?

   a. I look forward to it as a reasonably enjoyable experience.
   b. I don't care one way or the other.
   c. I am a little uneasy about it.
   d. I am afraid that it will be unpleasant and painful.
   e. I am very frightened of what the dentist might do.

2. When you were waiting in the dentist's reception room for your turn in the chair, how did you feel?

   a. So anxious that I broke out in a sweat or almost felt physically sick.
   b. Anxious.
   c. Tense.
   d. A little uneasy.
   e. Relaxed.

3. You are in the dentist's chair waiting while he gets his drill ready to begin working on your teeth. How do you think you will feel?

   a. So anxious that I might break out in a sweat or almost feel physically sick.
   b. Anxious.
   c. Tense.
   d. A little uneasy.
   e. Relaxed.

4. You are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments which he will use to scrape your teeth around the gums, how do you think you will feel?

   a. Relaxed.

   b. A little uneasy.

   c. Tense.

   d. Anxious.

   e. So anxious that I might break out in a sweat or almost feel physically sick.

SELF-EVALUATION QUESTIONNAIRE

Developed by C. D. Spielberger, R. L. Gorsuch and R. Lushene

STAI FORM X-1

Name _____ Date _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel right now, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe your present feelings best.

| | | Not at all | Somewhat | Moderately so | Very much so |
|---|---|---|---|---|---|
| 1. | I feel calm | 1 | 2 | 3 | 4 |
| 2. | I feel secure | 1 | 2 | 3 | 4 |
| 3. | I am tense | 1 | 2 | 3 | 4 |
| 4. | I am regretful | 1 | 2 | 3 | 4 |
| 5. | I feel at ease | 1 | 2 | 3 | 4 |
| 6. | I feel upset | 1 | 2 | 3 | 4 |
| 7. | I am presently worrying over possible misfortunes | 1 | 2 | 3 | 4 |
| 8. | I feel rested | 1 | 2 | 3 | 4 |
| 9. | I feel anxious | 1 | 2 | 3 | 4 |
| 10. | I feel comfortable | 1 | 2 | 3 | 4 |
| 11. | I feel self-confident | 1 | 2 | 3 | 4 |
| 12. | I feel nervous | 1 | 2 | 3 | 4 |

13. I am jittery . . . . . 1 2 3 4

14. I feel "high strung" . . . . . 1 2 3 4

15. I am relaxed . . . . . 1 2 3 4

16. I feel content . . . . . 1 2 3 4

17. I am worried . . . . . 1 2 3 4

18. I feel over-excited and rattled . . . . . 1 2 3 4

19. I feel joyful . . . . . 1 2 3 4

20. I feel pleasant . . . . . 1 2 3 4

SELF-EVALUATION QUESTIONNAIRE

STAI FORM X-2

Name _____ Date _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe how you generally feel.

| | | Not at all | Somewhat | Moderately so | Very much so |
|---|---|---|---|---|---|
| 21. | I feel pleasant | 1 | 2 | 3 | 4 |
| 22. | I tire quickly | 1 | 2 | 3 | 4 |
| 23. | I feel like crying | 1 | 2 | 3 | 4 |
| 24. | I wish I could be as happy as others seem to be | 1 | 2 | 3 | 4 |
| 25. | I am losing out on things because I can't make up my mind soon enough | 1 | 2 | 3 | 4 |
| 26. | I feel rested | 1 | 2 | 3 | 4 |
| 27. | I am "calm, cool, and collected" | 1 | 2 | 3 | 4 |
| 28. | I feel that difficulties are piling up so that I cannot overcome them | 1 | 2 | 3 | 4 |
| 29. | I worry too much over something that really doesn't matter | 1 | 2 | 3 | 4 |
| 30. | I am happy | 1 | 2 | 3 | 4 |

