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Long-term efficacy of EMG biofeedback for chronic rheumatic back pain

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Summary

Short-term effects of EMG biofeedback for chronic rheumatic back pain have been documented, however, the long-term efficacy of this treatment modality has not yet been established. Twenty-two patients of an original sample of 24 patients who participated in a treatment outcome study [6] were followed up 2.5 years after they had been treated with either EMG biofeedback, pseudotherapy, or conventional medical treatment alone. The results indicate that patients treated with EMG biofeedback maintained beneficial effects and differ significantly from the control groups both on behavioral and cognitive responses to the pain, but not global pain intensity ratings. These data support the long-term utility of biofeedback for chronic rheumatic back pain.

Key words: EMG; biofeedback; long-term efficacy; back pain; rheumatism

Introduction

Chronic back pain (CBP) is a major health problem that affects millions of people but is often resistant to medical treatment [15] and, therefore, is extremely costly [2]. The inadequacy of a purely biomedical explanation for chronic back pain has been increasingly recognized [13,16]. As a consequence, multidimensional approaches to the treatment of CBP have been developed, with varying emphasis on

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operant [8], cognitive-behavioral [23], or psychophysiological variables [10]. A number of studies have demonstrated successful treatment of chronic back pain with a variety of behavioral methods such as relaxation training [24], operant conditioning [9], cognitive-behavioral therapy [24], or EMG biofeedback training [6,18]. For a review of these studies see Turk and Flor [21]. However, the long-term efficacy of these procedures as compared to appropriate controls has not been established.

It has been observed clinically that CBP patients frequently show palpable hypertension of the paravertebral musculature. A psychophysiological model of chronic back pain was proposed, associating CBP with elevated resting levels of the back muscles [10] or phasic hyperactivity due to inadequate responses to stressful events [5]. This model has received some support [7,12]. Consequently, EMG biofeedback has been employed frequently with back pain patients. EMG biofeedback has led to considerable pain reductions in several studies [6,10,18] while other psychological approaches only obtained minimal or no pain relief [9,24]. Although there have also been reports of treatment failure [17,20], or a lack of significant differences between treated and untreated patients [3], inconsistencies in the results may be explained by the diversity of biofeedback procedures, the omission of appropriate control groups, and inconsistent criteria for patient selection employed in these studies.

When effects of EMG biofeedback for CBP have been demonstrated, most studies failed to include any follow-ups. The longest follow-up of a single case study to date is 6 months [1] and 4 months for a controlled group study [6]. Transfer and maintenance of the beneficial treatment effects are a problem for all treatments of chronic pain. This is a special concern for biofeedback due to the dependency of the treatment on the biofeedback apparatus and the potentially large placebo effect attributed to the biofeedback apparatus per se [19]. The purpose of this study was to assess the long-term maintenance of EMG biofeedback for chronic rheumatic back pain.

Methods

Subjects

Twenty-four patients who had participated in a treatment outcome study [6] were included as subjects in this study. The following criteria were employed in the selection of the original sample: duration of the pain more than 6 months, localization of the pain in the lumbar or cervical region, no or only minor degenerative changes of the spine, no litigation pending, tension levels of at least 2 μV in the neck-shoulder and at least 4 μV in the lumbar region, significant pain levels (more than 2.5 on a 10-point scale). The mean age of the patients was 49.5 years (range 24–59 years), 20 patients were female, the average duration of the pain was 12.9 years (range 3–27.5 years). Seventeen patients were employed, 5 patients were homemakers and 2 patients were unemployed. Nineteen patients used analgesic medication. This sample is comparable to patients of pain clinics with respect to age

and pain duration, however, it differs with respect to degenerative change (less), number of surgeries (none), and employment status (the majority was employed).

Design

In the original study the patients had been randomly assigned to 1 of 3 groups, EMG biofeedback, pseudofeedback, or conventional medical treatment. Both of the biofeedback groups also received the conventional medical treatment. The groups did not differ on any of the demographic or clinical variables. The true biofeedback group received 12 sessions of EMG biofeedback of the paravertebral muscles, a second group served as a placebo control group receiving 12 sessions of pseudofeedback and the third group was assigned to standard medical treatment. Dependent variables included self-report, behavioral and physiological measures (the latter only pre–post treatment). At post-treatment and at the 4-month follow-up, patients in the true biofeedback group demonstrated large and significant reductions in pain levels, duration of pain, as well as all dimensions of an adapted version of the McGill Pain Questionnaire [14]. Furthermore, paraspinal EMG levels were significantly reduced following treatment, and pain-related maladaptive self-statements as well as number of physician visits were significantly reduced at post-treatment and at the 4-month follow-up. Additional details about the procedures employed may be found in Flor et al. [6].

