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Eleanor Belle Callon
Louisiana State University and Agricultural & Mechanical College

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Callon, Eleanor Belle

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THE EFFECT OF MUSCLE CONTRACTION HEADACHE CHRONICITY ON FRONTAL EMG

A Dissertation

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in

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by
Eleanor B. Callon
B.S.Ed., University of Florida, 1959
M.Ed., University of Florida, 1961
Ed.D., University of Florida, 1970
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Dedicated

to the memory of my mother,

ANNIE BELLE MCCLELLAN CALLON

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Abstract

The hypothesis that frontal EMG levels measured by surface electrodes change as a function of the number of years of muscle contraction headache activity was tested. Three levels of muscle contraction headache chronicity ($\geq$ 20 years, $\leq$ 10 years, and none) were examined under imagined stress and a quiz falsely presented as a measure of intelligence. The two stress conditions were counterbalanced across subjects. The three groups had 10 members each and were equivalent in age and subjects' ratings of the laboratory stressors. Psychophysiological recordings were done during a headache free period. An ANOVA indicated no group effect and no group X trials interaction. An ANCOVA showed that frequency of headache during the month prior to psychophysiological recording had no effect on the ANOVA results. Baseline frontal EMG levels, responses to laboratory stressors, and recovery from laboratory stress were not associated with either having a history of muscle contraction headaches nor the length of headache history. These findings suggest that structural changes do not occur as a result of muscle contraction headache. The assumption that increased muscular responses occur as a response to life stress, as stated in the standard definition of this type of headache, is questionable if there is a positive correlation between laboratory and life stressors. A further implication of

these results is that decreased headache following frontal EMG biofeedback treatment is the result of factors other than learning to decrease frontal EMG levels. It remains possible that there are subgroups of muscle contractions headache sufferers. However, chronicity of the problem is not associated with frontal EMG levels. Furthermore, these findings add to the body of literature suggesting that EMG levels do not contribute to an understanding of the disorder.

Introduction

Five to 30 per cent of the United States population reports headaches during any given year (Beaty & Haynes, 1979; Feuerstein & Gainer, 1982; Ogden, 1952). As many as 72 per cent within nonclinical populations report having headaches (Waters, 1970). Muscle contraction headaches are the most frequently reported (Bakal, 1975; Plum, 1982; Taylor, 1982). One survey of headache patients (Philips, 1977a) showed 77 per cent of the women and 87 per cent of the men describing this type of headache. It has been suggested that the best estimate of the number of muscle contraction headache sufferers in the United States today is 100 million (Budzynski, 1983).

Muscle Contraction Headache

The American Medical Association's Ad Hoc Committee on the Classification of Headache (1962) identified 15 types of headache. They suggested diagnostic guidelines and basic pain mechanisms for each type of headache. Muscle contraction headache was described as

> 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. The ambiguous and unsatisfactory terms "tension," "psychogenic," and "nervous" headache largely refer to this group. (p. 718)

The Committee's description was based on a series of studies (Ray & Wolff, 1950; Tunis & Wolff, 1954) in which it was found that sustained contraction of extracranial muscles results in pain. Factor analytic studies of patients' responses to questionnaires (Arena, Blanchard, Andrasik, & Dudek, 1981; Granberry, 1985; Granberry, Williamson, Pratt, Hutchinson, & Monguillot, 1981; Zeigler, Hassanein, & Hassanein, 1972) have found factors consistent with the Committee's classification system, but they have also found factors suggesting that there may be subgroups within classifications.

The Committee's goal of identifying basic pain mechanisms has proven to be somewhat elusive in the case of muscle contraction headache. A satisfactory pathophysiology is difficult to describe (Plum, 1982). This is especially true for patients who complain of the symptoms "day after day for months or years on end despite all other evidence of good health" (p. 1948). If there are subgroups within headache classifications, this fact may account for the difficulties encountered in the search for a pathophysiological description. Nearly all of the research to date has considered subjects within each of the standard classifications as a group.

Normal Muscle Activity

Some level of contractile activity is normal in skeletal muscles (Murphy, 1983). Relaxed muscles are firm in comparison to the flaccidity found in isolated, unstimulated muscles. The degree of tone is largely influenced by the state of contractile activity in the gamma motor system (Diamond & Dalessio, 1982). Gamma efferent neurons contract the muscle spindle after receiving impulses from the brain, relayed through the reticulospinal system. In the case of head muscles, the contracting muscle spindle produces a stimulus that is transmitted to the motor nuclei of the brain stem, discharging the efferent peripheral nerve and resulting in muscle contraction. Ordinarily, the contracting muscle inhibits firing of the muscle spindle, and the muscle relaxes. However, if the gamma efferent system continues to fire (secondary to cortical influences, local disease, or systemic disease), the muscle spindle remains tight, prolonging the contraction to the point of pain.

The Measurement of Muscle Activity

Instrumentation

Muscle activity has been, and remains, a dependent variable of interest in investigations of headache. The electromyogram (EMG) provides an indirect measure of the total series of action potentials that cause muscle contraction. Needle electrodes, placed directly in the muscle, are used when the specific activity of a single motor unit is of interest. The most commonly used type of EMG recording in psychophysiological studies of headache has employed surface electrodes that yield records from groups of muscles rather than single motor units. Two live electrodes are placed along the muscle of interest, with a ground electrode between them. The electrical signal detected by surface electrodes is that which diffuses through tissues to the skin. After the signal has been detected and amplified, it is displayed by one of several means. Permanent records are normally obtained through one of a variety of pen-writing techniques. Records of raw EMG signals are very complex and are very difficult to interpret (Lippold, 1967). At least three types of records integrate the raw signal (Blanchard & Epstein, 1978). The average, or leaky, integrator is best used to detect changes in EMG level over time. The ordinate at any given point represents the product of the amplitude and the frequency of the electrical signal at that time. It can be hand scored at intervals chosen by the experimenter. Intervals of one minute, 30 seconds, 20 seconds, 15 seconds, 10 seconds, and four seconds have been reported.

Electrode Placement

Standard placements for various muscle groups have been described and illustrated (Lippold, 1967). The placement for frontal EMG has been questioned. Davis, Brickett, Stern, and Kimball (1978) argue that, since the frontalis muscles run vertically above each eye, the standard horizontal placement does not measure the activity of either muscle.

Instead, it measures the potential difference between the two. Williamson, Epstein, and Lombardo (1980) found significant positive correlations between EMG recordings from horizontal and left vertical placements on 12 college students. The values obtained with the horizontal placements were greater than those obtained from the vertical placements. They concluded that placement (horizontal vs. vertical) is critical when assessing specific magnitude but not when assessing changes in muscle contraction. Sanders and Collins (1981) replicated the study and added a right vertical placement. Their subjects were six migraine and seven muscle contraction headache patients. Correlations of placement (taken in pairs) with each group of subjects and the group as a whole were statistically significant. The highest correlations obtained were those for the muscle contraction group. Within subjects correlations were consistently significant for the horizontal-left comparisons made for the muscle contraction subjects. This was not the case for either (1) other placement comparisons or (2) the migraine subjects. The investigators also found no statistically significant differences between group or placement site means. They did find large within-cell variance in mean EMG, however. The Sanders and Collins data suggest that horizontal vs vertical placement is not a crucial issue when examining group effects. The large variances noted do raise the possibility that not all headaches of a given diagnostic classification are alike.

