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Case Reports and Training Techniques

The Use of EMG Feedback and Progressive Relaxation in the Treatment of a Woman with Chronic Back Pain

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In this systematic single-case study, a 71-year-old white female with chronic back pain and paravertebral muscle spasm was treated with 17 sessions of electromyographic (EMG) feedback, with recording site just below the right inferior scapular angle. Progressive relaxation practice was also employed. EMG level was monitored during baseline, treatment, and follow-up phases. Backaches were recorded by the subject on a daily basis. There was a marked decrease in both EMG level and frequency of backaches, as well as an increase in activities at home. Improvement was maintained 12 weeks after the last treatment session.

Many comprehensive pain clinics utilize biofeedback techniques as part of rather complex treatment packages, making it difficult to determine the value, if any, of biofeedback as compared to other components such as group psychotherapy, operant management techniques, electrical stimulation, or physical therapy. In fact, while controlled research has demonstrated the usefulness of electromyographic (EMG) biofeedback with home relaxation practice in the treatment of chronic muscle tension headache pain (Budzynski, Stoyva, Adler, & Mullaney, 1973), there is inadequate documentation of its effectiveness with chronic back pain patients. This is despite the fact that this population constitutes the majority of patients seen at numerous pain clinics.

Hendler, Derogatis, Avella, and Long (1977) report "some promise in the use of EMG biofeedback in chronic pain patients" (p. 7), based on an

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uncontrolled study of 13 patients with either back or neck pain. Six of these 13 patients reported less pain on 4 out of 5 days after frontalis EMG feedback training and "some relief" 1 month posttraining. However, it is unknown whether these 6 were primarily back or neck pain patients or how much of an overall reduction in pain was experienced as compared to a pretreatment baseline period.

Most recently Kravitz, Moore, Glaros, and Stauffer (1978) reported on the treatment of patients with pain in the lumbosacral region using either relaxation training or a combination of relaxation plus EMG feedback. The target of the five training sessions was to reduce paralumbar muscle activity during a differential tension procedure. Results indicated that immediately posttraining 69% of all patients reported less frequent back pain. In addition, treatment groups showed a significant reduction in paralumbar muscle activity. However, at 1-month follow-up the authors report that both groups demonstrated some return to pretreatment levels of EMG activity. The fact that results did not appear to be consistently maintained posttreatment might be explained by the limited number of treatment sessions used in this study. Although the task is somewhat more complex than that used in other EMG training programs, the number of training sessions is less than usual.

In sum, of the two studies in the literature concerning the EMG feedback treatment of chronic back pain, neither reports a follow-up period of more than 1 month. In addition, the study by Hendler et al. (1977) is particularly unsystematic with respect to subject selection and data presentation.

The present report describes a systematic single-case study of a woman with chronic back pain in the area of the right inferior scapular angle (bottom of the shoulder blade) who was successfully treated with EMG feedback and home relaxation practice. It is a documented case study where the targets of EMG feedback training were upper back muscles, with the goal of controlling tension and the accompanying pain.

METHOD

Subject

The subject was a 71-year-old white married female with a 3-year history of chronic pain in her right upper back. She was referred by a neurologist who had made the diagnosis of paravertebral muscle spasms in the area of the right inferior scapular angle. The subject's problems with back pain began when she had lifted a rock and sustained multiple com-

pression fractures of the thoracic spine. In addition, she was diagnosed as having rheumatoid arthritis. She reported episodes of severe knifelike pain in her right upper back that were especially prevalent whenever she used her right arm; she was unable to drive and could not stand on her feet "to do anything" without severe pain. Emotional upset also increased her pain. As a result, her husband performed most of the household tasks. However, even with her forced inactivity, she experienced at least one severe backache per day, which sent her to bed for approximately an hour. Previous therapeutic interventions included novocaine injections, use of a brace, and transcutaneous nerve stimulation, all without significant relief. Psychological evaluation, including diagnostic interview, sentence completions, and the Minnesota Multiphasic Personality Inventory (MMPI), revealed no chronic emotional problems that might exacerbate her experience of pain, nor any substantial sources of reinforcement for pain behavior.

