AN INVESTIGATION OF THREE BEHAVIORAL APPROACHES
USED IN THE TREATMENT OF CHRONIC MUSCLE CONTRACTION HEADACHES

A Dissertation
Presented to
The School of Graduate Studies
Drake University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

by

Michael Henry Palmer
October 1985
AN INVESTIGATION OF THREE BEHAVIORAL APPROACHES

USED IN THE TREATMENT OF CHRONIC MUSCLE CONTRACTION HEADACHES

by

Michael H. Palmer

Approved by Committee:

Dr. George S. Lair, Chair

Dr. Susan Varhely

Dr. W. Scott Wood

Dr. W. R. Abell
Dean of the School of Graduate Studies
AN INVESTIGATION OF THREE BEHAVIORAL APPROACHES
USED IN THE TREATMENT OF CHRONIC MUSCLE CONTRACTION HEADACHES

An abstract of a Dissertation by
Michael Henry Palmer
September 1985
Drake University
Advisor: George Lair

The purpose. The purpose of this research was to determine the effectiveness of three behavioral methods (Relaxation Training, Biofeedback, and Systematic Desensitization) of treating muscle contraction headache pain in individual chronic headache patients.

Procedure. Nine chronic muscle contraction headache patients were treated with behavioral methods as an adjunct to regular medical treatment at the Mercy Hospital Pain Center. Three subjects received relaxation training, three received biofeedback in addition to relaxation, and three received systematic desensitization in addition to relaxation and biofeedback. Headache intensity of all the subjects was monitored for a week prior to treatment, during treatment and for four weeks following treatment. Follow-up data was compared with baseline data to produce a percentage improvement score for each subject.

Findings. Three of these subjects treated with desensitization in addition to other behavioral methods in contrast to one of three subjects receiving relaxation alone or with biofeedback were successfully improved to a sixty percent criterion level.

Conclusions. While it can not be concluded with scientific precision, desensitization appears to be a powerful adjunct to regular medical and behavioral treatments of muscle contraction headaches at the Mercy Hospital Pain Center.

Recommendations. The use of systematic desensitization as an adjunct to medical and other behavioral treatments should be evaluated as a treatment option. Additional research is recommended to determine the generality of its effectiveness and cost efficiency, both as an adjunct to and in lieu of medical treatments.
# TABLE OF CONTENTS

## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>iv</td>
</tr>
</tbody>
</table>

## Chapter

1. Introduction .................................................. 1
2. Behavioral Approaches to Treatment of Headache ............ 2
   Biofeedback .................................................... 2
   Relaxation Training .......................................... 3
   Desensitization ............................................... 4
3. Purpose of Study .............................................. 6
4. Definitions .................................................... 6
5. Relaxation Training .......................................... 6
6. EMG Biofeedback .............................................. 7
7. Systematic Desensitization .................................. 7
8. Muscle Contraction Headache ................................ 8
9. Limitations ................................................... 9
10. Review of the Literature .................................... 10
2. Relaxation Procedures ....................................... 12
3. Progressive Relaxation ...................................... 13
4. Autogenic Relaxation ........................................ 13
5. Relaxation as a Treatment for Muscle Contraction Headache 14
6. Biofeedback .................................................. 16
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research on the Effectiveness of Biofeedback with Muscle Contraction Patients</td>
<td>16</td>
</tr>
<tr>
<td>Research on the Mechanism of Action of EMG Biofeedback</td>
<td>19</td>
</tr>
<tr>
<td>Research Comparing EMG Biofeedback with Relaxation Training Procedures</td>
<td>23</td>
</tr>
<tr>
<td>Comparisons of Biofeedback and Other Treatments for Muscle Contraction Headache</td>
<td>26</td>
</tr>
<tr>
<td>Systematic Desensitization</td>
<td>28</td>
</tr>
<tr>
<td>Desensitization as a Treatment for Headache</td>
<td>30</td>
</tr>
<tr>
<td>3. Methodology</td>
<td>33</td>
</tr>
<tr>
<td>Subjects</td>
<td>33</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>33</td>
</tr>
<tr>
<td>Pre-admission Headache Record</td>
<td>34</td>
</tr>
<tr>
<td>Design</td>
<td>35</td>
</tr>
<tr>
<td>Conditions</td>
<td>36</td>
</tr>
<tr>
<td>Relaxation Training</td>
<td>36</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>37</td>
</tr>
<tr>
<td>Procedure</td>
<td>37</td>
</tr>
<tr>
<td>Systematic Desensitization</td>
<td>38</td>
</tr>
<tr>
<td>4. Results</td>
<td>40</td>
</tr>
<tr>
<td>Presentation of Individual Results</td>
<td>40</td>
</tr>
</tbody>
</table>
## Chapter

<table>
<thead>
<tr>
<th>Subjects One, Two and Three: Relaxation</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone</td>
<td>40</td>
</tr>
<tr>
<td>Subject Two</td>
<td>42</td>
</tr>
<tr>
<td>Subject Three</td>
<td>44</td>
</tr>
<tr>
<td>Subjects Four, Five and Six; Relaxation and Biofeedback</td>
<td>46</td>
</tr>
<tr>
<td>Subject Five</td>
<td>47</td>
</tr>
<tr>
<td>Subject Six</td>
<td>49</td>
</tr>
<tr>
<td>Subjects Seven, Eight and Nine: Relaxation, Biofeedback and Desensitization</td>
<td>51</td>
</tr>
<tr>
<td>Subject Eight</td>
<td>53</td>
</tr>
<tr>
<td>Subject Nine</td>
<td>55</td>
</tr>
<tr>
<td>Presentation of Results by Group</td>
<td>57</td>
</tr>
</tbody>
</table>

### 5. Discussion

- Subject Eight                          | 53   |
- Subject Nine                           | 55   |

### Appendix

- Presentation of Results by Group       | 57   |
- Discussion                            | 59   |

### Bibliography

- Appendix                               | 64   |
- Bibliography                           | 65   |
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Presentation of Individual Results by Group</td>
<td>58</td>
</tr>
</tbody>
</table>
CHAPTER ONE

Introduction

Headache pain has been classified into several categories, each with general symptom clusters unique to its classification. Approximately ninety percent of all chronic headaches are vascular headaches typically identified as migraine, muscle contraction headaches, and combinations of the two.¹

Migraine headaches are believed to be brought about by autonomically mediated changes in the cephalic vascular system. In classical migraine, a period of vasoconstriction is followed by a period of subsequent dilation. Initially pulsating head pain exists resulting from increased blood volume. It is believed that the increased blood volume distends the pain receptors surrounding the blood vessels. The consequent cluster of symptoms commonly described include increased irritability, periods of nausea, visual distortion and light sensitivity, constipation, vomiting and diarrhea. Migraine head pain is frequently described as unilateral or of greater intensity on one side of the head than the other.²

Muscle contraction headaches are believed to be the products of excessive muscle contractions in the forehead, scalp, and neck muscles and are believed to be largely psychogenic. While typographies vary across individuals, tightness, pressure or bands of dull pain are


² Ibid.
Behavioral Approaches to Treatment of Headache

Both migraine and muscle contraction headaches have been treated using behavioral techniques with varying degrees of success. In contrast to medical remedies behavioral interventions have focused on prevention of the onset of headaches, rather than on remediation of the headache once present.

Biofeedback

The majority of the literature on behavioral treatment of headache has emphasized biofeedback, either alone or in combination with other approaches. In view of the prevalent vascular perspective of migraine, the biofeedback literature has emphasized the use of thermal (handwarming) feedback, with generally noted success in treating migraine headache. Muscle contraction headache, on the other hand, has been shown to respond to electromyogram (EMG) feedback. Electromyogram feedback most commonly involves "providing the patients with a tone with a frequency proportional to the integrated EMG activity in the frontalis muscle". It is assumed that relaxation of the frontalis muscle is

---

2 Kallman and Gilmore, pp. 384-87.
3 Bird, Cataldo and Parker, pp. 415-16.
consistent with relaxation of other muscles involved in muscle contraction headache.