Reliability

Action potential recordings from one muscle group have been found to be poor predictors of those from another site. Whatmore, Whatmore, and Fisher (1981) computed correlation coefficients for all the nonredundant pairs among muscles in the forehead, jaw-throat, right forearm, and left leg. Separate coefficients were derived for each of 10 alert individuals seated at rest, with their eyes open. Correlations varied widely within and across subjects. The authors noted that their findings were consistent with the known structure of the skeletal motor system that allows discrete and isolated motor acts. Thus, comparisons of results across muscle groups are meaningless.

There are reports of the reliability of EMG records for a given site. Epstein and Webster (1975) calculated within and between subject correlations between cumulative integrated EMG recorded at 1 minute intervals and each of several other scoring methods. Within subject correlations varied widely, more so for some subjects than others. Between subject correlations with cumulative integrated EMG were .91 when scored at a one-minute interval; .90 when scored at a 30-second interval and averaged per minute, .77 at a 15-second interval, .90 at a 4-second interval. Each of these correlations was calculated to have a less than 1 percent probability of being due to chance.

Test-retest reliability of EMG has also been reported. Voas (cited in Goldstein, 1972) calculated reliabilities of muscle action potentials from seven muscle groups across three conditions over an average of 9 days. Reliability coefficients for frontalis activity was consistently high across all conditions (relaxation, $r = .806$; mental work, $r = .905$; frustration, $r = .954$). Frontalis musculature was the only measurement site for which correlations of this magnitude were obtained under all three conditions. Arena, Blanchard, Andrasik, Cotch, and Myers (1983) recorded a number of psychophysiological measures including frontal and forearm flexor EMG in 15 headache free undergraduates on multiple occasions (days 1, 2, 8, and 28). Measures were taken under multiple stimulus conditions (baseline, self-control, cognitive stress, and physical stress). Frontal EMG was recorded once a minute on a cumulative integrator. Reliability coefficients were computed on absolute scores, change scores from baseline to stressful conditions, and percent change from baseline. Between session correlations for absolute frontal EMG during baseline ranged from .814 to .938 ($p < .001$ for all comparisons). During mental arithmetic, coeffients ranged from .579 to .834 ($p < .01$ or $p < .001$). The correlations were inconsistent during stressful imagery and a cold pressor test. Change score reliability coefficients for frontal EMG were significant (.847 $\leq$ r $\leq$ .922, p < .001) for mental arithmetic, and for the cold pressor test (.573 $\leq$ r $\leq$ .892, .001 $\leq$ p < .01), but inconsistent under stressful imagery. Percent change scores for frontal EMG were significant, highly significant, or very highly significant (.433 $\leq$ r $\leq$ .924) under all conditions except for the correlations between sessions 1 and 3 for the cold pressor test (r = .294). Contradictory data from another laboratory are in preparation (Waters, personal communication, 1985). Those researchers found that frontal EMG was less reliable across sessions than are any of several other psychophysiological measures. Although such a report cannot be ignored, the bulk of the currently published findings strongly suggest that EMG measures of frontal activity are more reliable across sessions than any of the other psychophysiological recordings tested. Despite these encouraging results, most researchers adhere to Goldstein's (1972) suggestion that it is important to average EMG responses so that "reliable comparisons can be made from subject to subject or in a given subject on different occasions" (p. 399).

Muscle Activity among Headache Subjects

A series of studies led Wolff and his co-investigators to conclude that sustained muscle contraction is associated with constriction of the arteries supplying those muscles and that the resulting ischemia leads to an increase in pain sensitivity.

Ray and Wolff (1940) made systematic observations of pain reports in 30 surgery patients under minimal local and general anesthesia. They found all the tissues covering the cranium to be pain-sensitive. The arteries are especially sensitive. They found small nerves passing along the supraorbital and temporal arteries. When they applied procaine hydrochloride (a local anesthetic) to the adventitia of the temporal artery, total anesthesia occurred a few centimeters distal to the injection site. Their conclusion was that the sensory nerve supply originates near and travels along the arteries. The supraorbital and frontal arteries supply the frontal region. The superficial temporal artery supplies the parietal region. The occipital artery and the postauricular artery supply the occipital and the suboccipital regions.

Tunis and Wolff (1954) examined arterial and muscular responding in 20 normotensive and six hypertensive muscle contraction headache subjects, during headache episodes and during headache free periods. Comparisons were made with the responding of ten nonheadache control subjects. Bilateral blood pulse waves were recorded from the supraorbital, temporal, and occipital arteries. EMG records were obtained from muscles supplied by these arteries. They reported that brief episodes of neither muscle contraction nor cranial artery vasoconstriction alone resulted in headache. Sustained muscle contraction or vasoconstriction led to discomfort. Muscle-contraction headache was associated with concurrent sustained contraction of a skeletal muscle and constriction of its associated artery, whether the subject was hypertensive or normotensive.

Brazil and Friedman (1956) concluded that, although local vascular insufficiency may play a part in muscle contraction headache, the insufficiency might be secondary to local muscle contraction. They gave parenteral injections of 100 mg of nicotinic acid (a vasodilator) to 42 muscle contraction headache sufferers during a headache episode. Pulse wave amplitude increased in all the subjects. However, the effects on pain were mixed. The headache was eliminated for 45 per cent of the subjects, partially relieved for 33 per cent, and not affected for 22 per cent. Ten subjects were given 1 cc dihydroergotamine (a vasoconstrictor) intramuscularly. Nine subjects reported no effect, and one reported an increase in the intensity of the headache. Intramuscular administration of sterile water resulted in neither subjective nor objective response. Injections of dihydroergotamine induced headache in four headache free subjects but had no effect in 11 others.

Muscle activity has been the focus of many investigations of muscle contraction headache since these early studies. EMG has been sampled from frontal, temporal, brachial, trapezial, and nuchal muscles. Measures have been taken during baseline, stress, and recovery from stress. Activity has been recorded during headache episodes and during headache free periods. The responses of muscle contraction headache subjects have been compared with those of individuals with migraine headaches and with headache free control subjects. The results have been mixed, leading to interest in hypotheses to explain the inconsistencies (Blanchard & Andrasik, 1982).

Resting EMG

Muscle contraction headache subjects have been shown to exhibit higher resting levels of frontal EMG than controls (Andrasik & Holroyd, 1978; Cohen, et al., 1983; Martin & Mathews, 1978; Philips, 1977a; van Boxtel & van der Ven, 1978). Resting nuchal EMG levels that are higher than those of controls have also been reported (Bakal & Kaganov, 1977; Martin & Mathews, 1978; Pozniak-Patewicz, 1976). The last of these authors also found significantly higher resting temporal EMG in muscle contraction headache subjects than in controls (Pozniak-Patewicz, 1976).