31. I am inclined to take things hard . . . . . 1 2 3 4

32. I lack self-confidence . . . . . 1 2 3 4

33. I feel secure . . . . . 1 2 3 4

34. I try to avoid facing a crisis or difficulty . . . . . 1 2 3 4

35. I feel blue . . . . . 1 2 3 4

36. I am content . . . . . 1 2 3 4

37. Some unimportant thought runs through my mind and bothers me . . . . . 1 2 3 4

38. I take disappointments so keenly that I can't put them out of my mind . . . . . 1 2 3 4

39. I am a steady person . . . . . 1 2 3 4

40. I become tense and upset when I think about my present concerns . . . . . 1 2 3 4

# APPENDIX E

## EMG RECORD FORMS

EMG RECORD

DENTAL APPOINTMENT

Name _____

3-Minute EMG Recording
First Appointment

Date _____
Time _____

| Seconds Into Interval | Microvolts |
|---|---|
| 1 sec. | |
| 11 sec. | |
| 21 sec. | |
| 31 sec. | |
| 41 sec. | |
| 51 sec. | |
| 61 sec. | |
| 71 sec. | |
| 81 sec. | |
| 91 sec. | |
| 101 sec. | |
| 111 sec. | |
| 121 sec. | |
| 131 sec. | |
| 141 sec. | |
| 151 sec. | |
| 161 sec. | |
| 171 sec. | |
| 180 sec. | |

EMG RECORD

DENTAL APPOINTMENT

Name _____

3-Minute EMG Recording
Second Appointment

Date _____
Time _____

| Seconds Into Interval | Microvolts |
|---|---|
| 1 sec. | |
| 11 sec. | |
| 21 sec. | |
| 31 sec. | |
| 41 sec. | |
| 51 sec. | |
| 61 sec. | |
| 71 sec. | |
| 81 sec. | |
| 91 sec. | |
| 101 sec. | |
| 111 sec. | |
| 121 sec. | |
| 131 sec. | |
| 141 sec. | |
| 151 sec. | |
| 161 sec. | |
| 171 sec. | |
| 180 sec. | |

EMG RECORD

TRAINING SESSIONS

Name _____

Session No. _____ Date _____ Time _____

| Intervals | Microvolts |
|---|---|
| 1st 20-sec. | |
| 2nd 20-sec. | |
| 3rd 20-sec. | |
| 4th 20-sec. | |
| 5th 20-sec. | |

Session No. _____ Date _____ Time _____

| Intervals | Microvolts |
|---|---|
| 1st 20-sec. | |
| 2nd 20-sec. | |
| 3rd 20-sec. | |
| 4th 20-sec. | |
| 5th 20-sec. | |

# APPENDIX F

## RESPONSE FORMS FOR HOME USE

## HOME RELAXATION INFORMATION

An important part of learning to relax includes daily home practice. You are asked to set aside two 15-minute periods every day for the purpose of relaxing at home. Relax in the same manner you have been relaxing at the doctor's office during this study. Remember not to go to sleep. Record information pertaining to each session below. In order to rank the maximum level of relaxation you have obtained during a session, use the following scale: 1--not relaxed; 2--slightly relaxed; 3--moderately relaxed; 4--considerably relaxed; 5--deeply and thoroughly relaxed.

| Date | Time Session Began | Length of Session | Rank | Comments |
|---|---|---|---|---|
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| Date | Time Session Began | Length of Session | Rank | Comments |
|---|---|---|---|---|
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# APPENDIX G