Procedure

Since the target behavior involved muscular control and treatment effects may not have been reversible, the systematic single-case study design was employed. This design can provide interpretable results if a change in the target behavior coincides with the institution of treatment, especially when the target behavior has been a long-standing one.

Informed consent for EMG biofeedback treatment was obtained. The subject was neither paid nor charged for the treatment program. The program consisted of 27 contact hours. The procedures by program phase are detailed in Table I. The second author served as the experimenter in this study. He is a 2-year post-internship-level graduate student in clinical psychology, who has had approximately 3 years of experience in the use of Jacobson relaxation training procedures.

Sessions 1–24 were held twice weekly; sessions 25 and 26 were at weekly intervals; session 27 was 6 weeks later. Frequency of backaches was recorded by the subject throughout. Beginning with session 6, the subject was instructed to practice progressive relaxation whenever a backache appeared imminent. Sessions took place in an 8′ by 10′ sound-attenuated room, with the experimenter in an adjoining observation area. The subject reclined face down for sessions 1–9 but changed for comfort reasons to a reclining chair in session 10 and remained so positioned for the remaining sessions except for number 24, in which a no-feedback session comparable to the baseline sessions was desired.

Silver-silver chloride disc electrodes were prepared and attached to the skin 2 inches below the right inferior scapular angle. The first active

Table I. Procedures by Program Phase and Session

Program	Session	Procedure
Baseline	1–5	EMG recording; 20 minutes with instructions to relax. During session 1, subject given instructions on how to monitor pain.
Treatment	6	Training in Jacobson progressive muscle relaxation exercises, instructed to practice for 20 minutes at least twice daily at home.
	7	Experimentation with equipment; instructions to alternately increase then decrease muscle tension to demonstrate control; 20 minutes.
	8–17	Pretraining baseline: 4 min; feedback training: 20 min; posttraining baseline: 4 min. Instructions to relax and to reduce auditory feedback during training.
	18–23	Fading out of feedback; instructions to relax (20 minutes).
Follow-up	24–27	EMG recording; no feedback. Instructions to relax (20 minutes).

electrode was placed 2″ to the right of the spinal column, with the ground and second active electrode spaced to its right at 1½″ intervals. This area was used as the recording site for every session. EMG data were obtained utilizing the Autogen 1700 Myograph and the Autogen 5100 Data Integrator. The band pass used was 100–200 Hz. Averaged (every 20 seconds) EMG activity was integrated over 1-minute intervals. The auditory feedback chosen by the subject was AN1, a pulsating tone that varied in both pitch and pulsation rate in logarithmic proportion to measured EMG activity.

RESULTS

Figure 1 illustrates the frequencies of backaches during weeks of base line (sessions 1–5), treatment (sessions 6–23), and follow-up (sessions 24–27). As can be seen, backache activity drops from an average of 1.17 backaches per day per week for the last 2 weeks of baseline to an average of .43 backaches per day per week during the 2nd and 3rd weeks of treatment. Except for a 4-week period (treatment weeks 9–12) when the attempt was made to alter the subject's medication usage, as described below, this

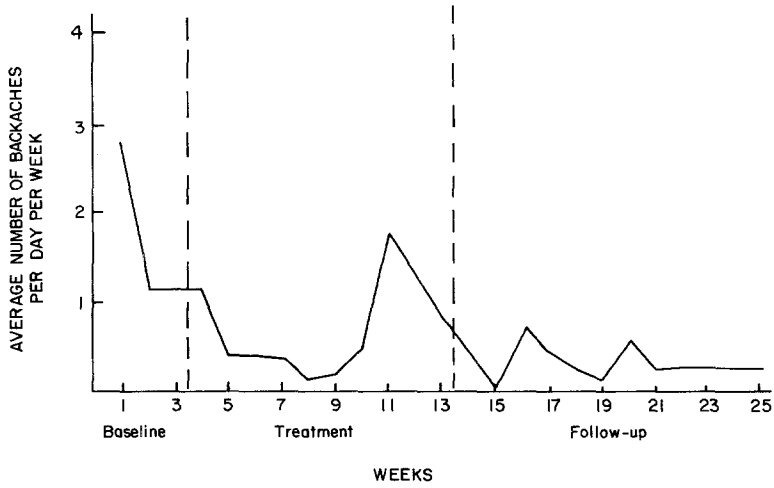

Fig. 1. Frequencies of backaches for weeks of baseline, treatment, and follow-up. Baseline includes sessions 1–5; treatment includes sessions 6–23; follow-up includes sessions 24–27.