Negative findings also appear in the literature. No statistically significant differences were found between muscle contraction headache subjects and controls when resting activity was sampled from frontal musculature (Anderson & Franks, 1981; Andrasik, Blanchard, Arena, Saunders, & Barron, 1982b; Bakal & Kaganov, 1977; Gannon, Haynes, Safrenek, & Hamilton, 1981; Sturgis, 1981), from nuchal musculature (van Boxtel & van der Ven, 1978), from temporal musculature (van Boxtel & van der Ven, 1978), and from brachial musculature (Anderson & Franks, 1981; Gannon, Haynes, Safrenek & Hamilton, 1981; van Boxtel & van der Ven, 1978).

Reactivity

The definition of muscle contraction headache suggests that sustained contraction may be one of the individual's responses to life stress. Such a definition contains an assumption that persons who suffer this type of headache will differ from other individuals in muscular reactions to stress. Muscular reactivity has been defined as (1) EMG level under a stess condition, (2) a change in EMG level between baseline and stress conditions, (3) variability of response within experimental conditions, or (4) recovery from stress. Stressors employed under laboratory controlled conditions have included stressful imagery, exposure to aversive pictures or sounds, mental arithmetic, cognitive activity presented as a measure of intelligence, and physical stress (cold pressor test). The laboratory stressors are of short duration and may not be equivalent to the kinds of stressors implied in the definition of muscle contraction headache. Thus, generalization of findings to nonlaboratory conditions is questionable.

A few studies have found increased EMG levels to be characteristic of muscle contraction headache subjects when exposed to a laboratory stressor. Philips (1977a) reported higher frontal EMG levels during mental stress for muscle contraction headache subjects but not for migraineurs, combined headache sufferers, or no headache controls. This finding did not generalize to measurements taken from other muscle groups -- nuchal, temporal, trapezial. Van Boxtel and van der Ven (1978) also found higher EMG levels for muscle contraction headache subjects than for controls. This finding, obtained during mental stress, appeared in the frontal musculature but not in the nuchal, temporal, or brachial.

Cohen, et al. (1983) examined the change from the average frontal EMG for five minutes preceding cognitive stress to the average for 12 minutes of responding to the Quiz Electrocardiogram, a task falsely presented as an intelligence test. They compared results among subjects diagnosed as having muscle contraction headaches, common migraine headaches, classic migraine headaches, mixed headaches, or no headaches. Employing canonical function analysis to look for variables which discriminated between groups reliably, they found that the muscle contraction group was relatively unresponsive for heart rate but very responsive for EMG. The other headache groups responded approximately equally on these two measures during stress. The control group was, on average, much more responsive for heart rate than for frontal EMG during stess. Andrasik, Blanchard, Arena, Saunders, and Barron (1982b) calculated percentage of change from baseline for three self control tasks, mental arithmetic, pleasant imagery, stressful imagery, and a cold pressor test. There were no group effects for among migraineurs, tension headache subjects, combined headache subjects, and no headache controls.

Sturgis (1981) examined the variability of resting frontal EMG, cephalic blood volume pulse (CBVP), and digital blood volume pulse (DBVP) among migraine and muscle contraction headache subjects and no headache controls. She defined variability as the sum of the squared deviations from the mean of the final 25 twenty second intervals during a five minute baseline. She found no statistically significant group differences.

Examining the Inconsistencies

The disparate results among the studies have become the focus of recent discussions in the literature on headache. Methodological problems have been examined. Andrasik, Blanchard, Arena, Saunders, & Barron (1982b) suggest that the differences across studies diminish when the following criteria have been met.

1. Comparisons with other headache groups as well as with controls are made.

2. Controls are carefully matched with the headache subjects.

3. Clearly defined inclusion and exclusion criteria are employed.

4. Adequate adaptation periods are used.

5. Adequate baseline periods are included.

Nevertheless, the studies of muscle contraction headache that they review (Anderson & Franks, 1981; Andrasik & Holroyd, 1980; Bakal & Kaganov, 1977; Gannon, Haynes, Safranek, & Hamilton, 1981; Martin & Mathews, 1978; Philips, 1977a; Pozniak-Patewicz, 1976; Sturgis, 1981; Vaughn, Pall, & Haynes, 1977; van Boxtel & van der Ven, 1978) are mixed in satisfying their criteria. None of them includes more than two of the reviewers' five suggestions.

Methodological differences, no doubt, do account for some of the discrepancies among the results. However, there is evidence that subject characteristics may account for a significant portion of the variance. These data argue for the hypothesis that there are subgroups of individuals within the category of muscle contraction headache.

Diagnostic reliability has been a problem for researchers. Turkat, Brantley, Orton, and Adams (1981) found 71 percent agreement across three graduate students, each of whom was guided by the criteria suggested by the Ad Hoc Committee on Classification of Headache (1962). Cohen, et al. (1981) reported 59 percent agreement between their own diagnoses and those made by their subjects' physicians. Blanchard, O'Keefe, Neff, Jurish, and Andrasik (1981) obtained 86 per cent agreement between diagnoses made in their laboratory and those of a board certified neurologist. Other studies have included only subjects for whom diagnostic agreement was reached by two or more individuals; thus, there was 100% agreement across raters. Still, there may be important intragroup differences among subjects diagnosed as having muscle contraction headaches. For example, Granberry (1985) conducted a factor analytic study of headache diagnostic questionnaires and found more than one factor related to muscle contraction headache.

Some evidence suggests that frontal EMG activity under certain conditions is correlated with age. Arena, Blanchard, Andrasik, and Myers (1983) examined EMG records from 73 normal individuals divided evenly into younger (18 - 28), middle (29 - 44), and older (45 - 68) age groups. They reported significant correlations with age under instructions to relax face ($r = .234$, $p \leq .05$) and while doing mental arithmetic ($r = .258$, $p \leq .05$) among subjects not reporting a history of headaches. These conditions were only two among eight. Thus, it is possible that these relationships, while statistically significant when considered in isolation, may have been due to chance. Nevertheless, the possibility that age may affect EMG cannot be ignored.

Other evidence, implicating frequency of headache complaints, is accumulating. Vaughn, Pall, and Haynes

(1977) compared frontal EMG responses between high and low frequency muscle contraction headache subjects. They found that subjects reporting three or more headaches per week had higher resting EMG levels than subjects reporting two or fewer headaches per month. The low frequency subjects showed higher levels in response to a mental arithmetic task than the high frequency subjects did. Other authors (Bakal & Kaganov, 1979; Thompson, Haber, Figueroa, & Adams, 1980) have found differences in self reports of tension in the forehead and a feeling of cephalic tightness between frequent and infrequent headache sufferers. Thus, investigators must account for frequency of headache in their studies of EMG.

If muscle contraction headache subjects differ among themselves, one could expect varying results when these subgroups are inconsistently represented across EMG studies. One factor that needs to be examined for possible significance is chronicity of the headache problem.