In the present study, maintenance of the improvements 2.5 years following treatment was assessed. A follow-up questionnaire was designed, consisting of 25 questions about the patients' current pain, impairment and employment levels, questions on past and current activities to relieve the pain, their effectiveness, and the patients' evaluation of the treatment they had received (most questions had to be rated on 11- or 7-point scales, impairment was reported in percentage scores). This short instrument was used in an attempt to maximize the return rate. In addition, patients received an extended assessment packet, consisting of a subset of the pre-treatment instruments, namely a pain diary that they completed for 1 week and a pain questionnaire, assessing pain-related self-statements and attributions [6]. In addition, a brief phone interview was conducted with all patients assessing estimated improvement of their pain problem and current pain intensity levels.

Twenty-two telephone interviews were conducted, 15 follow-up questionnaires, and 10 of the extended questionnaires were returned. All of the patients in the biofeedback group completed the follow-up questionnaire, however, only 50% of the patients in the control groups returned the questionnaire. Based on the global improvement ratings obtained by phone, the non-responders to the questionnaires all fell into the 'not improved' category, whereas the responders were comprised of a mixed group of 'improved' and 'not improved' patients. Thus, there may have been some overestimation of the improvements reported by the control groups.

Results

During the phone interview patients were asked to give ratings of the overall improvement of their pain problem. All patients in the biofeedback group stated

that their overall condition had improved. Only 2 patients in the pseudotherapy group and 3 patients in the control group indicated any improvement 2.5 years following treatment (χ^2 (2) = 9.22, $P < 0.01$).

Seven of the 8 patients in the biofeedback group and 4 patients each in the control groups had returned the follow-up questionnaire. Since on post-treatment and the 4-month follow-up there were no significant differences between the pseudotherapy and the conventional medical treatment groups, all subsequent comparisons will refer to the biofeedback group in contrast with the 2 control groups combined. Patients in the biofeedback group reported 68.3% improvement (S.D. = 30.9) of their pain problem compared to only 13.8% improvement (S.D. = 17.7) in the control groups (t (14) = 8.53, $P < 0.001$). These results support the relative efficacy of the biofeedback treatment over the extended period of the follow-up.

The global improvement ratings were confirmed by the patients' ratings of the interference of the pain with their lives as well as self-reported pain-related behaviors. The patients in the biofeedback group indicated significantly less interference of pain with their lives in a number of areas (e.g., family relations). Table I shows the means, standard deviations and the results of independent t tests for all of the interference ratings.

The biofeedback group reported a significantly shorter duration of pain than the control groups (M = 6.60 (S.D. = 10.11) versus M = 15.29 (S.D. = 4.54), t (14) = 4.32, $P < 0.01$). The biofeedback patients also indicated significantly less pain when sitting, walking, standing, and bending (ratings on an 11-point scale ranging from 0 = no pain to 10 = extreme pain, all Ps < 0.05). There were no significant differences between the groups for pain during lifting, working, or when lying down. Current pain intensity ratings were not significantly different for the 2 groups. There was, however, a significant difference between the 2 groups in the estimated pain levels following treatment. The biofeedback group reported pain levels as much lower following treatment (M = 2.50, S.D. = 1.50) than the control groups (M = 4.06, S.D. = 1.35, t (14) = 4.07, $P < 0.01$). These results suggest some regression to the mean.

TABLE I

PERCENTAGE OF INTERFERENCE OF PAIN WITH VARIOUS ACTIVITIES

Interference with	Biofeedback		Controls		t
	M	S.D.	M	S.D.	
Life in general	14.3	19.0	38.9	29.1	−1.79 *
Work	19.9	21.5	48.6	32.5	1.95 *
Leaving the house	5.5	9.5	36.4	31.7	−2.29 **
Marital relationship	4.7	7.6	43.3	35.6	−2.60 **
Family relations	4.7	7.7	45.0	26.0	−3.65 ***
Sexual activity	2.0	4.5	45.0	40.9	−2.34 **
Hobbies	17.6	23.1	41.4	29.3	−1.69

* $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$.

Biofeedback patients have sought significantly fewer treatments since the end of therapy (average number of treatments: Bfb: M = 1.28, S.D. = 1.11, CGs: M = 4.17, S.D. = 1.70, t (14) = 7.79, $P < 0.001$). A similar trend is observed in the patients' use of medication. Five of 7 patients in the biofeedback group no longer used analgesic medication, in contrast with 5 of 7 patients in the other groups who continued to use analgesic medication (Fisher's exact test: $P < 0.10$). The 2 groups did not differ in number of hours spent working or number of hours of activity per day. It should be noted, however, that these patients were already very active before they entered treatment (most of them were working in full-time jobs).

Patients were asked what they were presently doing to relieve their pain. Whereas the control groups used mostly medically oriented strategies (6 of 8 patients use treatments such as taking medication, going to see a doctor, etc.), all the patients in the biofeedback group reported using psychological strategies (e.g. relax, 'try to take my mind off the pain') or a combination of psychological and medical strategies (Fisher's exact test: $P < 0.01$). Additionally, 6 of 7 patients in the biofeedback group continued to use relaxation exercises regularly. Only 1 of 6 patients in the control groups practiced relaxation (Fisher's exact test: $P < 0.05$).