# SAMPLE CHARACTERISTICS

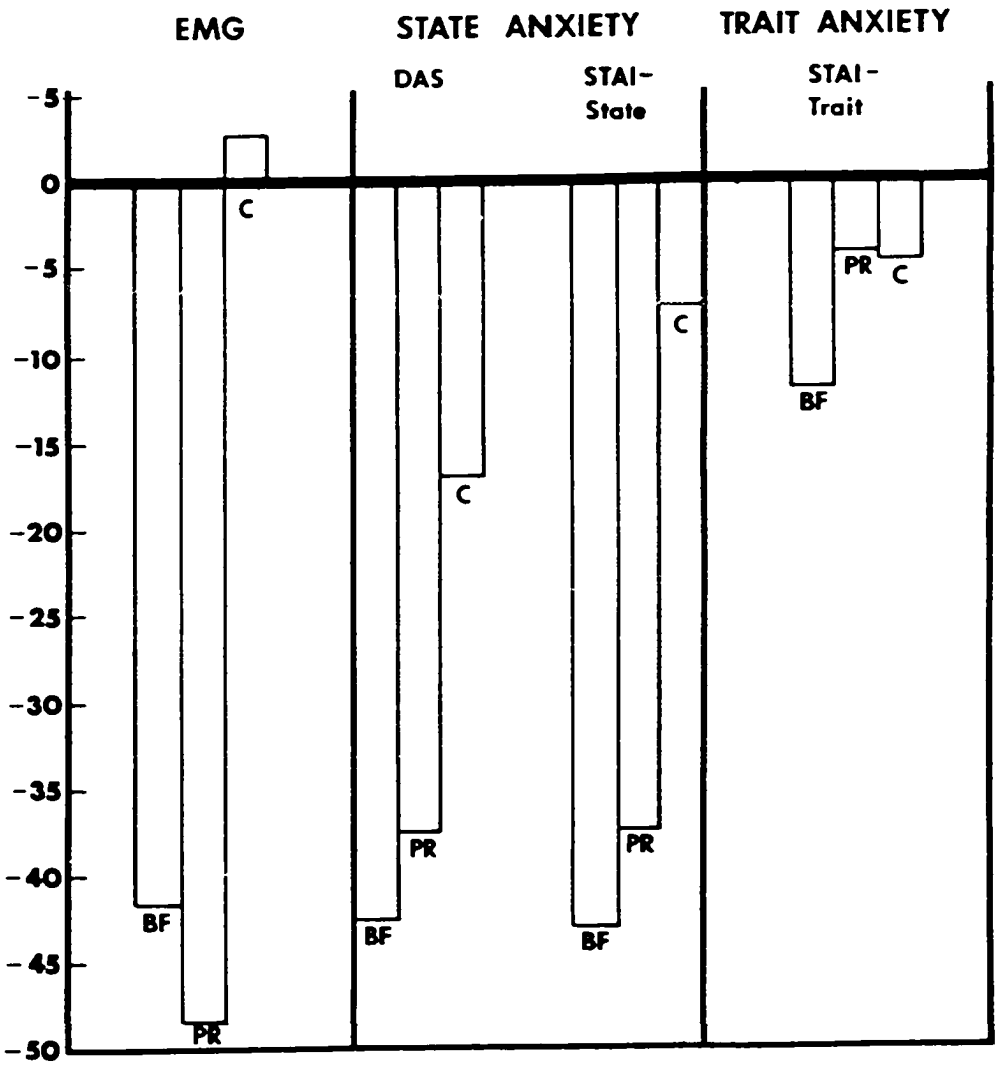
TABLE 6

CHARACTERISTICS OF TOTAL SAMPLE

| Mean Characteristics | Females (N = 17) | Males (N = 4) | Totals (N = 21) |
|---|---|---|---|
| Age | 34 | 38 | 35 |
| Age at First Dental Appointment | 8 | 12 | 9 |
| Number of Teeth Filled by Age 18 | 13 | 2 | 10 |
| Number of Extractions by Age 18 | 1 | 0 | 1 |
| Number of Other Dental Stress-Prone Family Members | 1 | 2 | 1 |
| Percent Having Post Traumatic Dental Experience | 94 | 75 | 91 |
| Percent Avoiding Regular Dental Care | 59 | 100 | 67 |

# APPENDIX H

# SUMMARY STATISTICS




BF – EMG Feedback Group
PR – Progressive Relaxation Group
C – Self-Relaxation Control Group

Figure 3. Percent Change Between Pre and Post Dental Appointments

TABLE 7

TEST FOR LINEAR TREND ACROSS TRAINING SESSIONS

FOR EMG FEEDBACK GROUP

| Source | df | MS | F |
|---|---|---|---|
| Between | 9 | 0.27 | |
| Linear trend | 1 | 1.85 | 6.38* |
| Linear error | 60 | 0.29 | |

*$p < .05$.

TABLE 8

TEST FOR LINEAR TREND ACROSS TRAINING SESSIONS

FOR PROGRESSIVE RELAXATION GROUP

| Source | df | MS | F |
|---|---|---|---|
| Between | 9 | 0.58 | |
| Linear trend | 1 | 2.87 | 8.97** |
| Linear error | 60 | 0.32 | |

**$p < .01$.

TABLE 9

TEST FOR LINEAR TREND ACROSS TRAINING SESSIONS

FOR SELF-RELAXATION CONTROL GROUP

| Source | df | MS | F |
|---|---|---|---|
| Between | 9 | 0.18 | |
| Linear trend | 1 | 0.40 | 0.46 |
| Linear error | 60 | 0.88 | |