Several studies have compared the effectiveness of electromyogram feedback with relaxation training in the treatment of muscle contraction headache. These studies found that both EMG biofeedback and relaxation instructions reduced headache activity and did not significantly differ from each other.¹ This finding is confirmed by the position taken by the Biofeedback Society of America that "EMG biofeedback and associated relaxation techniques can be considered viable alternatives to traditional medical treatments."²

Relaxation Training

Relaxation training has been shown to decrease muscle contraction headache symptoms either alone,³ or in combination with biofeedback.⁴ Most commonly, relaxation training procedures for headaches have emphasized progressive muscle relaxation and autogenic practice. In progressive muscle relaxation, the subject is taught to recognize minute muscle contractions. The procedure is based on the simple procedure of comparing muscle tension against relaxation. Training follows a


² Bird, Cataldo and Parker, p. 416.


progression of systematic relaxation of major muscle groups.\textsuperscript{1} Autogenic relaxation involves the repetition of relaxation phrases and the imaging of pleasant scenes.\textsuperscript{2} Several studies have indicated some improvement for headaches following autogenic practice.\textsuperscript{3} The effectiveness of progressive relaxation and autogenic practice is roughly equivalent.\textsuperscript{4}

\textbf{Desensitization}

Desensitization has been successfully used as a treatment approach for both migraine and non-migrainous headaches in clinical practice.\textsuperscript{5} While research on desensitization with the headache population is quite limited, the contribution of a desensitization procedure and training in other cognitive-behavioral self change procedures has been investigated by Mitchell and White. They argue that single model symptom oriented (e.g. relaxation, biofeedback) interventions are inadequate and ignore the antecedent stressors involved in the production of headaches. According to Mitchell and White, many researchers have fallen short in their curative attempts "by focusing their intervention on the last link in the behavioral chain that precedes pain (the migraine symptoms) and by failing to provide the individual with alternative behaviors for

---


\textsuperscript{3} Kallman and Gilmore, pp. 385-86.


coping with stressful features of their environment." In contrast, Mitchell and White argue that a desirable therapy goal is to assist the individual to raise his stress threshold by "training the individual to control his cognitive and emotional reactions to everyday events and situations perceived as stressful."\(^1\)

Systematic desensitization, a well-established procedure, is described in detail by Wolpe.\(^2\) According to Wolpe, systematic desensitization involves four separate sets of operation:

1. introduction of the subjective anxiety scale
2. training in relaxation
3. construction of anxiety hierarchies
4. counterposing of relaxation and anxiety-evoking stimuli from the hierarchies

The goal of systematic desensitization is to diminish autonomic responses to stressful imagery stimuli which are introduced to a patient in a state of relaxation.

It is probable that systematic desensitization may have a significant effect on muscle contraction headache patients. Recent research by Thompson and Adams indicates that muscle contraction patients were more autonomically reactive during stressful imagery than migraine patients or controls. According to Thompson and Adams, muscle contraction headache subjects "exhibited the most consistent pattern of responding: A tendency toward greater musculoskeletal reactivity to


\(^2\) Wolpe, p. 140.
imagined stressors than migrainers or normals. This occurred in spite of the fact that their resting levels were similar for all three groups." Further, they noted that head pain for muscle contraction subjects "may be the result of transient increases in EMG to stressful stimuli and not altered basal levels."¹

The use of desensitization to decrease transient increases in stress responses brought about by stressful stimuli would seem desirable in the treatment of muscle contraction headache.

Purpose of Study

The purpose of this study is to determine the effectiveness of three behavioral methods (Relaxation Training, Biofeedback, and Systematic Desensitization) of treating headache pain in individual chronic headache patients.

Definitions

Relaxation Training

Relaxation training procedures refer to a group of verbal approaches to training people to attain a state of physiological and subjective calm. The most common of these procedures include progressive muscle relaxation and autogenic relaxation. Progressive relaxation involves training in the systematic tensing and relaxation of muscle groups. The individual is asked to compare the sensations of tension against relaxation, which eventually promotes skill in the voluntary relaxation

of skeletal muscles. Autogenic relaxation involves the passive repetition of phrases thought to induce sensations of heaviness and warmth in the body. In actual practice, phrases with physiological referents (e.g., my arm is warm) are interspersed with more general suggestions of relaxation.

**EMG Biofeedback**

Biofeedback refers to a class of procedures in which electronically mediated information about ongoing body functions are provided to an individual. This information promotes the learning of voluntary control over ordinarily involuntary responses. Biofeedback of muscle activity, EMG biofeedback, provides a specific procedure for learning to decrease muscle tension. During EMG biofeedback, three electrical sensors are placed over a target muscle, the resulting electrical signals are conducted by wires to the feedback device where they are amplified. This biological information is fed back to the individual by a more easily perceived stimulus, a change in a light or tone.

**Systematic Desensitization**

Systematic desensitization refers to a technique developed by Dr. Joseph Wolpe to decrease autonomic responses to anxiety evoking stimuli. Based on a classical conditioning model, the technique involves training an individual to relax, and then systematically exposing him to greater intensities of anxiety producing stimuli. Essentially this procedure

---

1 Brown, pp. 43-6.
2 Brown, p. 47.
3 Ibid, pp. 51-2.
adds the requirements of controlled stimulus exposure to relaxation training. As ordinarily conducted, the procedure includes training in relaxation, development of a subjective anxiety scale, building of a hierarchy of stressful stimuli ranked from low to high intensities, and relearning. While the procedures are rigidly defined, it remains a highly individualized technique due to the idiosyncratic nature of hierarchy construction.1

Muscle Contraction Headache

The Muscle Contraction Headache is a generalized, steady, bilateral, non-pulsatile ache. Pain is most often reported in the forehead, temples, occipital region, or as discomfort in the neck and upper back. Muscle contraction headache is also identified by its frequency. Thirty percent of chronic patients report at least one headache a day; twenty percent report constant pain.2

For inclusion in this study, a patient was required to meet these criteria:

1. The Medical Director's concurrence that the patient has muscle contraction headaches.

2. Chronic status; patient reports that headaches have persisted for six months or more.


3. Information from history includes patient reports of periods of bilateral pain without aura.

4. Information from history indicates that patient typically has at least three headaches per week.

5. Medical Director verifies that the patient does not have classical migraine or cluster headaches.

Limitations

This study is limited due to the self report nature of it's dependent measure of pain and the consequent unavailability of reliability data. Decreases in the reported severity of headache pain therefore will have to be interpreted carefully. A functional relationship between variables cannot be established with scientific precision.

A second important limitation is that this project was conducted at a medical treatment center with ongoing medical treatments concurrent with the behavioral treatments studied by this researcher. While the medical treatments were relatively constant, they were not controlled with laboratory rigor and therefore blur the present results.
CHAPTER TWO

Review of the Literature

Headache is one of the oldest and most common afflictions of mankind. Some thirty percent of the Western population suffer from headaches.\(^1\) An estimated ten to fifteen percent of the population suffer from severe headaches which are responsible for eighteen million doctors' office visits per year and eight million days of restricted activity. While at least fifteen major classes of headache have been identified,\(^2\) the two most common are migraine and muscle contraction. Among the population with severe headaches who seek treatment at a headache clinic, approximately sixty-five percent suffer from a migraine variant while an additional twenty-five percent suffer from muscle contraction headaches.\(^3\)

Migraine headaches are commonly unilateral in onset; are usually associated with anorexia and sometimes with nausea and vomiting. When attacks are preceded by transient visual or motor disturbances they are designated as "classic." Attacks which occur with an absence of associated prodromes are called "common."\(^4\)

Migraine headaches are believed to be brought about by autonomically mediated changes in the cephalic vascular system. In


\(^3\) Wilkinson, p. 6.

\(^4\) Ad Hoc Committee, p. 717.
classical migraine, a period of vasoconstriction is followed by a period of subsequent dilation. Initially pulsating head pain results from increased blood volume. It is believed that the increased blood volume distends the pain receptors surrounding the blood vessels resulting in migraine symptoms.

Muscle contraction headache was described by an Ad Hoc Committee on classification of headache in 1962 as the second major class of headache subsuming previous designations of tension, psychogenic and nervous headaches. Muscle contraction headaches are defined as an:

Ache or sensations of tightness, pressure or constriction, widely varied in intensity, frequency, and duration, sometimes long-lasting, and commonly suboccipital. It is associated with sustained contraction of skeletal muscles in the absence of permanent structural change, usually as part of the individual's reaction during life stress.

Generally, muscle contraction headache is believed to be the product of excessive contractions in the forehead, scalp and neck muscles and are believed to be largely psychogenic. While topographies vary across individuals, tightness, pressure or bands of dull pain are typically described in the forehead, temporal or posterior head areas.

While chronic muscle contraction headache is sometimes improved by prescription of antidepressant medication, chronic headache patients frequently find no relief with medical remedies. "To the patient who has suffered over a long period of time, his headache is most

1 Kallman and Gilmore, p. 382.
2 Ad Hoc Committee, p. 718.
important, not 'just a headache.' He will travel from doctor to doctor and to large research and diagnostic centers." Further, medical solutions, while sometimes effective are not necessarily curative, that is, the headache symptoms recover when the treatment is discontinued. The development of behavioral methods as an adjunct to medical treatment of headache have offered a partial solution to the treatment of intractable cases. Reports of headache improvement using behavioral solutions range from thirty percent to eighty percent.

Behavioral approaches to treatment of muscle contraction headache have largely emphasized biofeedback. Electromyogram (EMG) biofeedback is typically used with electrodes placed on the frontalis muscle. Relaxation training is a second major behavioral treatment for muscle contraction headache. Reports of other behavioral techniques, eg., assertiveness training and coping strategies are scattered and less frequent.

**Relaxation Procedures**

Relaxation training procedures refer to a group of verbal approaches to training people to attain a state of physiological and subjective calm. The most common of these procedures in clinical

1 Diamond and Dalessio, p. 106.
2 Ibid.
4 Ibid.
practice include progressive muscle relaxation and autogenic relaxation. Meditative approaches to relaxation, while effective, appear less commonly employed. The effectiveness of both progressive relaxation and autogenic training has been demonstrated and is roughly equivalent.\(^1\)

**Progressive Relaxation**

Progressive relaxation emphasizes the relaxation of voluntary skeletal muscles. The technique initially devised by Dr. E. Jacobson was developed to treat anxiety neurosis and other related diseases which are aggravated by muscle contraction.\(^2\) Essentially, the subject is taught to recognize minute muscle contractions. Progressive relaxation is based on the simple procedure of comparing muscle tension against relaxation.\(^3\) A person is first asked to tense a set of muscles as hard as he can until tension is quite apparent, then the muscles are allowed to relax as the patient is asked to pay attention to the difference between tension or relaxation. Relaxation typically follows a progression of systematic relaxation of major muscle groups.

