

A Retrospective, Follow-up Study of Biofeedback-Assisted Relaxation Therapy in Patients with Posttraumatic Headache

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Although biofeedback in the treatment of migraine and tension-type headache has been widely researched, there is little research examining biofeedback therapy in posttraumatic headache (PTH). In this retrospective study, 40 subjects with PTH who had received biofeedback-assisted relaxation at our headache clinic were questioned at least 3 months following the completion of therapy. Subjects were queried about improvements in headache, increases in ability to relax and cope with pain, and overall benefits, lasting effectiveness, and continued use of biofeedback in daily life. Results indicate 53% reported at least moderate improvement in headaches; 80% reported at least moderate improvement in ability to relax and cope with pain; 93% found biofeedback helpful to some degree; 85% felt headache relief achieved through biofeedback had continued at least somewhat; and 95% stated they were continuing to use biofeedback skills in daily life. A correlation analysis revealed a negative relationship between response to biofeedback and increased chronicity of the disorder. In other words, the more chronic the disorder, the poorer the response to treatment. A stepwise regression analysis found that chronicity of the disorder and number of treatment sessions significantly affected response to treatment. Data suggest that biofeedback-assisted relaxation should at least be considered when planning treatment strategies for posttraumatic headache.

KEY WORDS: post-traumatic headache; EMG biofeedback; thermal biofeedback; mild head injury; relaxation training.

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Each year, it is estimated that 2 million persons in the United States sustain closed head injuries (Brown, Fann, & Grant, 1994); approximately 82% are classified as mild or minor (Kraus & Nourjah, 1988). Following mild head injury (MHI), a variety of distressing posttraumatic symptoms are frequently observed. The most common include headache, dizziness, visual blurring, tinnitus, concentration and memory disturbances, depression, anxiety, irritability, and fatigue. Headache is the most common symptom, with 30% to 80% of MHI victims developing posttraumatic headache (PTH) (Brenner, Friedman, Merritt, & Denny-Brown, 1944; Evans, 1992, 1994; Speed, 1986). Unfortunately, these headaches are often severe and resistant to traditional headache management (Packard, 1994; Packard & Ham, 1994).

Biofeedback therapy has been effective in the treatment of migraine, tension-type, and mixed migraine/tension-type headache (Andrasik & Blanchard, 1987; Andrasik, Blanchard, Neff, & Rodichok, 1984; Bell, Abramowitz, Folkins, Spensley, & Hutchinson, 1983; Blanchard & Andrasik, 1987; Blanchard et al. 1982a; Blanchard et al., 1982b; Budzynski, Stoyva, & Adler, 1970; Diamond & Montrose, 1984). In retrospective studies examining long-term outcome of biofeedback treatment for headache, results have typically been positive (Adler & Adler, 1976, 1985; Diamond, Medina, Diamond-Falk, & DeVenio, 1979; Diamond & Montrose, 1984). In one 5-year follow-up study of 58 patients, significant improvement (75% to 100% remission) occurred in 86% (Adler & Adler, 1976). In another 5-year follow-up study of 413 patients, 90% believed biofeedback helped them relax; 40% believed biofeedback produced permanent reductions in headache frequency or severity; 30% found temporary or intermittent relief; and about 30% reported no improvement (Diamond, 1979). It is not surprising that patients with idiopathic headache represent, for many practitioners, the largest category of patients treated with biofeedback (Adler, Adler, & Packard, 1987; Schwartz, 1995).

Despite the success of biofeedback in idiopathic headache management, there is a paucity of research examining biofeedback therapy in patients with PTH. In fact, many research studies examining biofeedback treatment in headache specifically exclude patients with PTH. A few studies have utilized biofeedback, primarily in the context of other treatment modalities, for PTH. McGrady, Bernal, Fine, and Woerner (1985) treated 12 patients with PTH and neck pain with EMG biofeedback. The subjects' pretreatment pain levels and forehead and neck EMG levels decreased significantly by posttreatment, with high pretreatment tension levels and mild to moderate pain being associated with greater success. Medina (1992) examined 20 work-disabled patients who were being treated in an individualized, outpatient, multimodal program (including biofeedback) for chronic PTH.