Chronicity

Hypotheses implicating chronicity have been offered to explain a significant part of the variance in the findings of studies examining EMG. Philips (1978) reviewed the available data on muscle contraction headache. She was impressed with the large standard deviations in EMG levels reported among headache subjects and speculated that analyses involving average EMG levels may obliterate differences that are quite real. She concluded that sustained muscle contraction, itself, is neither the cause nor the effect of headache. She noted that changes in pain behavior (reduced frequency of complaints, reduction in medication intake) and changes in the intensity of pain reported lag behind changes in EMG levels in biofeedback studies. She suggested that other factors might influence the patients' skill at detecting changes in EMG levels and thus, their pain experience. She argued that there are subgroups of muscle contraction headache patients and that chronicity of headache complaints might be one differentiating dimension.

Bakal (1982) proposes that headache susceptibility and the symptoms experienced during headache attacks are progressive conditions. Although he emphasizes frequency of headache in his arguments, he alludes to time in explaining them. He refers to a transition from the status of occasional headache sufferer to that of chronic headache patient (Bakal & Kaganov, 1979). He suggests that the result of this transition is an increasing independence of the underlying physiological mechanisms from psychological mechanisms such as response to stress, anxiety, or depression. Their hypothesis would suggest that baseline EMG levels are higher for chronic muscle contraction headache sufferers than for nonchronic sufferers or those who do not experience headaches. EMG responses to stress may not necessarily be greater for chronic than nonchronic sufferers or nonsufferers. To date, no one has published a systematic investigation of EMG recordings using chronicity as an independent variable.

Several investigators have acknowledged chronicity as of likely significance by the criteria used in selection of their subjects or by specifying the duration of the problem in their descriptions of the subjects. Both criteria and descriptions have varied widely, as is illustrated in Table 1. Some authors have reported measures of the variability of chronicity represented in their samples. Blanchard, Andrasik, Evans, et al. (1985) reported a standard deviation of 13.3 years; Cram (1980), 14.0 years; Harper & Steger (1978), 8.4 years. Epstein and Abel (1977) reported a range of 1 to 24 years; Martin and Mathews (1978) 1 to 46 years. These figures indicate that, if chronicity of the problem is of significance in the muscular activity of individuals suffering muscle contraction headaches, the studies to date have not been designed to allow its impact to be analyzed. Philips and Hunter (1981) indicated how many of their subjects reported symptoms of one to 10 years duration, of 10 to 20 years, and of 20 to 30 years. However, they did not analyze their data along this dimension. A study doing so would provide an empirical test of the chronicity hypothesis.

Table 1

Definitions of Chronicity

Investigator(s)	Criterion	Description Mean (yrs)
Anderson & Franks (1981)	≥ 5 yrs	
Andrasik & Holroyd (1980b)		3.5
Blanchard, Andrasik, Evans, et al. (1985)		15.2
Cram (1980)	≥ 1 yr	14.6
Demjen & Bakal (1981)		10.1
Epstein & Abel (1977)		8.3
Epstein, Hersen, & Hemphill (1974)		16.0
Gannon, Haynes, Safranek, & Hamilton (1981)	≥ 2 yrs	
Hart & Cichanski (1981)	≥ 3 yrs	11.9
Holroyd, Andrasik, & Noble (1980)		5.5
Martin & Mathews (1978)	≥ 1 yr	12.0
Paiva, Nunes, Moeira, Santos, Teixeira, & Barbosa (1982)	≥ 1 yr	
Philips & Hunter (1982)	≥ 6 mos	
Sanders & Collins (1981)		20.0

Indirect Evidence

Evidence from several sources suggests that chronic contraction may alter the normal activity of skeletal muscles.

Treatment failures. Psychological treatments designed to train muscle-contraction headache subjects in muscle relaxation show 40 to 80 per cent of the samples improved, leaving 20 to 60 per cent unimproved (Blanchard, Andrasik, Ahles, Teders, & O'Keefe, 1980). A few investigators have attempted to identify outcome predictors. Though none has looked specifically at chronicity as a critical variable, the variables that have been identified suggest that chronicity might be an underlying factor.

Very high initial levels of frontal EMG have been associated with poor treatment response with both biofeedback (Epstein & Abel, 1977) and relaxation training (Blanchard, et al., 1983). Invariance in daily reports of high headache intensity during baseline periods was associated with decreased ability to understand biofeedback procedures (Blanchard, et al, 1983). There was a statistically significant positive relationship between muscle discrimination ability and outcome in relaxation training (Blanchard, Jurish, & Andrasik, 1981). Patients 46 years of age and older have been reported to respond to frontal EMG biofeedback treatment less successfully than patients 31 to 46 years old, while those younger than 31 responded most favorably (Diamond, Medina, Diamond-Falk, & De Veno, 1979).

Temporomandibular joint pain (TMJ). Another medical condition involving pain that has been successfully treated by teaching patients to relax associated musculature is the TMJ syndrome. Gale and Funch (1984) reported that one of the factors associated with short-term successful treatment was chronicity of the problem. Those patients who had suffered with the problem for longer periods of time were less frequently responsive to the behavioral interventions offered.

Non-articular rheumatism. Non-articular rheumatism ("muscular rheumatism") is a condition marked by pain of muscle, tendon, and fascia in the absence of clear indications of inflammation. Its significance is in its chronicity and pain. Fassbender (1975) reported the results of electron microscopic examination of tissue taken from the upper medial border of the trapezius of 11 patients in the presence of a painful spastic condition. In comparison to normal skeletal muscle, the samples taken from these patients (aged 29 - 65 years) showed all stages of destruction of the parenchyma, corresponding to different stages of degeneration of contractile muscular elements. The loss of contractile muscular elements was associated with prolonged contraction of the muscle; that is, the muscle lost its ability to relax. It seems logically possible that a similar kind of step-wise degeneration of contractile muscular elements could occur in chronic muscle-contraction headache. If so, then one would expect changes to occur over time in the electrical activity of the muscle. This researcher is not prepared to conduct the histological studies required to test that hypothesis. However, the knowledge that such findings have occurred in other conditions assumed to originate in the absence of structural change is very interesting.

Rival Hypotheses

Age. Some evidence suggests that frontal EMG activity under certain conditions is correlated with age. Arena, Blanchard, Andrasik, and Myers (1983) reported significant correlations under instructions to relax face ($r = .234$, $p \leq .05$) and while doing mental arithmetic ($r = .258$, $p \leq .05$) among subjects not reporting a history of headaches. These conditions were only two among eight. Thus, it is possible that these relationships, while statistically significant when considered in isolation, may have been due to chance. Nevertheless, the possibility that age may affect EMG cannot be ignored.

Frequency of headaches. Fairly strong evidence is accumulating to suggest that frequency of headache episodes is associated with other characteristics of muscle contraction headaches. McAnulty, Rappaport, Waggoner, and Brantley (1984) reported that scores on psychological tests were related to frequency of headaches.