**Autogenic Relaxation**

Autogenic training is a technique of relaxation based on a set of mental exercises devised by Dr. H. H. Shultz.\(^4\) The complete training program is divided into three phases: Autosuggestion about relaxation,  

---

3. Brown, p. 44.
Single-focus mental concentration, and finally meditation on abstract qualities of universal consciousness. Principally only the first set of exercises are used in clinical treatment. These exercises include focusing attention on the induction of sensations of heaviness and warmth in the limbs of the body. Autogenic phrases, for example "My right arm is heavy," are repeated while the person is reclining comfortably to facilitate this process.

**Relaxation as a Treatment for Muscle Contraction Headache**

The first evidence of relaxation as a successful treatment of tension headaches was provided by Jacobson in 1938 in the second edition of *Progressive Relaxation*. Jacobson reported the treatment of four cases of tension headache. Marked improvement was reported in one case, very marked improvement was reported in the other three. Due in part to the emergence of biofeedback in the treatment of muscle contraction headache in the early 1970's, the use of various relaxation procedures as treatment agents were explored. In an early demonstration, Tasto and Hinkle reported the successful treatment of six college students with muscle contraction headaches. The students were trained in muscle relaxation over four sessions, one week apart. Subjects were asked to practice one time per day at home between sessions, and whenever they felt a headache coming on.

---

2. Pelletier, pp. 239-40.
Philips and Hunter evaluated the effectiveness of "general relaxation" both with and without the provision of "calming imagery" on the success of treatment of muscle contraction headache patients. Both groups were successful in reducing headache activity but did not show clear differences. The addition of calming imagery did not lead to improved treatment outcomes.  

Recently, Traylor showed improvement in two of three headache patients treated with a muscle relaxation procedure. Eufemia and Weslowski evaluated the effectiveness of training in a procedure called behavioral relaxation on decreasing the headache activity of a twenty-one-year-old female with a fifteen year history of muscle contraction headaches. Behavioral relaxation involved postural training of ten postures found conducive to relaxation. Headache activity was reduced following training and treatment effects maintained over a six month follow-up.

As recently as 1979 no controlled group outcome studies on the effectiveness of relaxation training alone on muscle contraction headaches had been performed. Williamson and his colleagues recently


did demonstrate that a therapist assisted relaxation training approach was superior to a self-help relaxation training approach in reducing headache symptoms in a controlled group study.\textsuperscript{1} Much research has, however, been conducted comparing relaxation training procedures with EMG biofeedback.

**Biofeedback**

Biofeedback refers to a class of procedures designed to enable the training of voluntary control over autonomic responses. Early work in biofeedback with animals was done by Neal Miller. Miller demonstrated that under experimentally controlled conditions animals could learn to control visceral and glandular responses.\textsuperscript{2} By 1970, procedures had been developed to extend the use of biofeedback for use with humans in an attempt to treat autonomically mediated disorders.

**Research on the Effectiveness of Biofeedback with Muscle Contraction Patients**

Budzynski and his colleagues presented data in 1970 which was the first important demonstration of EMG biofeedback in the treatment of muscle contraction headaches.\textsuperscript{3} Five persons with muscle contraction headaches were provided with frontalis EMG. Decreases in EMG levels were demonstrated and associated with decreases in reported headache symptoms.

\begin{itemize}
  \item \textsuperscript{1} D. A. Williamson, et al., "Relaxation For the Treatment of Headache Controlled Evaluation of Two Group Programs," \textit{Behavior Modification} 8, No. 3 (1984), 407-24.
  \item \textsuperscript{2} Neal E. Miller, "Learning of Visceral and Glandular Responses," \textit{Science}, 163 (Jan 1969), 434-45.
\end{itemize}
duration and frequency. This study was replicated in 1973 using control subjects. Six subjects in each of three groups received contingent EMG biofeedback, "pseudofeedback", or no training. All subjects were asked to keep to an hourly record of their headache intensity. Baseline measures were similar for all three groups. The contingent feedback group showed dramatic decreases in EMG and in headache ratings while no clear differences occurred in the pseudofeedback group or the no training group.

Budzynski's early data influenced W. G. Wickramasekera to investigate the use of EMG biofeedback with a group of five subjects. Following an initial three week baseline period, subjects were provided with "false" or non-contingent feedback for six sessions over the following three weeks. During a third phase, subjects were provided with "true" or contingent biofeedback. No significant differences between baseline and false feedback were apparent. However, true biofeedback resulted in substantial reductions of headache pain.

In 1975, Cox and his colleagues reported EMG biofeedback to be superior to a medication placebo with a tension headache population. By the end of that decade, biofeedback had grown in stature as an acceptable treatment alternative for some patients with muscle strain.


contraction headaches. Researchers began to look for variables which would be predictable of successful implementations.

Diamond and his colleagues evaluated outcome data from five years for 556 patients treated with EMG and thermal biofeedback sequentially. Patients were classified as having migraine, muscle contraction or mixed headaches. Biofeedback sessions followed a regime including thermal feedback with autogenic training followed by muscle relaxation exercises and finally by EMG biofeedback. Home practice in muscular relaxation and temperature feedback was encouraged. Using this comprehensive training approach, biofeedback was found to be generally successful. Younger patients usually reported greater gains. Women reported greater gains than men. Generally, patients who had not become habituated to drugs improved the most.\textsuperscript{1} These results were confirmed by Diamond and Montrose in 1984.\textsuperscript{2} In analyzing data from 692 subjects, Diamond and Montrose indicated that not only did younger patients attain more therapeutic gains, their ability to maintain gains was also higher. Younger patients showed a greater likelihood of decreasing or eliminating medications and greater ability to understand the concept of stress and its effect on headache. Women were found to be more able to decrease headache duration. Women were also more likely to be described as mixed headache sufferers while men were more likely to be either muscle contraction or migraine. In general, sixty-eight percent of all patients rated themselves as improved on follow-up.


Blanchard and his colleagues investigated therapist characteristics as a predictor of successful treatment outcomes. Data from 103 patients were evaluated. No clear differences were found in analysis of therapist experience level on the effectiveness of biofeedback training. Therapist characteristics of competence, warmth and helpfulness as rated by the patients at the time of therapy were also unrelated to outcomes.

In 1983 Blanchard and colleagues reported using psychometric instruments as a predictor of treatment outcome with ninety-three subjects. In general, the more psychometrically described pathology the poorer the prognosis was found to be. A notable exception was found with vascular patients receiving biofeedback, however. For vascular patients, high scores in depression (scale two on the MMPI) were associated with positive treatment outcomes.

While the literature clearly indicates that biofeedback is effective, one area of apparent conflict is the "mechanism" by which biofeedback is effective.

**Research on the Mechanism of Action of EMG Biofeedback**

Muscle contraction headache has been defined as an ache or sensation of tightness associated with sustained contraction of skeletal muscles in the absence of permanent structural change. This definition reflects the view that heightened levels of tension in the muscles of the neck and scalp were responsible for headache. It was hypothesized

---

3. Ad Hoc Committee.
that lowering of EMG levels would produce a consequent lessening of headache symptoms.\textsuperscript{1}

Early support for the view that the effectiveness of EMG biofeedback was due to the learned physiological relaxation of contracted muscles was provided by Budzynski and his colleagues.\textsuperscript{2} Budzynski found a high correlation between EMG levels and headache activity across baseline and treatment periods. Muscle contraction patients treated successfully with EMG biofeedback were also found to have decreases in EMG levels which maintained during follow-up periods.\textsuperscript{3}

In a single subject case study design, Kemsdorph and his colleagues found that while biofeedback successfully lowered EMG levels, headache activity was lowered only with the addition of a cognitive coping procedure, a finding that blurred the contribution of EMG levels to headache activity.\textsuperscript{4} Sustained headache activity has also been shown to maintain despite lowered EMG levels in a group design as well.\textsuperscript{5}

\textsuperscript{1} Budzynski, et al., "EMG Biofeedback"

\textsuperscript{2} Ibid.


Phillips and Hunter investigated the efficacy of EMG biofeedback with a selected group of headache sufferers who had excessively high resting levels of frontalis or temporal muscle tension.\(^1\) Two matched groups received training in raising and maintaining or in lowering muscle tension. Each group demonstrated mastery over tension levels consistent with their training conditions. While the EMG lowering group demonstrated lower pre-session EMG resting levels, the EMG raising group was unchanged. None of the treatment groups attained a significant reduction in headache control, however. Recently, Blanchard et al. similarly found no relationship between change in EMG level and headache reduction among successfully treated muscle contraction patients.\(^2\)

Inconsistent results have been reported within the same study. Traylor showed that while lowered EMG levels had no effect on reported headache activity for one subject, a paradoxical pattern was present in two other subjects. During the first half of treatment, lowered EMG levels were associated with lowered reported hours per week of headache. During the second half of treatment, subjects who reported an improvement in headache activity showed a gradual and paradoxical increase in EMG levels. A third change occurred during follow-up when EMG paralleled symptom improvement. Traylor's data suggests a complex relationship between EMG and headache.\(^3\)

Pavia and his colleagues demonstrated that "false" as well as "true" biofeedback groups demonstrated reductions in EMG levels across

\(^1\) Phillips and Hunter, pp. 485-88.