The results of the follow-up questionnaire were replicated when the pain diaries of the biofeedback group were examined. Table II shows the pre-treatment and follow-up means and standard deviations for the pain and interference ratings in the diary as well as the changes in pain-related cognitions and the results of correlated t tests. At follow-up, the patients reported substantially less interference of pain with daily activities compared with pre-treatment. There was a significant reduction in negative pain-related cognitions from pretreatment to the 2.5 year follow-up, whereas positive cognitions remained unchanged. As may be expected from the global pain ratings, the pain index in the pain diary was not significantly lower than at pretreatment, however, there is a trend towards a significant reduction in the number of hours of pain per day (pre M = 15.48, post M = 8.65).

The patients also evaluated the utility of the treatment they had received. The biofeedback group considered its treatment to be substantially more useful (M = 9.00, S.D. = 1.73) than the 2 control groups (on an 11-point scale ranging from 0 to

TABLE II

PRE TO FOLLOW-UP CHANGES IN THE BIOFEEDBACK GROUP

	Pre-treatment		Follow-up		t
	M	S.D.	M	S.D.	
Pain index (diary)	4.41	0.66	3.00	2.51	0.93
Hours in pain (per day)	15.48	0.30	8.65	6.83	1.95 *
Interference of pain with life in general	35.00	15.00	15.00	18.93	2.47 **
Negative pain-related self-statements	40.67	11.38	29.00	8.36	2.91 **

* $P < 0.10$, ** $P < 0.05$.

10, M = 4.75, S.D. = 4.37, t (13) = 2.41, $P < 0.05$). They also rated the true biofeedback as significantly more effective (M = 8.00, S.D. = 2.77 versus M = 3.75, S.D. = 3.88, t (13) = 2.41, $P < 0.05$).

Discussion

The results of this study support the maintenance of the effects of EMG biofeedback for chronic rheumatic back pain 2.5 years following the original treatment. Reductions in interference of the pain with daily functioning, reduced use of the health care system, and improved ability to cope with the pain were the most prominent long-term effects observed. Although global pain estimates did not improve significantly, the patients reported less pain when performing specific activities. Moreover, the amount of time they experienced pain was significantly less than reported by the control groups. Interestingly, despite the relatively small changes in pain levels, the patients in the biofeedback group viewed their pain problem as significantly improved. This indicates that the patients may have learnt to cope more effectively with their pain problem and have become less preoccupied with pain.

Patients in the biofeedback group also rated their treatment as more effective than the patients in the control groups and they utilized more psychological than medically oriented coping strategies. The most improved patients all indicated that they continued to use relaxation to control their tension and pain levels and were pleased that they themselves could do something to relieve their pain problem. The unimproved patients indicated feelings of helplessness and hopelessness and relied to a greater extent on medical assistance than their own abilities to cope with pain. These most improved patients seem to have undergone a change in attitude regarding the pain and themselves. That is feelings of helplessness appear to have been changed to those of resourcefulness. This improved coping ability may explain the marked reductions in interference of the pain with a number of areas of daily living and the reduced utilization of the health care system. The results confirm previous reports on the importance of attitude changes for the effects of biofeedback [6,11,17].

There are several limitations of this study. First, the number of patients utilized in the study is small (N = 24). The 68% return rate also poses some concerns. However, as stated earlier, the only patients who had not participated in the follow-up were all unimproved patients from the control groups. Thus, if anything, even the limited improvement for the control groups may be an overestimate. Moreover, self-report mail follow-up questionnaires had to be used since the patients lived at very far distances from the clinic. It would have been desirable to observe the patients' behavior and to evaluate EMG activity in order to relate improvements in self-report to behavior and psychophysiology. However, it should be noted that some of the self-report measures that changed most were self-reported behaviors (e.g., physician visits). These problems suggest that all statements made here should be viewed as tentative albeit provocative.

Strengths of the study include: (a) all patients in the original biofeedback group responded to the follow-up questionnaire, (b) the length of the follow-up, and (c) attention-placebo control groups were used. It should also be noted that only patients who showed muscular hyperactivity prior to treatment were included. The positive results of this study demonstrate the utility of targeting specific populations for treatment modalities associated with these physical conditions rather than applying the techniques to heterogeneous patient groups [23]. Approximately 70% of the unselected back pain patients in a recent study by Flor et al. [7] showed significant muscular hyperreactivity to psychological stress.

Further research should assess the long-term efficacy of EMG biofeedback on the subjective, behavioral, and physiological level. Larger patient samples should also be used to allow for identification of predictors of treatment outcome. The inclusion of patients with greater degrees of impairment should be examined to establish the generality of the findings. Comparison of biofeedback to less costly relaxation training would also seem warranted [22].

The long-term effects of EMG biofeedback presented in this study are most promising. They surpass the effect of traditional medical treatment and do not appear to be explained solely by attention or placebo factors. If these results are replicated, EMG biofeedback should be considered as a treatment adjunct for chronic rheumatic back pain associated with muscular hyperactivity.

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