All patients reportedly improved: 14 markedly, 4 moderately, and 2 slightly. Finally, in a case study, cognitive-behavioral treatment (including EMG biofeedback) was effective in reducing severe, chronic PTH (Duckro, Tait, Margolis, & Silversintz, 1985). These studies, although obtaining positive treatment results for PTH, provide limited evidence implicating biofeedback in headache improvement, since either the entire treatment program was the focus of attention or sample sizes were small.

We have treated many PTH patients with thermal and EMG biofeedback-assisted relaxation and have generally observed improvement in headache and overall functioning. To further quantify and document this clinical observation, the present retrospective study was conducted. Changes in headache pattern, ability to relax and cope with headaches, and overall usefulness of biofeedback-assisted relaxation were examined. Patients were evaluated by interview at least 3 months following this treatment.

METHOD

Participants

Subjects consisted of outpatients receiving biofeedback-assisted relaxation for PTH at a private headache clinic from January of 1992 to August of 1994. All subjects were diagnosed with posttraumatic headache (generally of a mixed migraine/tension-type pattern) by the neurologist/psychiatrist clinic director (second author). Only patients with mild trauma to the head or neck (loss of consciousness less than 20 minutes, duration of post-traumatic amnesia less than 48 hours, no evidence of neurological deficit, and no obvious need for intracranial surgical procedures) as assessed by the clinic director were included. Patients with a prior history of headache or head injury were not specifically excluded. Although all subjects were not diagnosed specifically according to the criteria developed by the International Headache Society (IHS, 1988), almost all, in retrospect, met IHS criteria for chronic posttraumatic headache associated with minor head trauma and no confirmatory signs.

In addition, patients had to have received at least four treatment sessions and to have completed treatment at least three months prior to follow-up evaluation to participate. Review of records indicated that 49 subjects met these criteria. We were unable to contact eight subjects, and one subject did not wish to participate. This resulted in a total of 40 subjects in this study.

Procedure

All patients were under the care of the physician director of the headache clinic and were seen for biofeedback-treatment by one of two certified biofeedback therapists (one of whom was the first author). Although biofeedback sessions were individualized depending on the needs of the patient, most were fairly uniform. Sessions typically entailed review of headache charts and any problems that arose, review of home practice (patients were instructed to practice taped relaxation exercises and short self-relaxations daily), baseline, relaxation training with audio and/or visual feedback, biofeedback training alone, and summary of performance and/or progress. Relaxation training usually involved autogenic phrases, progressive muscle relaxation (progressively tensing and relaxing various muscle groups), deep muscle relaxation (focusing on heaviness and warmth in various muscle groups, without prior tensing of muscles), and/or diaphragmatic breathing. The ability to generalize training and incorporate skills into daily life was a focus of treatment for all patients.

During sessions, subjects typically received both thermal and EMG biofeedback. Thermistors were generally placed on the second finger, third phalanx, palmar side. EMG electrodes were placed on the forehead, trapezii, frontal-posterior neck, or neck. The majority of readings were taken from the forehead.

An employee of the headache clinic unrelated to the study and trained to avoid biasing subjects' responses (i.e., limited conversation to a prepared script and asked treatment-related questions without vocal inflection) contacted all subjects by telephone. Subjects were asked five questions concerning biofeedback treatment (see Table I). Questions were designed to assess improvement in headaches at the completion of biofeedback (both short-term and long-term), increase in ability to relax and cope with pain, overall helpfulness of the treatment, and its current usage in daily life. Responses were based either on a 5-point scale (no, slightly, moderately, significantly, maximally) or a 3-point scale (no, somewhat, yes). As previously stated, 9 patients out of the original 49 were lost to follow-up.

RESULTS

Of the 40 participating subjects, 30 were female. The mean age when initiating biofeedback treatment was 37.1 years (range = 20 to 60), with 14 in the 20-30 age range, 11 aged 31-40, 10 aged 41-50, and 5 aged 51-60. The mean years of education was 13.5 (range = 9-20): 5 had not completed high school, 8 had completed high school (no college), and 27 had taken

some college courses or earned college degrees. Two subjects had completed graduate degrees. Thirty-three subjects were involved in litigation.