\(^2\) Blanchard et al., "Four Process Studies"

\(^3\) Traylor.
the treatment sessions, although the "true" biofeedback group was superior to the "false" group in reducing headache activity during treatment. During follow-up, the "false" biofeedback emerged as effective in reducing headache activity which according to the authors suggested that the effect of biofeedback is complex and may involve cognitive factors.¹

The hypothesis that cognitive and behavioral rather than physiological factors may provide the "mechanism" by which biofeedback effects reductions in headache activity was further investigated by Andrasik and Holroyd.² The effects of three biofeedback training procedures were evaluated in contrast to a self recording procedure in decreasing muscle contraction headaches. Actual EMG biofeedback conditions included training in increasing, maintaining, or decreasing frontalis muscle tension although all subjects were told that they were learning to decrease muscle tension. No differences were observed between the biofeedback groups although all biofeedback subjects attained significant decreases in headache activity scores in contrast with control (self recording) subjects. Treatment effects maintained over a three year follow-up.

While cognitive factors may underlie the demonstrated effectiveness of biofeedback, the present literature on the mechanism of action is certainly inconclusive.

¹ Paiva et al.
Research Comparing EMG Biofeedback with Relaxation Training Procedures

A parallel direction in research in biofeedback which emerged in the early 1970's and developed throughout that decade contrasted relaxation training procedures with EMG biofeedback. Initially, Wickramaskera demonstrated that EMG biofeedback training potentiated the effects of relaxation instructions. Training in deep muscle relaxation was administered over a three week period and was followed with contingent EMG training for an additional three weeks. Wickramasera's early data demonstrated that while headache intensity was slightly reduced with relaxation training, marked reductions occurred immediately following the onset of EMG training. These data promoted the tentative conclusion that biofeedback produced a more specific and forceful treatment. Conflicting results were reported in a study designed by Cox et al. to investigate differential effects of relaxation instructions and EMG biofeedback with tension headache sufferers. Cox provided five sessions of muscle relaxation procedure followed by imagery of pleasant scenes for five sessions. The relaxation-only group was compared to comparable groups receiving either EMG biofeedback or a medication placebo. Both treatment groups were superior to the placebo group and were found to be equal. Both the biofeedback and the relaxation groups were encouraged to practice cue controlled relaxation at home which provided a confounding factor. Similar findings have been


2 Cox et al.
recently reported in a well controlled study.¹

Steger and Harper compared "comprehensive" biofeedback with relaxation.² Biofeedback consisted of EMG training followed by discussion of life stressors and adaptive coping strategies. The relaxation-only group was provided with cassette tapes devised for individual subjects consisting of breathing exercises, autogenic phrases and pleasant scenes. The biofeedback group was found to be superior in reducing headache frequency and intensity, however biofeedback subjects reported more home practice. In contrast to these findings, the addition of progressive relaxation to EMG biofeedback has been shown not to significantly improve reductions in headache ratings.³

While the equivalence of biofeedback and relaxation procedures have become generally accepted, the possibility that individual differences influence differential responsiveness has been explored. Blanchard and his colleagues speculated that individual differences in improvement could be obscured by the effects of averaging.⁴ In a recent study, muscle contraction patients who did not improve to a sixty percent level over an eight week relaxation program were offered EMG biofeedback. Significant differences were not found in an analysis of baseline to


² Steger and Harper.


⁴ Blanchard et al., "Nonpharmacologic Treatment"
post relaxation, although post relaxation to post biofeedback analysis were significant. Improvement was noted in post treatment analysis for headache index, maximum headache intensity as well as headache free days per week. It was concluded that the increased treatment outcome for initial failures in relaxation demonstrates that the machines may be helpful some of the time.

Individual differences in the pretreatment data obtained from the MMPI and other psychometric instruments have also been shown to have some utility in predicting success of relaxation or biofeedback therapy. Success in prediction appears inconsistent across the type headache diagnosis.

Capacity for "absorption" has been shown to predict a differential response to relaxation and biofeedback treatment as measured by reduction in headache activity. Capacity for absorption was described as one's ability to engage in representational activities to the extent that one becomes unaware of distracting events. For tension headache patients, high scorers in capacity for absorption responded best to biofeedback, while subjects low in absorption did not. In addition to predictions of differential response to EMG biofeedback versus relaxation training procedures by personality variables, differential effects on personality variables have been described. In a recent investigation by Janssen, subjects were assigned to an EMG feedback condition with home practice encouraged but without specific

1 Ibid.
instructions for home practice. An EMG plus progressive relaxation training condition where home practice in progressive relaxation was encouraged; or a waiting list control condition. While both experimental groups showed similar decreases in EMG level and headache data, the EMG plus progressive relaxation group showed a post treatment decreases in the psychometric variables of neuroticism and somatization.¹

While relaxation and EMG biofeedback procedures may be generally equivalent, reported individual differences appear to support the addition of biofeedback to relaxation procedures in cases where relaxation alone was unsuccessful. However, one recent review concluded that compared to other less expensive relaxation training procedures, "there appears to be no advantage, and some disadvantage in terms of cost, to using EMG biofeedback to treat tension headaches."²

Comparisons of Biofeedback and Other Treatments for Muscle Contraction Headache

While most of the behavioral literature in treating muscle contraction headaches have focused on EMG biofeedback or its comparison with relaxation procedures, a few reports have compared its effectiveness with other treatments. Kemsdorth, Kochanowicz and Costell studied the effects of "cognitive coping" and EMG Biofeedback on two


subjects with muscle contraction headaches. In a single subject design, one subject received cognitive coping followed by cognitive coping plus biofeedback. The second subject received biofeedback alone followed by biofeedback plus cognitive coping. Both headache activity and EMG levels were monitored. Biofeedback lowered EMG levels but headache activity was lowered only with the addition of cognitive coping.

Schluter and Golden compared EMG biofeedback, hypnosis, and biofeedback plus relaxation training on patients with chronic muscle contraction headaches. All three treatments were found to be equally effective leading the researchers to conclude that relaxation was important, not the method used to achieve it.

One interesting study compared the effects of EMG biofeedback and Diazepam in the treatment of tension headache. Each of the four treatment groups received either "true" or "false" biofeedback or "true" or "false" Diazepam. Both true groups were superior to controls in alleviation of headaches. Interestingly, the false biofeedback group demonstrated reductions in EMG across treatment sessions. Headache activity was effected during treatment with Diazepam more than its placebo or any other group, but follow-up data indicated that biofeedback (true or false) produced lasting gains while headache activity recovered in the Diazepam group.

1 Kemsdorph, Kochanowicz and Costell.
2 Schluter, Golden and Blume.
3 Paiva et al.
Biofeedback has also been compared with psychotherapy.¹ Thirty-six muscle contraction patients were assigned to either biofeedback, brief eclectic psychotherapy, biofeedback plus psychotherapy or a waiting list control group. All three experimental groups improved as compared to waiting list controls. In general, exposure to EMG biofeedback produced more clinical gains than brief psychotherapy suggesting that psychotherapy was only inconsistently associated with alleviation of headache symptoms. Interestingly, only biofeedback produced an essential shift on personality indices from externality to internality. Further, biofeedback was better than psychotherapy in producing improvement in psychological symptoms other than headache.

**Systematic Desensitization**

Systematic desensitization, a well established behavior therapy technique, was developed by Joseph Wolpe. It is most often used in the treatment of phobias but is also appropriate in the treatment of a wide variety of social fears.² The goal of systematic desensitization is to diminish autonomic responses to stressful imagery stimuli which are introduced to a patient in a state of relaxation. The process involves the counterposing of relaxation and anxiety-evoking stimuli from a hierarchy of stressful stimuli which is developed through interviews with individual patients.

Systematic desensitization is widely recognized as effective. A study by Paul in 1966 demonstrated its effectiveness in contrast to

---


² Wolpe, p. 140.
traditional psychotherapy. College students with a fear of speaking in public were treated by one of five highly regarded psychotherapists of diverse theoretical orientations. Students were assigned to one of four groups. An insight-oriented group received the routine strategies employed by the five therapists. A systematic desensitization group received desensitization therapy from one of the therapists who had been specifically trained to do the treatment for the experiment. An attention-placebo group was told that they were receiving a tranquilizer to calm them while they performed a repetitive task and were given therapeutic attention at each session. Five treatment sessions were provided in each condition. The results showed significantly superior effectiveness of systematic desensitization over conventional therapy and placebo treatment. Eighty-six percent of the desensitization subjects and twenty percent of the insight subjects were rated as "much improved." None of the attention-placebo subjects were "much improved" although forty-seven percent were rated as "improved" in contrast to seventeen percent of the waiting list controls. Following treatment the therapists rated desensitization as more effective than their own approaches and began to incorporate it into their daily practices. Over the years, desensitization has emerged as a powerful treatment for a broad range of problems in which anxiety is a major factor with symptom substitution and relapse being notably lacking.