A major study supporting the frequency hypothesis is that of Vaughn, Pall, and Haynes (1977). They compared frontal EMG responses between high and low frequency muscle-contraction headache subjects. They found that subjects reporting three or more headaches per week had higher resting EMG levels than subjects reporting two or fewer headaches per month. The low frequency subjects showed higher levels in response to a mental arithmetic task than the high frequency subjects did. They noted that the narrow range of within subject variability of responses among the high frequency subjects limited subjective reports of relaxation and could interfere with accurate perception of physiologic changes. Does a history of muscle-contraction headaches affect the variability of normal activity of the muscles? A study by Bakal and Kaganov (1977) suggests that it might. They examined frontal EMG in headache patients and headache-free controls. Mean Square Successive Difference (MSSD) scores were used to quantify the variability of response during rest. Controls demonstrated significantly more variability than headache patients did. This suggests that something may happen to the elasticity of the muscles. Bakal and Kaganov (1979) hypothesize a change in the underlying mechanisms but do not suggest what that change may be. It could be a physiological phenomenon; that is, some change may take place in the muscles themselves. It could be a learning phenomenon; that is, some change may occur the organism's response to its environment. This possibility has been suggested by Philips (1978).

Investigators must account for frequency before drawing conclusions. In fact, frequency of headache activity is the major alternative to the chronicity hypothesis.

Focus of this Study

EMG responses are standard dependent variables in studies of muscle contraction headache. Early studies were based on the findings that prolonged muscle contraction leads to pain and that subjects with this type of headache showed higher EMG levels than persons who did not suffer headaches. These data resulted in the traditional conceptualization of muscle contraction headache as being the result of sustained contraction of the musculature, with the added assumption that this was a response to life stress. Later studies, including larger numbers of subjects and comparisons with persons having other types of headaches, have resulted in a confusing picture of mixed findings. It appears highly likely that, if abnormal EMG responses are associated with the presence of a muscle contraction headache disorder, the relationship is different from the traditional conceptualization.

Early work was based on the assumption that individuals with muscle contraction headaches represent a homogeneous category of patients. Evidence from a variety of studies suggests that, instead, the group is heterogenous. Factor analytic studies of assessment instruments find clusters of items strongly associated with the diagnosis of muscle contraction headache. They also find this diagnosis associated with clusters more descriptive of other types of headache. Studies of the reliability of EMG records find some muscle contraction headache sufferers to have highly similar responses across sessions whereas others do not. Investigations of EMG responses have yielded varying results whether examining baseline levels, levels during stress, or changes from one experimental condition to another.

Some evidence suggests that the length of headache history may account for a significant portion of the variance in the results across EMG studies. The chronicity hypothesis has been offered previously. To date, the evidence is indirect. It is derived from data examining treatment failures or other disorders in which sustained muscle contraction plays a significant role. A few studies examining the relationship between chronicity and aspects of muscle contraction headache other than EMG responses have failed to find strong associations between length of headache history and the other variables studied. Yet, the chronicity hypothesis has not been tested in reports that appear in the headache literature.

Purpose of the Study

The chronicity hypothesis as it applies to EMG responses was tested. The hypothesis suggests that a large part of the disparity of results across studies may be accounted for by the fact that subjects whose headache histories vary widely in length have been treated as one group, averaging out differences among the subjects.

Frontal EMG responses for each of two groups of subjects suffering muscle contraction headaches were compared with those of subjects who report that headaches are not a problem. The headache groups included subjects with (1) relatively long or (2) relatively short histories of muscle contraction headaches. The rival hypothesis of age was controlled for by selecting groups of subjects who are equivalent along this variable. Frequency is often suggested as the major hypothesis rivaling chronicity. Therefore, frequency of headache complaints was held as a covariate in the analysis of the data. Frontal EMG responses were recorded at rest and during both an imagined stressor (identified by each subject) and a cognitive stressor. Data were examined for differences across groups and experimental conditions.

Hypotheses

If changes in muscle activity occur when an individual experiences muscle contraction headaches over a period of years, then one would expect those alterations to be evident in the absence of a headache, both at rest and during stress. A number of hypotheses are suggested by the theories and data that have been reviewed in this paper.

One would expect that baseline EMG levels would be greater for individuals with long histories of muscle contraction headache than for those with short histories. Individuals with short headache histories would be expected to have EMG levels greater than or equal to those for whom headaches are not a problem. These expectations would hold for both prestress and poststress baselines. Specifically, one would expect the following to be true of average frontal EMG during prestress and poststress baseline periods.

$$L > S \geq C,$$

where L = long duration headache subjects

S = short duration headache subjects

C = no headache control subjects.

A different picture is expected under conditions of stress. The chronicity hypothesis suggests that the frontal muscles may be (or may become) more responsive to stress early in the course of a history of muscle contraction headaches. However, as the history of headaches lengthens, the hypothesis suggests that the muscles become less and less responsive, perhaps as a result of loss of elasticity. Therefore, if the theory is correct, the following inequality would be expected

$$S > L > C.$$

Method

Subjects

The subjects were drawn from subsamples of a larger headache study. Newspaper articles and radio advertisements announced a headache study in progress. Other possible subjects were referred by physicians. All interested parties were required to have had their headaches diagnosed by a physician. Initial telephone screening excluded individuals

(1) under 18 years of age; or

(2) with auditory or visual impairments that would preclude participation in the procedures; or

(3) with a psychiatric history.

Individuals who passed the telephone screening were invited to appear for further screening. They were interviewed independently by a neurologist and by a clinical psychology graduate student, each of whom had been trained in using the diagnostic criteria established by the Ad Hoc Committee (1960). The purpose of this interview was to establish the diagnosis of muscle contraction headache and to rule out headaches of other varieties such as those arising from space occupying lesions, sinusitis, temporomandibular joint syndrome, vascular causes, etc. A copy of the structured diagnostic interview used by the psychology graduate student appears in the appendix. Diagnostic agreement between the two examiners was required for the individual to be included for further consideration.

<u>Muscle-Contraction Headache Criteria</u>.

(1) at least three headaches per week;

(2) headache described as aching, tightness, or cap- or bandlike pressure;

(3) presence of no more than one of the following:

nausea,
unilateral pain,
throbbing pain.

<u>Experimental Groups</u>. Two experimental groups were formed on the basis of chronicity of the headache problem. The subject's current age and the age of onset of headache symptoms was obtained during interview. The difference between those two figures constituted a chronicity score. Those individuals with headache histories of 19 or more years were designated Long Duration; those with headache histories of 10 years or less, Short Duration subjects. The years of muscle contraction headache as a problem ranged from 19 to 41 for the Long Duration subjects; the mean was 25.20, and the standard deviation was 6.71. Histories among the Short Duration subjects varied from 1.5 to 10 years; the mean was 5.70, and the standard deviation was 3.28. The frequencies of self-monitored headaches during the month prior to psychophysiological recording were similar between the two experimental groups. The Long Duration group reported an average of 16.70 headaches that month; the

standard deviation was 7.79. The Short Duration group reported a mean of 19.00 with a standard deviation of 7.10.