TABLE 10

ANALYSIS OF VARIANCE FOR SIMPLE MAIN EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL ON DENTAL APPOINTMENT EMG LEVELS

| Source | df | MS | F |
|---|---|---|---|
| Between Subjects | | | |
| Between G at $a_1$ | 2 | 5.37 | 2.65 |
| Between G at $a_2$ | 2 | 0.60 | 0.30 |
| Error (within cell) | 36 | 2.03 | |
| Within Subjects | | | |
| Between A at $g_1$ | 1 | 10.51 | 6.87* |
| Between A at $g_2$ | 1 | 11.81 | 7.72* |
| Between A at $g_3$ | 1 | 0.02 | 0.01 |
| Error (A x S/G) | 18 | 1.53 | |

*$p < .05$.

TABLE 11

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN
EMG LEVELS OF TREATMENT GROUPS
AT POST DENTAL APPOINTMENT

| Treatment Group | BF | PR |
|---|---|---|
| EMG Feedback (BF) | -- | 0.31 |
| (M = 2.03) | | |
| Progressive Relaxation (PR) | | -- |
| (M = 1.86) | | |

TABLE 12

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN EMG LEVELS OF DENTAL APPOINTMENTS FOR EMG FEEDBACK GROUP

| Dental Appointment | Pre | Post |
|---|---|---|
| Pre | -- | 3.13* |
| (M = 3.50) | | |
| Post | | -- |
| (M = 2.03) | | |

*$p < .05$.

TABLE 13

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN EMG LEVELS OF DENTAL APPOINTMENTS FOR PROGRESSIVE RELAXATION GROUP

| Dental Appointment | Pre | Post |
|---|---|---|
| Pre | -- | 3.91* |
| (M = 3.70) | | |
| Post | | -- |
| (M = 1.86) | | |

*$p < .05$.

TABLE 14

SCHEFFE'S TEST OF DIFFERENCES BETWEEN MEAN EMG LEVELS
OF TREATMENT GROUPS VS. CONTROL GROUP
AT POST DENTAL APPOINTMENT

| Groups | BF + PR | C |
|---|---|---|
| BF + PR | -- | 1.64 |
| (M = 1.95) | | |
| C | | -- |
| (M = 2.43) | | |

TABLE 15

ANALYSIS OF VARIANCE FOR SIMPLE MAIN EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL ON DENTAL APPOINTMENT DENTAL ANXIETY SCALE SCORES

| Source | df | MS | F |
|---|---|---|---|
| Between subjects | | | |
| Between G at $a_1$ | 2 | 5.29 | 0.99 |
| Between G at $a_2$ | 2 | 29.91 | 5.61* |
| Error (within cell) | 36 | 5.33 | |
| Within Subjects | | | |
| Between A at $g_1$ | 1 | 126.00 | 43.90*** |
| Between A at $g_2$ | 1 | 77.79 | 27.10*** |
| Between A at $g_3$ | 1 | 20.64 | 7.19* |
| Error (A x S/G) | 18 | 2.87 | |

*$p < .05$.

***$p < .001$.

TABLE 16

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN DENTAL ANXIETY SCALE SCORES OF TREATMENT GROUPS AT POST DENTAL APPOINTMENT

| Treatment Group | $\bar{BF}$ | PR |
|---|---|---|
| EMG Feedback (BF) | -- | 0.33 |
| (M = 8.00) | | |
| Progressive Relaxation (PR) | | -- |
| (M = 7.71) | | |

TABLE 17

SCHEFFE'S TEST OF DIFFERENCES BETWEEN MEAN DENTAL ANXIETY SCALE SCORES OF TREATMENT GROUPS VS. CONTROL GROUP AT POST DENTAL APPOINTMENT

| Groups | BF + PR | C |
|---|---|---|
| BF + PR | -- | 14.81* |
| (M = 7.86) | | |
| C | | -- |
| (M = 11.43) | | |

*$p < .05$.