2 Wolpe, p. 176.
Desensitization as a Treatment for Headache

Surprisingly, desensitization has received relatively little attention in the behavioral literature on the treatment of headache, with more emphasis on its use with migraine than with muscle contraction patients. The only controlled studies on desensitization as well as most of the case studies described by 1979 had been performed by an Australian, Kenneth Mitchell and his colleagues.¹ A dialog search for the present report revealed that Mitchell is still the major researcher.

Essentially, Mitchell's position is that in the most commonly used behavioral strategies, biofeedback and relaxation, intervention is focused on the last link in the behavioral chain that precedes the onset of pain. These "single-model, symptom-oriented" interventions not only ignore each individual's response variation to particular features of the environment, but also ignore the specific antecedent stressors which occasion the onset of pain.²

In an early demonstration, a behavioral treatment package including progressive relaxation, systematic desensitization, and assertive training was compared to the effects of relaxation alone and found to be superior with migraine sufferers.³ In a later case study with a chronic muscle contraction patient, combined behavioral

¹ Blanchard, Ahles.


³ Mitchell and Mitchell.
treatment was demonstrated as effective.\(^1\) Combined treatment followed a two stage progression. In stage one, training included two audio tapes on muscle relaxation and one on self desensitization with practice encouraged at home over a six-week period. During the second stage, a series of eight additional tapes on a variety of self change behavioral procedures were provided. These procedures included thought stopping, timeout for worry, experiential focusing and flooding, assertion training, time restriction, imaginal modeling, blow-up, projected rehearsal, invivo desensitization and rational thinking. Headache frequency was diminished sixty-four percent once the self desensitization skills had been mastered with additional improvement following the acquisition of the second stage skills.

A major research project with migraine subjects again demonstrated the advantage of combined treatment.\(^2\) In this study, Mitchell and White studied the frequency of migraine attacks with twelve subjects over a sixty week period. Using a "dismantling strategy," all twelve subjects were trained to self record headache frequency. On week four, nine of the subjects were trained in self monitoring while the three subjects in group one continued only to record headache frequency. Self monitoring entailed the identification of environmental stressors associated with headache. On week twenty-four, stage one skill-training tapes were provided to groups three and four.\(^3\) Stage two skill-tapes were provided

---

2. Mitchell and White, "Behavioral Self Management"
only to group four at week thirty-six. While the self record and self monitored groups were essentially unchanged, self desensitization provided greater than fifty percent improvement. Stage two skills training provided additional gains. Mitchell's research clearly demonstrated additional benefit of additional treatments.

In a case study, Gainer demonstrated that while eight one-hour assertive training sessions did not improve headache symptoms in a twenty-six-year-old woman with a ten year migraine history, use of medication and headache duration were improved following eight one-hour desensitization sessions. Frequency and intensity were, however, unchanged. Recently Milne described the use of autogenic hand warming plus systematic desensitization combined with hypno-relaxation as a successful treatment for preventing migraine attack.

This review of the literature indicates that research on the effectiveness of systematic desensitization with muscle contraction patients is notably lacking. Additional research on the effectiveness of desensitization with muscle contraction patients appears warranted.

---

1 Ibid.


CHAPTER THREE
Methodology

Subjects

Nine headache patients entering treatment for chronic headache pain without a significant secondary pain complaint served as subjects. All subjects had been identified as having muscle contraction headaches by the Medical Director. Each subject was informed prior to treatment that they were being invited to be in a study of headache treatment at Mercy Hospital Pain Center. The first nine patients who were invited accepted and became subjects.

Potential subjects were given the following paragraph to read and sign indicating permission:

As part of our continuing effort to improve treatment we are placing a special emphasis on headache patients. For patients involved in this project, some additional information will be necessary. You will be required to rate (on the attached form) the amount of headache pain that you experience two times a day, morning and evening, for a week prior to admission to the Pain Center. In addition to routine rating during treatment, you will be asked to provide follow-up information on a weekly basis for a month following your discharge. This will be accomplished by a telephone interview. Additional interviews may be scheduled for you during the course of treatment. If you agree to be part of this project, please sign below.

NAME: __________________

DATE: __________________

INSTRUMENTATION

Each day subjects were asked to rate the intensity of their headache pain two times per day: upon rising in the morning and again before supper. The procedure for reporting this level of subjective
distress will be comparable to that presently in use at the Pain Center. Patients were requested to mark their subjective evaluation of pain on a "Pain Line" which was 10 cm in length. Low pain was assumed to be at the zero cm extreme with high pain assumed to be toward the 10 cm extreme. Subjects were asked to draw a perpendicular line cutting through Pain Line to indicate their pain level.

Sample Pain Line:

No Pain ——————————— Excruciating Pain

Pre-admission headache record

Upon being informed that they were being considered, each subject was given a pre-admission headache record and the accompanying instructions to complete during the week immediately prior to admission. Subjects were presented with the following paragraph:

For the week prior to your admission to the Mercy Hospital Pain Center, please rate your headaches two times each day. Your morning rating should be as soon as possible upon rising for the day and your evening rating should be immediately prior to eating supper. The Pre-Admission Headache Record is attached to this page. When you rate your headaches you should consider the amount of pain you are experiencing at the moment you rate it. "Excruciating Pain" is assumed to be extremely painful. If you rate your headache at this extreme, it should mean that your headache is so severe that it is interfering with your ability to do normal activities. If you rate your pain at the "No Pain" extreme it means that you are headache free. You may rate your pain at either extreme or anywhere in between, depending on severity."

The Pre-Admission Headache Record was attached to the instructions. A sample of the Pre-Admission Headache Record is presented in Appendix A.
DESIGN

This study employed a single subject AB design. The description "AB" refers to the two phases of the design: The "A" or Baseline Phase and the "B", or intervention phase. During the "A" phase baseline data were collected over time and recorded. Once a baseline had been established, treatment was introduced which marked the beginning of the "B" phase. During this phase, intervention data was recorded. Data from the two phases were graphed and inspected. The trend of the intervention data, as compared with the baseline data provided a suggestion of the effectiveness of the treatment.¹

In the present study, all subjects completed the Pre-Admission Headache Record which provided one week of pretreatment baseline. The treatment phase consisted of two weeks for seven of the subjects and three weeks for two of the subjects. During treatment, intervention data consisted of the Pain Line ratings collected each morning and evening. Subjects nominally identified as subjects one through three received Relaxation Training as a behavioral intervention throughout the "B" phase. Subjects four through six received Relaxation Training plus daily Biofeedback Training sessions throughout the "B" phase. Subjects seven through nine received Relaxation Training plus Biofeedback plus Systematic Desensitization throughout the "B" phase. Subjects were arbitrarily assigned to treatment conditions by the researcher prior to the initial meeting with the subject.

Conditions

Relaxation Training

Relaxation training included a yoga type stretch and flex exercise period, progressive relaxation and autogenic practice. The forty-five minute stretch and flex exercise period was conducted each workday, Monday through Friday at 10:00 AM by the Mercy Hospital Pain Center's exercise physiologist. Her training includes a Master of Arts degree in exercise physiology; she is a certified cardio pulmonary technologist. The stretch and flex exercises entail a progression of static stretching exercises designed to increase flexability and reduce muscle tension. This series of exercises involves a progression of stretching all major muscle groups. Each muscle is stretched for a minimum of twenty seconds followed by a fifteen second muscle relaxation accompanied with deep breathing instructions. The progression includes muscles in the back, hamstring, calf, shoulders, neck and legs. The stretch and flex exercise period ended with a fifteen minute relaxation period during which patients lie in the supine position on a foam rubber mat with the lights dimmed. During this relaxation period, autogenic relaxation and wellness oriented affirmations were directed by the trainer.

A second fifteen minute relaxation period was conducted each day at 3:00 PM. During this period, patients sat in recliner chairs in a room with dimmed lights. Following an initial two to three minutes of deep breathing instruction, pleasant scenes, guided imagery and affirmations were described by the trainer. The afternoon session was conducted by an RN with ten years experience in relaxation training. In addition, relaxation tapes were available to all patients. Patients were encouraged to listen to a fifteen minute tape each evening in their rooms.
Biofeedback

During biofeedback training, patients were seated in a recliner in a room with the lights dimmed. Biofeedback included both thermal and EMG biofeedback. A model T 808 Termal Monitor (manufactured by Bio-Logic Devices, Inc., Plainview, New York) was used for thermal feedback with the thermister taped to the middle finger. Sound feedback was turned off with feedback being provided by the digital display only. Electromyogram feedback was concurrently provided. A Myosone 404 EMG Monitor (manufactured by Bio-Logic Devices, Plainview, New York) was used with standard frontalis electrode placement. Feedback sessions began with the establishment of a basal level. The feedback threshold was set to activate at three microvolts below the stabilized basal level. Session length was thirty minutes with additional time for instruction as needed.