Only patients with four or more individual treatment sessions were included (range = 4-14). An initial, introductory session was not included. The modal number of treatment sessions received was 10, the mean was 9, and the median was 10. The mean time period from last biofeedback session until date of contact was 10.7 months, ranging from 3 to 27 months. Fifteen subjects were contacted 3 to 6 months after completing biofeedback, 12 between 6 and 12 months, 9 between 12 and 24 months, and 4 subjects were contacted more than 24 months after completing biofeedback.

The time period from date of accident until initiating biofeedback treatment was 1 to 92 months: $M = 12.7$ months, $Mdn = 9$ months. Only two patients initiated biofeedback less than 2 months after injury, the traditional definition of chronicity (IHS, 1988). Since we recently proposed 6 months be used as the definition for determining chronicity in PTH (Packard & Ham, 1993), 6 months was selected as the chronicity time-indicator in this study. Only 6 patients completed biofeedback prior to 6 months postinjury. Thus, 85% of the sample consisted of patients with chronic PTH, a much more difficult group to treat.

The length of time from accident until onset of headaches occurred immediately in 20 patients, within a few days in 15, within 1 to 2 weeks in 3 patients, and after 3 weeks in 2 patients. The typical headache pattern was a dull, daily, headache (usually in the occipital region) interspersed with episodes of severe, throbbing headaches (typically in the frontal area) ($n = 34$). Subdivisions for this group include those per week who had approximately one or two severe headaches ($n = 13$), three to five severe headaches ($n = 6$), or varying numbers of severe headaches ($n = 15$). In the remaining 6 patients, 4 reported three to four headaches per week (varying intensity) and 2 had one headache per week (varying intensity). In addition to headache, other pain symptoms related to the accident included neck pain ($n = 17$), shoulder pain ($n = 8$), pain in jaws ($n = 3$) and back pain ($n = 2$).

Almost all ($n = 30$) denied any prior, significant headaches or head injury problems. Three patients reported a previous head or facial injury without subsequent headaches, and 2 reported prior PTH that had resolved before the current situation. Previous idiopathic headaches were reported by 5 patients. Three subjects had a history of infrequent migraines, which were aggravated by the trauma. The other 2 subjects had, respectively, episodic tension-type headaches (aggravated by injury) and occipital neuralgia (resolved prior to injury).

Because of the severity of the headache problem, most patients were additionally undergoing drug treatment, with the vast majority receiving prophylactic (usually anti-depressant) and/or palliative (usually anti-inflammatory or nonnarcotic analgesic) medications. Patients receiving medications can be classified into those taking prophylactic medications either alone or with palliative medications ($n = 30$), those taking palliative medications alone ($n = 7$), and those taking no medications ($n = 3$).

Subjects' responses to queries are listed in Table I. In this study, 53% reported at least moderate improvement (15 moderately, 6 significantly) in headaches at the completion of biofeedback. Thirty-eight percent (15) reported slight improvement and 10% (4) had no headache improvement ($M = 2.6$, $SD = .87$). In learning to relax and cope more effectively with pain, 80% reported at least moderate improvement (5 maximally, 9 significantly, 18 moderately), 15% (6) reported slight improvement and 5% (2) reported no improvement ($M = 3.25$, $SD = 1.02$). All patients except three (93%) found biofeedback helpful to some degree—6 maximally, 10 significantly, 11 moderately, 10 slightly ($M = 3.15$, $SD = 1.16$). Eight-five percent felt that headache relief achieved through biofeedback had continued at least somewhat, and 95% stated they were continuing to use biofeedback techniques to some degree in daily life. Interestingly, only 1 patient who reported that biofeedback had originally helped stated it was no longer helpful. This patient, however, was also one of the two who stated that he or she no longer used biofeedback techniques in daily life.