TABLE 18

ANALYSIS OF VARIANCE FOR SIMPLE MAIN EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL ON DENTAL APPOINTMENT STAI-STATE SCORES

| Source | df | MS | F |
|---|---|---|---|
| Between Subjects | | | |
| Between G at $a_1$ | 2 | 277.20 | 3.74* |
| Between G at $a_2$ | 2 | 977.48 | 13.19*** |
| Error (within cell) | 36 | 74.10 | |
| Within Subjects | | | |
| Between A at $g_1$ | 1 | 2162.58 | 2021.10**** |
| Between A at $g_2$ | 1 | 896.01 | 837.39**** |
| Between A at $g_3$ | 1 | 41.14 | 38.45**** |
| Error (A x S/G) | 18 | 1.07 | |

*$p < .05$.

***$p < .001$.

****$p < .0001$.

TABLE 19

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN STAI-STATE SCORES FOR EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL GROUPS AT PRE DENTAL APPOINTMENT

| Groups | BF | C | PR |
|---|---|---|---|
| BF | -- | 0.84 | 3.69* |
| (M = 55.43) | | | |
| C | -- | -- | 2.86 |
| (M = 52.71) | | | |
| PR | -- | -- | -- |
| (M = 43.43) | | | |

*$p < .05$.

TABLE 20

TUKEY'S HSD TEST OF DIFFERENCES BETWEEN MEAN STAI-STATE SCORES FOR EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL GROUPS AT POST DENTAL APPOINTMENT

| Groups | PR | BF | C |
|---|---|---|---|
| PR | -- | 0.97 | 6.73** |
| (M = 27.43) | | | |
| BF | -- | -- | 5.76** |
| (M = 30.57) | | | |
| C | -- | -- | -- |
| (M = 49.29) | | | |

**$p < .01$.

TABLE 21

ANALYSIS OF VARIANCE FOR SIMPLE MAIN EFFECTS OF EMG FEEDBACK, PROGRESSIVE RELAXATION, AND CONTROL ON DENTAL APPOINTMENT STAI-TRAIT SCORES

| Source | df | MS | F |
|---|---|---|---|
| Between Subjects | | | |
| Between G at $a_1$ | 2 | 25.76 | 0.30 |
| Between G at $a_2$ | 2 | 72.91 | 0.84 |
| Error (within cell) | 36 | 86.98 | |
| Within Subjects | | | |
| Between A at $g_1$ | 1 | 77.78 | 5.52* |
| Between A at $g_2$ | 1 | 8.64 | 0.61 |
| Between A at $g_3$ | 1 | 12.07 | 0.86 |
| Error (A x S/G) | 18 | 14.08 | |

*$p < .05$.

TABLE 22

CORRELATIONS BETWEEN EMG LEVELS AND SELF-REPORT MEASURES AT PRE AND POST TRAINING DENTAL APPOINTMENT

| Variable | EMG | DAS | STAI-State | STAI-Trait |
|---|---|---|---|---|
| Pre EMG | 1.00 | 0.01 | -0.01 | 0.03 |
| Pre Dental Anxiety Scale (DAS) | | 1.00 | 0.68*** | 0.40 |
| Pre STAI-State | | | 1.00 | 0.36 |
| Pre STAI-Trait | | | | 1.00 |
| Post EMG | 1.00 | 0.26 | 0.27 | -0.11 |
| Post Dental Anxiety Scale (DAS) | | 1.00 | 0.82*** | 0.46* |
| Post STAI-State | | | 1.00 | 0.44* |
| Post STAI-Trait | | | | 1.00 |

*$p < .05$.

***$p < .001$.

TABLE 23

TEST FOR DIFFERENCES BETWEEN PRE AND POST DENTAL APPOINTMENT CORRELATION COEFFICIENTS USING FISHER'S Z TRANSFORMATION

| Correlations | Pre | | | | | |
|---|---|---|---|---|---|---|
| Post | EMG to DAS | EMG to STAI-State | EMG to STAI-Trait | DAS to STAI-State | DAS to STAI-Trait | STAI-State to STAI-Trait |
| EMG to DAS | 0.81 | -- | -- | -- | -- | -- |
| EMG to STAI-State | | 1.19 | -- | -- | -- | -- |
| EMG to STAI-Trait | | | 0.25 | -- | -- | -- |
| DAS to STAI-State | | | | 1.03 | -- | -- |
| DAS to STAI-Trait | | | | | 0.23 | -- |
| STAI-State to STAI-Trait | | | | | | 0.30 |