Procedure

On the initial session, patients were presented with these instructions:

The band which I am putting around your forehead will feed electrical input into the monitor which will be fed back to you through the earphones, and visually by the needle on the meter. In order to control the needle and the sound, you must learn to relax; to let go of anything which might incline you to tense your muscles. Since through association we tend to relax or tense our muscles in accordance with what we are thinking, pleasant thoughts should be encouraged while preoccupations, fears and deep concerns should be avoided.

Depending on your preference, you may try to concentrate on a pleasant scene from the past, that is, try to relive it visually. If you choose, you may want to just try to blank out your mind making it void of all thoughts. If you prefer, you may try instead to tense and relax your muscles and concentrate on the sensations of relaxation each time.

Your goal is to lower the tone, which means you’re relaxing your muscles and to warm your hands by allowing
a greater volume of blood to flow into your finger tips. One good way to do this is to just imagine that your hands are being warmed by the sun. The feedback that indicates that you are warming your hands is provided by the digital display on the second monitor. As the temperature readout goes up, it means that you are relaxing the smooth muscles which line the blood vessels in your finger tips.

Following the initial session, an interview was conducted to determine the approach attempted by the patient. On subsequent sessions some patients were encouraged to try different relaxation strategies depending on their initial success.

Biofeedback training was conducted by Mercy Hospital's biofeedback therapist. This therapist has a Master's degree in counseling and nine years experience in biofeedback therapy. He is certified by the Biofeedback Certification Institute of America and is a member of the Biofeedback Society of America.

Systematic Desensitization

Systematic desensitization was conducted by this researcher. Initially, patients were introduced to the subjective anxiety (SUD) scale. The scale was introduced using Wolpe's method as follows:

"Think of the worst anxiety you have ever experienced, or can imagine experiencing, and assign to this the number 100. Now think of a state of being absolutely calm and call this zero. Now you have a scale of anxiety. On this scale, how do you rate yourself at this moment?"¹

Once the SUD scale was established, the session continued in an interview format to establish anxiety producing situations which were thematic. SUD values were assigned to each situation, and hierarchies

¹ Wolpe, p. 141.
of anxiety producing situations were established within each theme.

Desensitization sessions were introduced to the patients by saying: "I am now going to ask you to get relaxed. When you are relaxed, I will ask you to imagine certain scenes. Each time the scene is clear in your mind, indicate this by raising your left index finger about an inch." The process of desensitization involved asking the patient to imagine the scenes from each hierarchy indicated by the therapist. Patients were asked to stop imagining the scenes about ten seconds following their signal. The patients were then asked to state how much the scene disturbed him in terms of SUD. Following each SUD report, the patient was asked to concentrate on relaxation for 20-30 seconds. Each scene was repeated until a zero level report was given by the patient. The next scene in the hierarchy was then presented. Data was recorded on the number of presentations of each scene and on the SUD report at each presentation.
CHAPTER FOUR
Results

For each subject, daily average pain ratings were calculated by determining the mean of morning and evening pain lines. Daily average pain ratings are reported in centimeters. Percentage of improvement for each subject was calculated from the mean of the daily average pain ratings. The formula for percentage of improvement was adapted from that used by Blanchard et al.:

\[
\text{Percent Improvement} = \frac{\text{Baseline} - \text{Followup}}{\text{Baseline}} \times 100
\]

Presentation of Individual Results

Subjects One, Two and Three: Relaxation Alone

Subject one, a twenty-seven year old male was a Ph.D. student at a university in another state. He had experienced headaches since age thirteen. He reported that his headaches had generally become worse, being especially unpleasant for the two months prior to exam time. Headaches were described as band-like, as if there were a "vice on both sides" of his head. Headaches were reported as daily and continuous, although he reported that he "never had headaches in the summers." Pain was described as usually dull with periods when it escalated and became throbing. No associated prodromata were present. The only associated

---

symptom reported was that sometimes he was unable to read while he had a headache. He had experienced wakefulness in the middle of the night for the two months prior to coming to the pain center. No family history of headache was present and previous neurological examinations were negative. At the time of treatment he was taking 60mg of Inderal three times per day.

Interview information indicated stress factors included his Ph.D. program, job, lack of social life and concern over family problems his parents were experiencing resulting from a recent divorce.

During baseline, daily average pain ratings ranged from 2.25 to 7.15 cm with an overall baseline mean of 5.0 cm. During treatment, daily average ratings dropped to an average of 1.85 cm, with a range from 4.55 to 0.9 cm. Throughout follow-up, Daily Average Ratings ranged from 0.75 cm. to 3.65 cm. with an overall mean of 2.45 cm. reflecting a Fifty-one percent improvement in average daily headaches compared with baseline data.

Interview information obtained at the end of the follow-up period indicated that subject found "no particular benefit from the Pain Center treatment but a general benefit was relaxation with no hard demands." Subject one dropped out of school at the time of seeking treatment at the Pain Center. Interview information indicated that he attributed the lessening of his headaches to the lack of academic pressures.

1 Parenthetical insertion was added for clarity.
Figure 1 presents average daily headache intensity ratings for subject one for baseline, treatment and follow-up periods.

Subject Two

Subject two was a twenty-eight-year-old female who had experienced headaches since she was fourteen. She was the wife of a minister in a small congregation and the mother of a thirteen-month-old son. Her headaches had generally become worse, although she reported periods of complete remission. Her daily headaches were described as band-like; all over her head, down the neck and between her shoulders, her forehead and the top of her head being most affected. In addition, about two times per month she experienced a headache which was localized in the right temporal region. Her daily headaches were reported as continuous and lasting all day getting worse as the day progressed. No prodromata were associated with her headaches although she reported some
nausea associated with her right temporal headaches. No sleep
disturbance was reported; however, she reported diminished sexual
activity due to headaches. No family history was present. Subject two
had previously had neurological examinations including brain scans and
EEG which were negative. She took Inderal and Midrin for headache
management although she stated she had a "fear of medications." She had
been previously treated for drug abuse elsewhere. Interview data
indicated that present stress factors included the social demands of the
ministry.

During baseline, daily average headache ratings ranged from 3.3 to
7.5 cm. The overall mean during baseline was 6.2 cm. Subject two
elected to stay for an additional week of treatment. During the three
week treatment period, daily average headache ratings ranged from 1.0 to
5.75 cm with an overall mean of 3.17 cm. Follow-up ratings ranged from
0.6 to 3.8 cm with a mean of 1.70 cm. Follow-up data, in comparison
with baseline, indicated a 72.6 percent improvement in headache ratings.

Follow-up interview information indicated that "practicing
relaxation helped the most." Subject two had refused to take Tricylic
antidepressants which are commonly prescribed for muscle contraction
patients.

Figure two presents average daily headache intensity ratings for
subject two for baseline, treatment and follow-up periods.
Subject Three

Subject three was a thirty-eight-year-old male with a twenty year history of headache. While his headaches generally had improved, they had become worse during the three weeks prior to coming to the Pain Center. His headaches were described as bilateral but including the forehead and neck, radiating down to his shoulders. Subject three reported his headaches as daily and continuous, generally a dull pain which became sharp during his "bad" periods. While no prodromata were associated with his headaches, some degree of light sensitivity was reported during occasional periods when the pain became sharp. Subject three reported early waking from sleep and diminished sex life resulting from headaches. No family history was present, an extensive neurological workup was negative. He had been on Elavil for two weeks.
prior to admission to the Pain Center. Subject three indicated that a major stress factor was his job; he worked for a state agency undergoing financial cutbacks.

During baseline, subject three's daily average pain ratings ranged from 5.1 to 6.7 cm with a mean of 5.9 cm. In treatment daily average ratings ranged from 4.65 to 5.75 cm with a mean of 5.13 cm. Follow-up data indicated that average daily ratings ranged from 4.7 to 6.0 cm with a mean of 5.3 cm. A comparison of follow-up and baseline ratings indicated a 10.3 percent improvement.

Follow-up interview information indicated that the "Pain Center was helpful." Subject three commented that "relaxation and exercise" were most beneficial. Further he indicated that his boss had given him good support and that he was caught up at work and that he was "out of the pressure zone" and consequently felt better. He commented that he had

![Figure 3. Average daily headache intensity rating for subject three.](image)
lost fourteen pounds and was in better physical shape than before.

Figure 3 presents average daily headache intensity ratings for subject three for baseline, treatment and follow-up periods.

Subjects Four, Five and Six; Relaxation and Biofeedback

Subject four was a thirty-one-year-old female with a seventeen year history of headaches. Since the onset of her headaches at age fourteen, she described them as having gradually become worse. She described her headaches as nagging starting at both temples and generalizing to a "sharp" pressure band around her head, occasionally accompanied by a throbbing sensation. She described her headaches as occurring daily and indicated that she wakes up with a headache almost every day. While no prodromata were present, photophobia, nausea and vomiting were occasionally associated with her headaches. Headaches were also associated with sleep disturbance, insomnia being both initial and terminal. Maternal history of undiagnosed headache was present. Extensive neurological examinations including skull x-rays, brain scans, EEG and a spinal puncture were negative. Subject was on Elavil at the time of admission to treatment. In addition, subject used aspirin, "pain pills," Midrin, Codine, Percodan and Demerol shots when necessary to manage headache pain.