decrease in backache activity was essentially maintained throughout the subsequent weeks of treatment and follow-up. Since change in monitoring position confounded overall comparisons of EMG data among baseline, treatment, and follow-up phases, only the mean EMG data from the five baseline sessions and session 24 (all of which were carried out in the reclining position) are shown in Figure 2.

The average EMG level at follow-up (session 24) was compared with the average EMG level for the fourth baseline session using a t test for correlated measures (Bruning & Kintz, 1968). The fourth baseline session was chosen for comparison because this was the most conservative test of change. Figure 2 illustrates the variability in pretreatment EMG, with respect to both mean level across sessions and intrasession varibility. It was in session 4 that the lowest pretreatment mean and variance were obtained, and thus this comparison with posttreatment EMG is the most conservative of all the possible statistical comparisons. Results indicate that the average EMG level for session 24 is significantly lower than the average EMG level for the fourth baseline session ($t = 5.29$, $df = 19$, $p < .0005$). Likewise, a t test for homogeneity of related variances revealed a significant decrease in intrasession variability from session 4 to session 24 ($t = 14.4$, $df = 18$, $p < .001$).

By the end of the treatment phase, the subject reported that she was driving, shopping, and doing housework but still had a decrease in backache frequency. She said she was able to anticipate a backache by

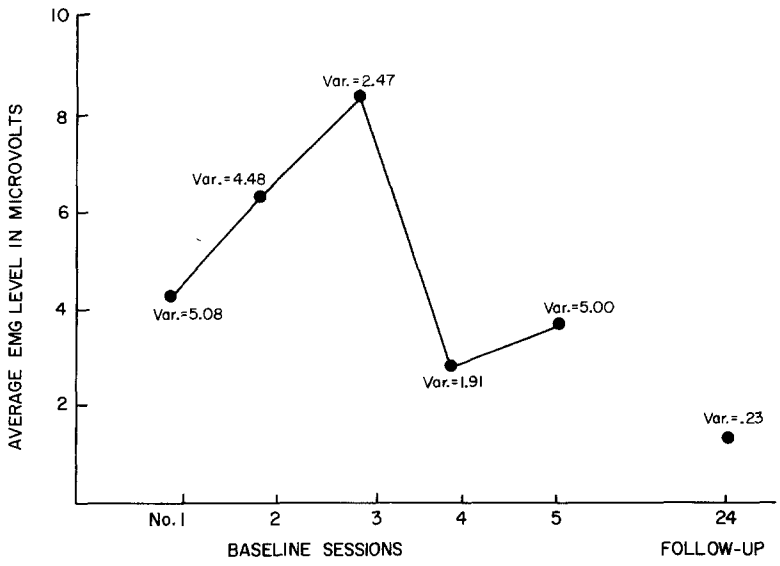

Fig. 2. Average EMG activity level for sessions 1–5 (baseline) and session 24 (follow-up). Intrasession variances are noted above each plotted mean.

attending to muscle tension cues in her back and then avoid a severe backache by practicing her progressive relaxation. (This decrease in backache frequency and increase in activity level was maintained over a 12-week posttreatment period during which daily pain was systematically recorded.)