Correlation analyses were used to determine relationships between response to biofeedback therapy and age, number of biofeedback sessions, chronicity of the disorder (date of injury until treatment initiation), and time period from treatment conclusion until telephone follow-up. The responses to biofeedback (questions 1 through 5) were combined and the total score served as the dependent variable. Pearson correlation coefficients indicated that a significant negative relationship existed between chronicity of the disorder and treatment response [$r(40) = -.319$, $p = .045$], suggesting that increased time period from the date of injury until initiation of biofeedback resulted in poorer treatment outcome. All other correlation coefficients were nonsignificant.

Stepwise regression analyses were used to determine joint effects of gender, number of treatment sessions, age, chronicity of the disorder, time period from treatment conclusion until telephone follow-up, involvement in litigation, and educational status on total responses to treatment. Results indicate that only number of treatment sessions ($p = .036$) and chronicity of the disorder ($p = .045$) significantly affected treatment response (see Table II for additional information on regression analyses). In other words, increased number of treatment sessions and decreased time period from the date of injury until initiation of biofeedback resulted in greater benefits.

Table I. Questions, Response Choices, and Subjects' Reactions to Biofeedback Treatment

Question	Response choices	Subjects' reactions
1. After completing biofeedback, did your headache pain improve?	1 = No	4
	2 = Slightly	15
	3 = Moderately	15
	4 = Significantly	6
	5 = Maximally	0
2. Did biofeedback help you learn to relax and cope more effectively with the pain?	1 = No	2
	2 = Slightly	6
	3 = Moderately	18
	4 = Significantly	9
	5 = Maximally	5
3. Overall, would you say that biofeedback was helpful for you?	1 = No	3
	2 = Slightly	10
	3 = Moderately	11
	4 = Significantly	10
	5 = Maximally	6
4. If biofeedback was originally helpful, do you feel that its benefits have continued (in other words is it still helpful)?	1 = No	6
	2 = Somewhat	18
	3 = Yes	16
5. Are you continuing to use techniques learned in biofeedback in day to day life?	1 = No	2
	2 = Somewhat	20
	3 = Yes	18

DISCUSSION

Results indicate that 53% of subjects had at least moderate improvement in headaches following treatment. More significantly, 80% found that biofeedback-assisted relaxation at least moderately increased their ability to relax and cope more effectively with the pain, and 68% reported it was at least moderately helpful. In addition, most patients felt biofeedback had continued to be helpful several months after treatment ($M = 10.7$ months), and most were continuing to use biofeedback techniques to some degree in daily life.

Table II. Summary of Stepwise Regression Analysis for Variables Affecting Treatment Response

	Parameter estimates	<i>t</i> -score	<i>p</i> -value	<i>R</i> -squared value
Intercept	11.74	5.51	.001	.24
Number of sessions	.43	2.07	.045	
Chronicity	-.07	-2.17	.036	

In this study, two factors appeared related to increased success with biofeedback-assisted relaxation. First, chronicity of the disorder affected outcome. As previously stated, the vast majority of our sample (85%) consisted of patients with chronic PTH. However, increased time period from date of injury until initiation of treatment may be related to poorer outcome. A possible reason for this is the increased likelihood of permanent PTH in patients whose symptoms have persisted for more than a year since injury (Packard, 1992). Secondly, number of treatment sessions affected biofeedback response. This is not surprising, since many patients with fewer treatment sessions had discontinued prior to our recommendations. A similar single-group, long-term study by Olson (1988) reported a relationship between percentage of patients improving and number of sessions up to 10.

Involvement in litigation was not related to treatment response. Although other research has indicated that patients involved in legal suits do not minimize improvement to achieve increased compensation or benefits (Evans, 1994; Packard, 1992), many still equate litigation with exaggeration of symptoms or malingering. This study provides another example of litigation having minimal effects on treatment outcome.

The potential usefulness of biofeedback-assisted relaxation in PTH may be more substantial when considering this population in greater detail. First, most of the patients had chronic PTH and had been exposed to several other treatment modalities (numerous medications, physical therapy, chiropractic treatment, trigger point injections) without significant success before attempting biofeedback. Second, total relief of pain is rarely a realistic goal in treating patients with chronic PTH. Most patients should search for a means of managing headaches, rather than "a cure" for headaches. Thirdly, many PTH patients have other postconcussion symptoms as well, and may have difficulty adjusting to the pain and subsequent lifestyle changes. Depression, anxiety and increased susceptibility to stress are commonly observed in these patients. Thus, subjects' strong endorsement of biofeedback-assisted relaxation in increasing ability to relax and cope with pain is beneficial in and of itself, even if headaches do not significantly improve.