Control Subjects. Persons naive to the experimental conditions served as control subjects. None reported having more than 3 headaches per year, and none had a headache during the month prior to collection of the psychophysiological data.

There were 10 subjects in each of the three groups. There were 5 males in the Long Duration group and 4 in each of the other two groups. The ages of the Long Duration subjects ranged from 36 to 50 years; the mean was 42.0. The Short Duration subjects varied in age from 23 to 66 years of age; the mean was 37.1. The ages of the Control subjects were from 26 to 54 years, with a mean of 35.5. A one-way ANOVA test indicated that the differences in the mean ages of the groups were not statistically significant ($F = 1.17$, $p > .05$). All except two of the headache subjects reported that their headaches commonly involved the forehead; the two exceptions were evenly divided between the headache groups.

All subjects signed an informed consent document. Headache subjects were offered treatment at the end of the study.

Measures

Electromyographic (EMG) responses were recorded by a Grass Model 7 polygraph. Beckman silver/silver chloride electrodes filled with Beckman electrolyte paste were used to detect the signals. Activity was amplified with a Grass Model 7P3 preamplifier on the integrator mode with a time constant of .087 seconds.

Frontal activity was measured from two 15 millimeter live electrodes attached 2.5 centimeters above the subject's eyes directly over the pupils while the subject gazed straight ahead; the ground was placed between the two live electrodes.

Procedures

All recording was completed in a single session, during a headache free period. Scheduling for this session was by convenience. No subject was experiencing more than a mild headache (greater than 2 on a ten-point scale). Subjects sat in a reclining chair in a room kept at constant temperature and insulated against extraneous noises. All jewelry was removed in order to reduce artifact associated with close contact to metal. Each subject was asked to describe briefly a recent event that was stressful to him/her. The skin areas associated with the electrode sites were cleaned with isopropyl alcohol-soaked pads and slightly abraded with Brasivol. Electrodes were attached while the experimenter engaged the subject in conversation designed to reduce undue anxiety. The subject was asked to sit quietly with eyes open and to relax.

A period of 10 minutes was allowed for the subject to adapt to the experimental setting. The next five minutes were designated Baseline 1. One of two stressors was then administered, the order being counterbalanced across subjects. Another five-minute baseline period was followed by the second stressor. The final segment of the session was a third five-minute baseline period. The stressors were (1) three minutes during which the subject was asked to imagine the scene described at the opening of the session and (2) tape-recorded administration of the Quiz Electrocardiogram (Schiffer, Hartley, Schulman, & Abelman, 1976). The quiz consists of 35 items of increasing difficulty. It was presented as a measure of intellectual capacity. Subjects recorded their responses on an answer sheet.

At the close of the session, subjects were asked to rate the clarity with which they were able to visualize the stressful scene. They also rated the level of stress experienced during both the quiz and the imagined scene. Ratings were on a scale of 0 to 10. The anchors for clarity were 0 = totally unclear and 10 = perfectly clear, as if I relived it just as it happened. The anchors for the quiz and the imagined scene were 0 = not at all stressful and 10 = as stressful as any I've ever experienced.

Data Reduction

Integrated EMG records were hand scored, sampling every 10 seconds. If artifact was apparent at any sampling point, the next artifact-free 10-second mark was scored. The mean score under each condition was used to represent the scores for each group.

Results

The data were organized into a split-plot design and analyzed through a 3 X 5 analysis of variance (ANOVA). The data were split into three levels of chronicity (Long Duration, Short Duration, and Control), the major hypothesis for this study. The five experimental conditions were Baseline 1, Stressor 1 (Imagined Stressor), Baseline 2, Stressor 2 (Quiz Electrocardiogram), and Baseline 3. The means for each group under each condition are shown in Table 2. The ANOVA results are illustrated in Table 3. Neither group effects nor interactions were significant. The only significant effect was for trials.

Because frequency of headache activity is the major rival hypothesis, an analysis of covariance (ANCOVA) was run with frequency of headache during the 28 days prior to psychophysiological recording used as the covariate. The results [$F(2,1) = 0.31$, $p > .10$] indicated that frequency had essentially no effect on the ANOVA results.

The only significant effect on either the ANOVA or the ANCOVA was trials. This effect was submitted to further analysis. The variance-covariance matrix was nonsymmetrical, so the Geisser-Greenhouse Conservative F test was applied. The $F(4,149) = 10.06$ had a $p < .00001$ by both the conventional and the conservative tests. The

Table 2

Mean frontal EMG scores (in microvolts)

Chronicity	n	Condition: baseline 1 M	baseline 1 SD	stressor 1 M	stressor 1 SD	baseline 2 M	baseline 2 SD	stressor 2 M	stressor 2 SD	baseline 3 M	baseline 3 SD
Long	10	8.23	4.98	12.64	6.28	10.45	7.35	13.39	7.71	12.22	5.27
Short	10	9.66	5.54	10.39	9.66	10.40	5.49	16.22	12.71	11.21	6.27
Control	10	10.51	7.95	13.23	7.36	11.05	6.97	20.31	9.19	11.24	6.45

Bonferroni *T* tests indicated that Stressor 2 (Quiz Electrocardiogram) accounted for the differences among trials. All subjects had higher mean EMG levels during this trial than during any other.

The data were submitted to several additional analyses. These were a repeated measures ANCOVA using the preceding baseline as a covariate, regression of each of the experimental conditions on chronicity, and a one-way ANOVA for between group differences in EMG levels during the quiz. None of these analyses changed the results.

Table 3

ANOVA Table

Source	Type III Sum of Squares	df	Mean Squares	F	*p*
Total Between	4881.03	29			
Chronicity (A)	107.56	2	53.78	.30	NS
Subjects Within Groups	4773.47	27	176.80		
Total Within	3527.53	120			
Trials (T)	899.01	4	224.75	10.06	$\leq$.0001
A X T	216.29	8	27.04	1.21	NS
Trials X Subjects Within Groups	2412.23	108	22.34		

One-way ANOVAs were used to test the hypotheses that EMG levels were associated with (1) how stressful the subjects found the experience they described, (2) the clarity with which they imagined the situation, (3) how stressful it was to imagine that situation, or (4) how stressful they found the quiz. The means are shown in Table 4. No significant differences were found between groups in any case.

Table 4

Mean Ratings Assigned to Experimental Conditions

Chronicity	Stressful Situation	Clarity of of Image	Imagined Stress	Quiz
Long	7.2	7.1	4.1	5.0
Short	8.1	6.9	4.3	5.2
Control	8.0	7.5	5.3	3.7

Discussion

This study was an attempt to account for at least part of the inconsistencies in EMG findings across investigations of muscle contraction headaches. It has been suggested that chronicity might be a dimension along which muscle contraction headache subjects could be divided into subgroups. Frontal EMG was chosen as the dependent variable, because it is the most frequently used measure and has been shown to discriminate between muscle contraction headache and control subjects under laboratory stress when EMG levels from other muscle groups have not (Philips, 1977a; van Boxtel & van der Ven, 1978).