The subject had been taking medication for her pain (Darvocet, 200 mg, three times per day, and Nalfon, 600 mg, three times per day; according to the subject, the latter was primarily for her rheumatoid arthritis) for some 3 years prior to the initiation of this treatment contact. She reported that the effects of the medication for her back pain were negligible. Due to the subject's self-reports of decreased backache activity, beginning with treatment session 14, an attempt was made to wean the subject from her medication by gradually decreasing the number of times a day that she took her medication (e.g., the first step was to have the subject take 200 mg of Darvocet and 600 mg of Nalfon only twice per day as opposed to her usual three-times-per-day regimen). The initial efforts in this area met with some success (i.e., decreased dosage with no change reported in backache activity). However, as this weaning procedure continued, the subject began to report more backaches of greater intensity. This is indicated in Figure 1 by the increase in backache frequency in treatment weeks 9–12. Because of

the subject's increasing concerns over changes in her medication, efforts to continue this weaning procedure were discontinued.

The subject was contacted via telephone for a 6-month posttreatment follow-up. These data are not reported in Figure 1. She continued to report significantly decreased backache frequency. In addition, she indicated that she was continuing to use her progressive relaxation exercises when muscle tension cues in her back suggested the onset of a backache. She was in particularly good spirits and indicated that she had remained very active since she was last seen for treatment. She took a 4- to 5-month vacation in the northeast with her husband and, since having returned, has continued to remain active by shopping, driving, visiting friends, entertaining people in her home, and sewing, an activity tht she had not participated in for approximately 3 years prior to treatment.

DISCUSSION

There is little question that the subject in this report demonstrated marked improvement during treatment with respect to decreased subjective reports of pain, increased physical activity, and decreased resting EMG levels in the area monitored. While it was not possible to effect a change in the subject's daily medication regimen during treatment, she was having daily back pain despite her medication. The need for this medication in controlling pain associated with her rheumatoid arthritis is not clear.

Given the five baseline sessions, and the daily baseline self-observation, change was probably not solely a function of measurement operations. In addition, the fact that her pain had a 3-year history and did not respond to other forms of treatment makes it likely but not certain that EMG feedback and home relaxation was an effective treatment package. The effects of coincidental life events of course cannot be ruled out as the cause of change, although the subject reported no unusual experience, nor can the relative contributions of home relaxation practice and clinic EMG feedback training be assessed in this design.

Finally, generalizations to other chronic back pain patients must be tempered by the fact that the subject in this study reported upper back pain, whereas the majority of back pain patients report central lower back discomfort. In addition, this subject did not display many of the psychological features described by other authors as being characteristic of chronic pain patients (Sternbach, 1974; Gentry, Shows, & Thomas, 1974). On MMPI these features are illustrated by significant clinical scale elevations on Hs, D, Hy, and sometimes Pd and Sc, with mean MMPI profiles of various chronic pain samples tending to show the "conversion V" configuration.

However, more recent research using multiple discriminant analyses (Bradley, Prokop, Margolis, & Gentry, 1978) demonstrates reliable, homogeneous MMPI profile subgroups among pain patients. Among 315 female low back pain patients, the most frequently found profile (39%) had no significantly elevated scales. Thus this subject's profile is more similar to this modal pattern than to any other profile subgroups.

In conclusion, we may speculate that a good candidate for treatment with EMG feedback training and home relaxation practice is a highly motivated individual with a focal back pain problem that is asociated with increased levels of highly variable muscle tension, and whose MMPI profile is within normal limits. In addition, successful treatment would necessarily involve the subject's learning to attend to the cues of increasing tension and then faithfully executing self-help techniques. Of course, the importance of none of these characteristics can be assessed from this report.

As Barlow, Blanchard, Hayes, and Epstein (1977) point out, the first step in clinical biofeedback research is to demonstrate clinically relevant effects, the next is to demonstrate change over and above placebo effects, and the third is to sort out the active from the inactive ingredients in treatment packages. This report represents an effort at the first step, to be followed by a multiple-baseline across-subjects design utilizing chronic back pain patients. Given the size of the clinical problem ("on a daily basis, an estimated 6,000,000 people are absent from work due to back pain" Freedman, 1976, p. 47), the widespread use on a fee-for-service basis of biofeedback for chronic back pain, and the lack of empirical support in the literature, this research thrust is essential. In addition, it should be kept in mind that patients who complain of back pain represent a very heterogeneous group of individuals. Additional research will be necessary in order to ascertain which subgroups within this larger population could potentially derive some benefit from the use of EMG biofeedback.

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