In spite of the strong support most patients gave to biofeedback, results should be interpreted cautiously, because several potential weaknesses exist. First, this study, being retrospective in nature and lacking a control group, has several inherent flaws. One particular flaw, often found in clinical retrospective studies, is a systematic bias to overstate level of improvement. Many clinical studies exhibit more impressive results than do prospective research studies because of clinicians' tendencies to use interviews or global questionnaires to obtain retrospective estimates of headache

improvement as opposed to more objective, daily reports such as headache diaries (Andrasik & Blanchard, 1987; Blanchard, Andrasik, Neff, Jurish, & O'Keefe, 1981). Research indicates that patients examined by interview overstate headache activity at pretreatment and underestimate headache activity at follow-up relative to diary evaluations, leading to greater discrepancies (Cahn & Cram, 1980). Unfortunately, it is rarely feasible for clinical investigators to obtain dairies in long-term follow-up data. Being unable to locate explicit headache diaries for all patients during initiation of biofeedback and throughout treatment, we similarly were required to use global evaluations. We do not feel, however, that this is totally undesirable, because patients' overall ratings of biofeedback for PTH, at least initially, are warranted. For more discussion of limitations of retrospective data collection, see Andrasik and Blanchard (1987).

Another potential problem was the possible confound from the use of medications and other treatment modalities. As previously stated, all patients except for three received medications. Many patients were also receiving chiropractic treatment, and a few physical therapy or massage therapy. Most patients, however, had been receiving other treatments for several weeks before initiating biofeedback, providing more credence that biofeedback produced the results described. In addition, patients were questioned specifically about improvements attributable to biofeedback rather than improvements attributable to multiple therapies. It is still difficult to credit biofeedback-assisted relaxation solely with the positive changes, since the interaction of this therapy with medication and other treatments may produce maximum benefits. Future researchers are encouraged to compare biofeedback-assisted relaxation both separately and in combination with other treatment modalities.

In spite of potential pitfalls, this study provides positive preliminary evidence for the efficacy of biofeedback-assisted relaxation in PTH. Results convincingly suggest the need for further research in this area. Future research should be conducted prospectively, employ larger sample sizes, utilize control groups, compare biofeedback with other treatment modalities, and attempt to standardize treatment to determine factors most associated with positive results.

Although several papers have cited biofeedback as a treatment choice for PTH (Adler et al., 1987; Elkind, 1992; Packard & Ham, 1994), studies examining biofeedback in PTH, particularly after an extended time period since treatment, are sparse. Methods for better managing PTH are vital considering the costs not only to the individual but also to the community at large. The annual cost to treat patients with head trauma is estimated at 83 billion dollars (Morgan, 1989). This does not include the potential added costs of loss of work time, decreased work capacity, and involvement

in litigation. Besides financial losses, individuals with chronic pain often face other losses such as diminished quality of life and subsequent psychological problems (Packard, 1994). This study indicated that biofeedback was more effective at improving relaxation and ability to cope with pain than in actually decreasing the pain. This is an advantage that most other treatments for PTH (such as medication, physical therapy, trigger point injections) do not typically possess. In addition, for patients who have psychological issues as a result of trauma, biofeedback may be effectively combined with psychotherapy to enhance treatment response (Adler et al., 1987).

In conclusion, results suggest that biofeedback-assisted relaxation should at least be considered for patients with PTH. The greatest benefit in this study was increased ability to relax and cope with pain. In addition, most patients found that benefits achieved with biofeedback continued, and most were continuing to use these skills at least somewhat in daily life. Surprisingly, only increased chronicity of the disorder and number of treatment sessions were associated with better responses to biofeedback. Future research will hopefully provide more evidence proclaiming biofeedback as a viable treatment (and not a "last ditch" effort) for PTH.

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