Chronicity of muscle contraction headache had no effect on frontal EMG in the subjects included in this study. This was true when chronicity was defined as the number of years the individual reported having had a problem with this type of headache and when frequency of self-monitored headaches was used as a covariate. It appears that responses in the muscles of the forehead as measured by surface electrodes do not change as a result of a long history of muscle contraction headaches. If length of headache history is a dimension along which sufferers of muscle contraction headaches may be classified, membership in a particular subgroup does not predict baseline frontal EMG levels, frontal EMG response to laboratory stressors, or baseline levels following stress during a nonheadache period.

Negative results have been found in other studies using frontal EMG recordings as a dependent variable (Anderson & Franks, 1981; Andrasik, Blanchard, Arena, Saunders, & Barron, 1982b; Bakal & Kaganov, 1977; Gannon, Haynes, Safrenek, & Hamilton, 1981; Sturgis, 1981). None of the above researchers examined their data using length of headache history as an organismic variable. Therefore, the value of this study lies in its doing so in order to test the hypothesis that changes in the frontal musculature response system occur over time.

It might be argued that the short chronicity group contains some members whose headaches will diminish over time and others who will inevitably become members of a long chronicity group. That is, the short chronicity group may not be a pure group. Only a longitudinal study would determine how many of the short chronicity group will later become eligible for membership in a long chronicity group. If the inclusion of those who will confounds the results, then one would expect differences between the no headache controls and the long duration group. The differences between those groups were by chance only, suggesting it is an academic point in terms of frontal EMG. Failure to find a statistically significant difference between the long duration group and the control group strongly suggests that the definition of short duration does not matter. Furthermore, people who have been suffering from muscle contraction headaches for only a few months do not volunteer for studies in sufficient numbers to warrant limiting the short duration category to them. Again, even if the definition of short duration were a major problem, there should have been a difference between the other two groups.

The positive findings of frontal EMG differences between groups at rest (Andrasik & Holroyd, 1978; Cohen, et al., 1983; Martin & Mathews, 1978; Philips, 1977a; van Boxtel & van der Ven, 1978) and in response to laboratory stressors (Cohen, et al., 1983; Philips, 1977a; van Boxtel & van der Ven, 1978; Vaughn, Paul, & Haynes, 1977) remain interesting. The division between studies with positive and with negative results is about even; of those reviewed in this work, 6 found frontal EMG differences between groups and 6 did not. The present study failed in its attempt to clarify the situation.

Andrasik, Blanchard, Arena, Saunders, & Barron (1982b) suggested that methodological differences account for the disparities. It could be. None of the studies they reviewed met more than two of the five criteria they proposed, and those with positive findings were no more or less likely to satisfy their criteria than those with negative findings. The studies with positive findings were no more or less likely to include a particular kind of stressor in their procedures than those with negative results. Size of the groups did not predict outcome; neither did age of subjects. The placements of the electrodes were described as standard across the studies. It could be that some researchers checked electrical resistance while others did not. If the resistance was higher than the acceptable range of 10,000 ohms or less, EMG levels would represent an artifact of the instrumentation rather than the activity of the muscle group (Goldstein, 1972). Of the ten studies reported by Andrasik, et al., only four included a report of the length of the adaptation period. Bakal and Kaganov (1977) reported a 19 minute adaptation period; Gannon, Haynes, Safranek, and Hamilton (1981) reported 14.5 minutes, and Sturgis (1981) reported 5 minutes. All had negative results. Their own study employed a 14-16 minute adaptation period, and their results were negative. Martin and Mathews (1978) used a 4 minute adaptation period and obtained positive results. These data might suggest a tendency toward obtaining negative results when longer adaptation periods are employed. The study being reported in this document included a 10 minute adaptation period and would appear to provide another data point consistent with that trend. However, Cohen, et al. (1983) also employed a 10 minute adaptation period and found differences in patterns of psychophysiological responses in their subjects.

Several characteristics of the present study decrease the probability that methodological peculiarities, rather than length of headache history, account for the findings. Diagnostic agreement between a neurologist and a clinical psychology graduate student, both of whom were trained in the use of the Ad Hoc Committee on the Classification of Headache (1962) criteria was required for inclusion of headache subjects. Self-monitoring of headaches in the month previous to psychophysiological recording indicated that the headache subjects did have muscle contraction headaches as defined by the Ad Hoc Committee and that the control subjects did not. Eighteen of the 20 headache subjects reported that their headaches involved the muscles of the forehead; the two who did not were divided between chronicity groups. Frontal EMG has been shown to be a reliable measure (Arena, Blanchard, Andrasik, Cotch, & Myers, 1983; Eptein & Webster, 1975). Standard electrode placements were used, and the electrodes were checked for acceptable resistance prior to initiation of the experimental procedure. The dependent variable for each subject stabilized toward the end of the ten minute adaptation period and remained stable throughout the five minute baseline. There were no systematic differences between groups in age, subjects' ratings of the stressful event they selected to focus on during the imagery part of the experiment, or their ratings of the stress they experienced during the experiment.

The law of initial values could affect the outcome of EMG studies. One might expect more elevated EMG levels in response to stress if the baseline levels were lower in a given study. Five of the studies finding no significant differences in frontal EMG between muscle contraction headache subjects and no headache controls during baseline (Anderson & Franks, 1981; Andrasik, Blanchard, Arena, Saunders, and Barron, 1982b; Bakal & Kaganov, 1977; Gannon, Haynes, Safranek, and Hamilton, 1981) found no differences between the two groups under stress. The studies reporting differences at baseline were mixed in their findings under stress conditions. The findings of Vaughn, Paul, and Haynes (1977) and Martin and Mathews (1978) were consistent with the law of initial values; that is, the direction of the differences were reversed from baseline to stress. The differences found at baseline by Andrasik and Holroyd (1980b) and by Bakal and Kaganov (1977) disappeared under stress conditions. Philips (1977a) found differences between muscle contraction headache subjects and no headache controls both during baseline and under stress. Several of the studies cited above examined other dependent variables in addition to frontal EMG. With one exception, statistical analyses considered each measure independently of the other. Cohen, et al. (1983) employed multivariate statistics to examine patterns of psychophysiological activity. They did not report baseline levels prior to the introduction of their stressors, so we cannot say if there was any association between baseline levels and levels under stress.