Subject four described her major life stressors as raising preschool age children and a bad marital adjustment.

During baseline, subject four's daily average pain ratings ranged from 0.3 to 9.8 cm, the mean being 4.53 cm. During treatment, daily
average pain ratings ranged from 1.0 to 6.1 cm with a mean of 3.52 cm. Throughout follow-up, daily average pain ratings dropped to a mean of 2.6 cm, with daily average ratings ranging from 0.0 to 8.4 cm. Overall, in follow-up, a 42 percent improvement was demonstrated in comparison with baseline data.

In a follow-up interview, subject four reported that there was "some improvement" in her headaches and that she was "able to control them better although they are not any less frequent". As means of control she mentioned ice treatments and relaxation as most helpful.

Figure 4 presents average daily headache intensity ratings for subject four for baseline, treatment and follow-up periods.

Figure 4. Average daily headache intensity rating for subject four.

Subject Five

Subject five, a forty-one-year-old female had a twenty-one year history of headache. She was employed as a university professor. She
described herself as having two distinct kinds of headaches, her "daily headaches" were described as beginning around her left eye and generalizing bilaterally across her forehead. These headaches were worse in the evening and generally have become worse during the last three years. She also described a second occasional headache which occurred about one time per month which was localized to the right side temporal-parietal region. Her daily headache was described as a dull continuous ache with periods of escalating pain. No Prodromata were present with any of her headaches and no consistent symptoms other than headache were associated. Subject five reported early waking and restlessness. She indicated that her mother had been diagnosed as having migraine headaches and a brain tumor. Extensive neurological examinations were negative. At the beginning of treatment, she was medication free.

During baseline, subject five's daily average pain ratings ranged from 1.1 to 3.1 cm with a mean of 2.29 cm. An additional week of treatment was elected by subject five. During the three weeks of treatment, daily average ratings dropped to a mean of 1.38 with a range from 0.6 to 2.65 cm. During the four weeks of follow-up, daily average pain ratings ranged from 0.0 to 2.25 cm with a mean of 1.07 cm, representing a 53.2 percent improvement in comparison with her baseline level.

In follow-up interviews, subject five indicated that she was "doing better" and that she was "satisfied with the improvement." She commented that relaxation and biofeedback had been helpful and that she could control her headaches with her TENS (Transcutaneous Electrical...
Nerve Stimulator) unit and relaxation which she practiced every day. Additionally, she mentioned that she believed exercise had also been helpful in reducing her symptoms and that she was walking two miles a day.

Figure 5 presents average daily headache intensity ratings for subject five for baseline, treatment and follow-up periods.

![Graph showing headache intensity ratings](image)

**FIGURE 5.** Average daily headache intensity rating for subject five.

**Subject Six**

Subject six was a forty-year-old female who began having headaches at age eighteen. She described two kinds of headache problems. Her "typical" headache was described as continuous dull pain located at the center of the back of her head, radiating down her neck and shoulders and bilaterally forward to her the temples, resulting in a pressure band around her head. These headaches have generally become more frequent since age twenty-five. A second class of headache which occurred an
estimated one to two times per month was described as a sharp pain being localized to one side of her head, but alternating sides. No Prodromata were reported and both types of headaches were accompanied with cranial tenderness and hypersensitivity to sound. No sleep disturbance was reported. There was a positive family history of headache; both her mother and brother had been diagnosed as having migraine headaches. Neurological examinations including skull x-rays, brain scan, and EEG were negative. Although several medicines had been used, no medication had provided any consistent relief. She had been using Tylenol III frequently at the time of admission to the Pain Center and admitted to analgesic abuse.

At the time of admission, subject six reported major life stressors as including having to tolerate other people not being practical, displaced objects in her home, and lack of control in her business; she attributed her most recent difficulties to her failure to be able to set up a complicated computer system at her business, which was jointly owned by herself and her husband.

During baseline, subject six's daily average pain ratings ranged from 1.55 to 7.7 cm with a mean of 3.99 cm. A substantial decrease occurred during treatment with daily average ratings ranging from 0.5 to 4.8 cm with a mean of 1.26 cm. Follow-up data provided a mean of 1.05 cm. with daily average ratings from 0.0 to 5.55 cm. Follow-up data indicated a 73 percent improvement in comparison with baseline ratings. Follow-up interviews indicated that "relaxation training was the most helpful." She further commented that she "didn't like biofeedback", she reported her headaches as less frequent in an initial
interview, about midway through the follow-up period. At that time she reported practicing relaxation ten to fifteen minutes each day and using it to abort headaches. In a second interview at the end of the follow-up period she reported headaches were "more frequent than two weeks ago." At that time she commented that she "still practices relaxation every three days or so" and when headaches start.

Figure 6 presents average daily headache intensity ratings for subject six for baseline, treatment and follow-up periods.

Figure 6. Average daily headache intensity rating for subject six.

Subjects Seven, Eight and Nine: Relaxation, Biofeedback and Desensitization

Subject seven was a thirty-six-year-old male. He began having headaches nine years ago. The onset of headaches was sudden and he was hospitalized. Generally, his headaches were reported as becoming worse during the two years previous to admission to the Pain Center. Pain was described as on both sides of his head, starting right above the eyes and then spreading to the entire forehead. He reported daily headaches
beginning as a dull pain and becoming sharp after about fifteen minutes. Headaches were described as a "constant pressure" lasting a few hours each day. No Prodromata were present although some photophobia accompanied the pain. Subject seven reported both sleep onset and terminal insomnia. No family history was present. Extensive neurological exams taken previously were negative. At the time of admission subject seven had unsuccessfully tried several medicines. His doctor had told him that the only stronger medications were narcotic preparations which he refused to attempt.

During baseline, daily average pain ratings ranged from 0.0 to 6.7 cm with a mean of 2.97 cm. During treatment, ratings ranged from 0.0 to 5.3 cm with a mean of 1.97 cm. Data recorded over the twenty-eight day follow-up period indicated the elimination of headaches with all zero pain ratings, representing a 100 percent improvement in comparison with baseline information.

In follow-up interviews subject seven reported that his headaches were "pretty much non-existent." He reported that he believed relaxation, biofeedback and desensitization were all helpful to him. At the end of the follow-up period he commented that he continued to practice relaxation and that there was "definitely a transfer from the scenes we practiced" (in desensitization). He also stated that he was "glad to have been involved in the research project."

Figure 7 presents average daily headache intensity ratings for subject seven for baseline, treatment and follow-up periods.
Figure 7. Average daily headache intensity rating for subject seven.

Subject Eight

Subject eight, a thirty-four-year-old female reported that she began having headaches at age thirteen. Her headaches were reported as generally becoming worse over the years, however, some periods of remission had occurred. She described her headaches at the time of admission as daily and continuous. The pain began as a dull ache which became stronger. Pain usually began at her shoulders and neck and then radiated up the back of her head forming a band-like ache. No aura was reported. She reported that she experienced some light sensitivity and cranial tenderness with her daily headaches. Nausea and vomiting accompanied her "migraines" which she reported as occurring one time per month. Subject eight reported no sleep disturbance since being placed on Elavil six months previously. A positive family history of migraine was present with both her mother and maternal grandmother. An EEG was performed previously and was negative with no other neurological
examinations reported. Subject eight indicated that in addition to
Elavil, Asprin, Tylenol, Ibuprofen, Darvon, Demerol and Codine
preparations were routinely used to manage headaches. She admitted to
analgesic abuse previously but denied abuse at the time of admission.
Subject eight reported that she had a "predisposition to alcoholism" but
that she had abstained during the last two years. She also reported
binge eating and said she "overeats to relieve stress." Interview data
suggested that a major life stress was her marriage. She attributed her
headaches to "frequent arguments with her husband."

During baseline, daily average pain ratings ranged from 4.25 to
10.0 cm with a mean of 6.76 cm. Daily average treatment ratings ranged
from 0.7 to 8.3 cm with a mean of 3.59 cm. During the twenty-eight day
follow-up period, daily average ratings ranged from 0.4 to 3.7 cm with a
mean of 1.67 cm. Mean follow-up ratings were 75 percent improved in
comparison with baseline reports.

In follow-up interviews, subject eight reported that her headaches
were better; that they didn't get as severe. She reported that she felt
desensitization had been most beneficial to her and that she believed
exercise had been the second major factor providing for her improvement.
She indicated that while her marriage problems had continued that she
had "been more calm" in dealing with them, and further that she
experienced "less worry." Overall, she reported being generally happy
with treatment.

Figure 8 presents average daily headache intensity ratings for
subject eight for baseline, treatment and follow-up periods.
Subject Nine

Subject nine was a thirty-five-year-old minister with a fifteen year history of headaches. His headaches first became a problem in college; however, symptom remission from college until eighteen months prior to admission was reported. Chronic headaches were reported for the eighteen month period prior to admission. Headaches were described as bilateral and daily, lasting two to eight hours. Band-like pressure on the forehead and base of the skull was described. No Prodromata was reported, headaches were described as rapid in onset. No sleep disturbance was reported. He reported childhood memories of his father having headaches. Neurological exams previously performed were negative. Subject nine was medication free at the time of admission. Previously Elavil was used with some benefit. Tylenol was used with minimal effect reported.