The failure to find a group effect among two headache groups and a no headache control group supports the growing skepticism about the use of frontal EMG biofeedback in the treatment of muscle contraction headaches (Roberts, 1985). There have been a number of reports that some, but not all, subjects decreased headache activity following frontal EMG biofeedback training (Andrasik & Holroyd, 1980; Chesney & Shelton, 1976; Epstein & Abel, 1977; Hutchings & Reinking, 1976; Kondo & Canter, 1977; McKenzie, Ehrisman, Montgomery, & Barnes, 1974; Martin & Mathews, 1978; Philips, 1977b;

Wickramsasekera, 1973). Several studies have examined treatment failures and found that age (Diamond, Medina, Diamond-Falk, & De Veno, 1979), initial levels of frontal EMG (Epstein & Abel, 1977), or invariance in reports of high headache intensity during baseline (Blanchard, et al., 1983) were negatively correlated with improvement during biofeedback. If one's history of muscle contraction headaches is not associated with frontal EMG, then it seems highly likely that the biofeedback treatment successes of this disorder have resulted from factors other than training of that particular group of muscles.

If EMG levels do not reliably discriminate those who have muscle contraction headaches from those who do not, then what are the characteristics that are important for diagnosis and treatment? Philips (1978) proposed that muscle contraction headache be considered one type of pain phenomenon rather than as one type of headache. She and others (Bakal, 1982; Blanchard & Andrasik, 1982; Diamond & Dalessio, 1982) conceptualize muscle contraction headache as similar to chronic pain in that it probably is a multidimensional phenomenon involving not only physiological responses but also affective, cognitive, and behavioral variables. Therefore, definitions of the disorder, as well as its assessment and treatment, must take a multimodal approach, addressing each of these areas.

This disorder that affects millions remains a fascinating puzzle and is likely to be a complex one. Frontal EMG will probably continue to be a variable of interest despite the fact that, taken alone, it does not appear to be a basis for reliable discrimination among muscle contraction headache sufferers or even to separate them consistently from nonheadache subjects. It will, however, be only one among many variables. It appears that complex designs including large numbers of subjects are going to be required to solve the mystery.

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Appendix

HEADACHE INTAKE

Name:______________________________ Date:_______________

Age:___________ Date of Birth:_______________

Sex:___________ Race:___________

Address:_____________________________ Tel:(H)______________

_____________________________ (W)______________

1. Have you been to a doctor for your headaches? Yes____No____
   If yes, what was the diagnosis?_____________________________

2. Does anyone in your immediate family have headaches?
   Yes____No____
   If yes, what type of headache?______________________________

3. Have you had any of the following:

   a)eye problems _____
   b)ear problems _____
   c)dental problems _____
   d)sinus problems _____
   e)head injury _____
   d)seizures or other neurological problems_____

4. When did you first experience headache problems?
   around the age of:____________

5. Do you experience two (or more) types of head pain, distinctly different? Yes____No____

6. When do you *usually* experience your headaches?

   a)morning ____
   b)afternoon ____
   c)night ____
   d)awaken with pain ____
   e)constant pain ____

7. How long do your headaches *usually* last (in hours)? _______

8. How frequently do you experience headaches?
   (per month or per week)_________________

9. What has been the average intensity of your headaches in the past six months? What has been the worst headache you've experienced during the past six months? (on a scale from 1 to 10)

	average	worst
1. just noticeable		
3. mild		
5. strong		
8. very intense		
10. excruciating		

10. What has been the average severity of your headaches in the past six months? What has been the worst headache you've experienced during the past six months?

	average	worst
a) NO interference with my daily routine	______	_____
b) some interference with my daily routine	______	_____
c) interrupts my daily routine	______	_____
d) have to go to bed as a result	______	_____
e) have to go to doctor or emergency room as a result	______	_____

11. Does your headache begin on: a)one side of your head _____
b)both sides of your head _____

12. Is your headache: a)throbbing or pulsating _____
b)constant or aching _____

13. Does your headache begin in the back of your neck, shoulders, and head? yes____ no____

14. Can your headache be described as a feeling of tightness or external pressure on your head (bandlike or caplike)
yes____ no____

15. Are your headaches worst at the end of the day? yes____ no____

16. Are headache attacks sudden? yes____ no____

17. Is the disappearance of your head pain a) gradual ____
b) abrupt ____

18. Is there any residual soreness, after the headache subsides?
yes____ no____

19. Is your headache associated with:

a) hypersensitivity to light ____
b) hypersensitivity to noise ____
c) hypersensitivity to odors ____
d) nausea ____
e) vomiting ____
f) anorexia, diarrhea, or ____
constipation ____

20. Prior to the onset of a headache, do you experience:

a) visual changes like seeing stars, blind spots or double vision ____
b) changes in hearing such as distortion or increased volume ____
c) paresthesias, numbness, or tingling in your extremities ____
d) mood changes ____
e) changes in activity level ____

21. How long was your longest spontaneous headache free period? __________ When did it occur? __________

22. How long was your longest headache free period as a result of treatment? __________ When did it occur? __________
What type of treatment? __________

23. Are you currently taking medication for your headaches?
yes____ no____ If yes, what kind? ____________________
____
Has it affectd your headaches? yes____ no____

24. Are you taking any other medications? yes____ no____
If yes, what kind?____________________________________
Has it affected your headaches? yes____ no____

25. Have your received any other form of treatment besides medication for your headaches? yes____ no____
If yes, what type? ____________________________________

26. Do your headaches tend to be associated with:

a) stress or life changes ____
b) relaxation, weekends ____
c) menstrual cycles ____
d) exercise ____
e) weather ____
f) foods ____
g) anything else ____
If yes, what? ____________________________________

27. Have your headaches changed in recent weeks:
   a) in intensity ____
   b) in pattern ____

28. In what area(s) of your head do your headaches generally occur? (Shade in areas.)

Vita

Eleanor B. Callon was born November 3, 1936, in Marianna, Florida. She attended public schools in Jacksonville, Florida, and graduated from high school in 1954. She earned the degree Bachelor of Science in Education, with a major in secondary education and a minor in mathematics, from the University of Florida, Gainesville, in 1959. Other degrees from the University of Florida were a Master of Science in Education, 1961, with major in personnel services and a minor in psychology, and Doctor of Education, 1970, with a major in counselor education and a minor in psychology.

Dr. Callon worked in education several years, teaching at the elementary and secondary school levels and serving as a school counselor. She was on the faculty of Atlanta University, in Atlanta, Georgia, from 1968 to 1979. She served as an extern in the Psychology Service at Earl K. Long Memorial Hospital, Baton Rouge, from 1981 to 1983. Her clinical psychology internship was with the Medical University of South Carolina - Veteran's Administration Medical Center consortium, Charleston, in 1983 and 1984. She has served as a consultant to the Rehabilitation Service at the National Hansen's Disease Center, Carville. She is currently with the RehabCare Unit at Our Lady of the Lake Regional Medical Center, Baton Rouge.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Eleanor B. Callon

Major Field: Clinical Psychology

Title of Dissertation: THE EFFECT OF MUSCLE CONTRACTION HEADACHE CHRONICITY ON FRONTAL EMG

Approved:

Phillip J. Brantley
Major Professor and Chairman

William Cooper
Dean of the Graduate School

EXAMINING COMMITTEE:

Frank M. Gresham

Mary L. Kelley

Arthur J. Riopelle

Michael Mangum

William F. Waters

Date of Examination:

October 24, 1985