Upon admission, subject nine indicated that stress factors
including the politics of the ministry and his relationship with his seven-year-old son were present.

Baseline daily average pain ratings ranged from 0.7 to 3.35 cm with a mean of 2.56 cm. During treatment, average pain ratings dropped to a mean of 1.30 cm with a range from 0.0 to 6.25 cm. A further decrease occurred during follow-up. The follow-up range was 0.1 to 3.4 cm with a mean of 0.48 cm. Comparison of baseline to follow-up data indicated an 81.25 percent improvement in reported headache intensity.

In follow-up interviews, subject nine reported that he was getting along with his son better and that he was handling stressors better in general. While all three behavioral treatments were described as important, subject nine reported that he believed desensitization was "the major treatment" associated with his headache reduction. By the end of the follow-up period subject nine reported headaches to be "only a minor problem" and added "I'm a well man."

In an unsolicited letter at the end of the follow-up period, he stated that desensitization was "very valuable in helping me get rid of my headaches, and my family and friends have often remarked at my more relaxed attitude."

Figure 9 presents average daily headache intensity ratings for subject nine for baseline, treatment and follow-up periods.
Presentation of Results by Group

Table I presents the mean of the daily average pain ratings for each subject in each treatment group for baseline, treatment and follow-up conditions. Percentage of improvement versus baseline and follow-up conditions is presented for individual subject in each group.
TABLE 1

PRESENTATION OF INDIVIDUAL RESULTS BY GROUP

MEAN OF AVERAGE DAILY PAIN RATINGS

<table>
<thead>
<tr>
<th>BEHAVIORAL TREATMENTS</th>
<th>SUBJECT</th>
<th>BASELINE</th>
<th>TREATMENT</th>
<th>FOLLOW-UP</th>
<th>PERCENT IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relaxation</td>
<td>1</td>
<td>5.0</td>
<td>1.8</td>
<td>2.4</td>
<td>51</td>
</tr>
<tr>
<td>Alone</td>
<td>2*</td>
<td>6.2</td>
<td>3.1</td>
<td>1.7</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5.9</td>
<td>5.1</td>
<td>5.2</td>
<td>10</td>
</tr>
<tr>
<td>Relaxation and</td>
<td>4</td>
<td>3.9</td>
<td>1.6</td>
<td>1.0</td>
<td>73</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>5*</td>
<td>2.2</td>
<td>1.3</td>
<td>1.0</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4.5</td>
<td>3.5</td>
<td>2.6</td>
<td>42</td>
</tr>
<tr>
<td>Relaxation</td>
<td>7</td>
<td>2.9</td>
<td>1.9</td>
<td>0.0</td>
<td>100</td>
</tr>
<tr>
<td>Biofeedback and</td>
<td>8</td>
<td>6.7</td>
<td>3.5</td>
<td>1.6</td>
<td>75</td>
</tr>
<tr>
<td>Desensitization</td>
<td>9</td>
<td>2.5</td>
<td>1.3</td>
<td>0.4</td>
<td>81</td>
</tr>
</tbody>
</table>

* Indicates treatment phase was extended for a 3rd week
CHAPTER FIVE

Discussion

Using the sixty percent improvement criteria established by Blanchard et al. as a definition of successful treatment,¹ three of three subjects receiving systematic desensitization as an adjunct to their treatment appeared to be successfully treated in contrast to one of three receiving either relaxation alone or relaxation plus biofeedback. While the design limitations of the present study preclude the conclusion that headache improvement was caused by the addition of systematic desensitization, the present data suggest that it was a powerful adjunct to regular medical and behavioral treatments at the Mercy Hospital Pain Center.

This study did, however, demonstrate that systematic desensitization therapy can be accomplished with about ten hours of professional time per patient in an inpatient medical setting for patients with intractable headache pain within a two week treatment period. Desensitization is clearly a treatment option as an adjunct to regular treatments in this setting.

While the present data suggest that systematic desensitization may be a powerful adjunct to other treatments, the reason for its apparent effect is unclear. Previous research by Diamond and Montrose has shown that a favorable treatment outcome with headache patients is associated with the number of treatment sessions.¹ Future research should control

¹ E. B. Blanchard, et al., pp. 409-81.
this variable. It is possible that a similar outcome would have been produced if patients merely received additional hours of individually conducted relaxation training or of therapist attention.

Conversely, it may be that desensitization is simply a more powerful treatment. A major benefit of relaxation training appears to be earlier discrimination of tension and the establishment of a strategy which can be used to relax once tension has emerged. Indeed the success of relaxation approaches to headache treatment are related to the frequency of home practice. Desensitization may, on the other hand, alter the basic interpretation of stress producing stimuli providing intervention at an earlier link in the behavioral chain leading to headache symptoms. This interpretation, consistent with Mitchell and White's position would predict greater clinical gains by eliminating additional undesirable responses precurrent to headache symptoms. Possibly the need for continued home practice could be reduced with a more robust treatment.

Both the review of the literature and the data provided by the present study provide a justification for additional research on the use of systematic desensitization in the control of muscle contraction headaches. As scientific rigor requires replications of results across settings and subjects, it is curious that more research has not been conducted in this area.

It is possible that desensitization has not been investigated more as a treatment for headache due to the level of skill and time, and

---

1 Diamond and Montrose, pp. 5-18.


3 Mitchell and White, 213-221.
consequently the cost involved in its implementation. This possibility is suggested in a review by Blanchard and Ahles who refer to the procedures of Mitchell and White as "a hefty package to say the least."\textsuperscript{1}

It is conceivable that a greater headache improvement may be provided by a heavier package. If this could be consistently demonstrated, the expense may be justified.

In contrast to biofeedback and relaxation training, desensitization is an individualized procedure. Hierarchies can only be designed through careful interviewing. The patient must perceive the therapist as trustworthy and highly skilled. Due to those requirements a more highly trained professional is usually involved. Biofeedback and relaxation training, on the other hand, can be conducted by competent paraprofessional staff.

Due to the increased requirements of skill and time, an obvious criticism of desensitization is its cost. Ten hours of professional time at an hourly rate of $50 would add an additional $500 to the $3,000 which approximates the present cost for two weeks of pain center treatment. One possibility would be to use professional time for an initial interview and subsequently to design the hierarchies. If professional time were cut to three hours, and desensitization could be accomplished by supervised paraprofessional staff an addition of only $150 might result.

In another framework, all three of the subjects receiving desensitization appeared successfully treated at sixty percent criteria in a two week period. In both other groups, one subject elected an additional week of treatment adding approximately $1,500 to their

\textsuperscript{1} Blanchard and Ahles, pp. 518-49.
overall cost. This is enough to pay for desensitization therapy for all three members of their respective groups in a two week treatment program.

In another context, the cost of medicines for treatment is quite high. In the United States $500 million is spent on medicines for headache control each year, not to mention the costs of other medical services.\(^1\) The indirect costs of headache to society also need to be considered. It has been estimated that in Great Britain three million working days a year are lost to headache, and that estimate is based on the loss of only one working day per year per patient.\(^2\) For intractable cases, the loss of one day per month or more could easily be possible. If a worker earning the modest sum of $12,500 annually lost one work day per month, a $500 desensitization program could be paid for in ten months.

An important limitation of the present study was the presence of concurrent medical interactions. Subjects routinely received physical therapy services, medicines (in particular tricyclics), exercise, dietary adjustments and lectures on the advantages of living a wellness oriented life style. These confounding influences, while relatively constant for all subjects were not controlled with experimental precision and therefore blur the results of this investigation.

An additional caution must be mentioned in interpreting the present results. The statistical calculation of a daily mean of headache ratings and an overall mean of daily averages implies linearity between

---


\(^2\) Ibid
various levels of subjective perception of pain. This implication is due to the requirement of an interval scale of measurement if a mean is to be calculated.1

Since painlines have not been demonstrated to be interval data, future researchers should consider using a median as a measure of central tendency as it is appropriate for ordinal measures.2

The present report utilized a case study design methodology to investigate behavioral approaches to treatment of muscle contraction headache patients in a medical setting. The advantage of the present design to the preliminary investigation includes the ability to focus treatment on individuals rather than on groups with relative ease of implementation. Future research is needed, however, to extend the generality of these findings.

Recommended future research issues include controlled outcome studies on the (cost) effectiveness of desensitization versus biofeedback and relaxation alone as well as in contrast with medical remedies. In the context of the limited previous research, the present data provide considerable justification for future research to investigate the effectiveness of systematic desensitization therapy in the treatment of muscle contraction headache.

---


2 Ibid.
APPENDIX A, SAMPLE PREADMISSION HEADACHE RECORD

PRE-ADMISSION HEADACHE RECORD

NAME: ___________________ WEEK OF: ___________________

<table>
<thead>
<tr>
<th></th>
<th>AM NO PAIN</th>
<th>PM NO PAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>TUESDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>WEDNESDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>THURSDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>FRIDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>SATURDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
<tr>
<td>SUNDAY</td>
<td></td>
<td>EXCRUCIATING PAIN</td>
</tr>
</tbody>
</table>


**Periodicals**


