Psychophysiologic Therapy for Chronic Headache in Primary Care

Angele V. McGrady, Ph.D.; Frank Andrasik, Ph.D.; Terrence Davies, M.D.; Sebastian Striefel, Ph.D.; Ian Wickramasekera, Ph.D.; Steven M. Baskin, Ph.D.; Donald B. Penzien, Ph.D.; and Gretchen Tietjen, M.D.

Background: Headaches account for a high percentage of office visits to primary care physicians, with migraine and tension-type headaches the most common. This article provides a summary of psychophysiologic therapies for migraine and tension-type headache and considers psychosocial factors relevant to headache. Psychophysiologic therapy of headache consists primarily of relaxation and biofeedback.

Method: Representative controlled studies, meta-analysis, and reviews are utilized to assess the efficacy of biofeedback and relaxation for migraine and tension-type headache.

Results: Psychophysiologic therapy comprising biofeedback and relaxation can be provided in standard or limited therapist contact formulas to patients as sole therapy or concurrently with medical therapy. Effectiveness has been demonstrated for thermal biofeedback– and electromyograph biofeedback–assisted relaxation with minimal or no side effects. A typical treatment protocol is offered to exemplify the integration of psychophysiologic therapy into primary care practice.

Conclusion: Psychophysiologic therapy represents an important adjunctive treatment for chronic benign headache that can be incorporated into primary care.

(Primary Care Companion J Clin Psychiatry 1999;1:96–102)

Received May 14, 1999; accepted July 12, 1999. *From the Departments of Psychiatry (Dr. McGrady) and Medicine (Dr. Tietjen), Medical College of Ohio, Toledo; Behavioral Medicine Laboratory, University of West Florida, Pensacola (Dr. Andrasik); the Department of Family Medicine, Eastern Virginia Medical School, Norfolk (Dr. Davies); the Center for Persons With Disabilities, Utah State University, Logan (Dr. Striefel); the Saybrook Institute, San Francisco, and the Complementary Medicine Clinic, Stanford Medical School, Hercules, Calif. (Dr. Wickramasekera); the New England Institute of Behavioral Medicine, Stamford, Conn. (Dr. Baskin); and the Department of Psychiatry, University of Mississippi Medical Center, Jackson (Dr. Penzien).*

Reprint requests to: Angele V. McGrady, Ph.D., Medical College of Ohio, Department of Psychiatry, Ruppert Health Center, 3120 Glendale Ave., Toledo, OH 43614-5809.

Headache is a clinical syndrome affecting 91% of all males and 96% of all females at some time during their life.[1] Headache is the seventh leading presenting complaint in ambulatory care in the United States, accounting for about 18 million visits a year.[2] Many headache sufferers do not consult a physician and are never diagnosed or treated systematically.[3,4] For those patients who are driven by severe pain to seek care, the majority are managed in primary care, with less than 5% referred to specialists.[1] This article describes the management of chronic headache in primary care with psychophysiologic therapy.

The differential diagnosis of headache represents one of the longest lists in medicine; more than 300 headache types are identified. Although most headaches are relatively benign, for 1% to 3% of patients, the etiology is life-threatening pathology.[5] In primary care practice, the most commonly diagnosed variety of headache is tension type, with vascular headaches occurring approximately half as frequently.[6] Migraine accounts for 12% of headache presentations.[7] Gender, socioeconomic status, culture, and lifestyle influence the incidence of migraine,[8] and the prevalence of migraine increases as household income decreases.[3] Genetic or family-related environmental factors are associated with about 50% of all cases.[9]

In pediatric practice, headache is also common.[10] Bille's cross-sectional study[11] of nearly 9,000 Swedish school children found that the prevalence of common forms of headache steadily increased from ages 7 to 15. By age 15, approximately 5% of the sample experienced migraines and another 15% experienced (probably) tension-type headaches. Prevalence of migraine was similar in males and females at younger ages; after age 10, however, headache prevalence leveled off for males but continued to climb for females. A small subset of children (N = 73) who had developed migraine at about age 10 were contacted again 20 years later. Sixty percent (50% of the males and 70% of the females) were still troubled by migraines.[12] Thus, pediatric headache is highly prevalent and resilient over time.[13]

Besides providing direct care of headache patients, primary care physicians are pressured to perform a wider range of services and to make fewer referrals to special-

ists, particularly if care is provided on a capitated basis.[14] Lifestyle change recommendations, shown to be central determinants of health,[15] and brief mental health interventions increase the time pressures of an office visit. In addition, physicians are asked to collect outcome data to demonstrate the quality of the services that they provide.[16]

PSYCHOPHYSIOLOGIC THERAPY

This section summarizes the use of biofeedback and relaxation therapy for tension-type and migraine headache based on representative controlled studies, reviews, or meta-analysis. Biofeedback is a therapeutic modality in which information about a specific physiologic function is provided to patients to increase awareness and improve control of that function. Reinforcement is provided by the feedback for lowered arousal. Electromyographic (EMG) biofeedback and thermal biofeedback coupled with relaxation therapy are used for tension-type and migraine headache. EMG biofeedback facilitates decreased muscle tension and thermal biofeedback is used to train increased hand temperature. Cognitive-behavioral therapy is sometimes incorporated into psychophysiologic therapy.[17]

Tension-Type Headache

An early, small study[18] entailed a controlled comparison of 3 groups totaling 31 persons with tension-type headaches. Group 1 received EMG biofeedback and were encouraged to alter cognitive and behavioral responses to symptoms, while the second group (meditation) concentrated on increasing body awareness and developing mental control. The monitoring group (group 3) received no therapy. Group 1 evidenced a 66% reduction in number of headaches 1 month after treatment, while groups 2 and 3 showed only a 12% decrease.[18]

In a larger study,[19] 311 tension-type headache patients were assigned at random to 4 groups: relaxation therapy, transcutaneous nerve stimulation, EMG biofeedback, or 2 of the therapies combined. Outcome analysis showed that the biofeedback techniques were most effective in decreasing intensity and frequency of headache posttreatment. The addition of biofeedback to relaxation alone was highlighted in a study of 34 subjects[20] with chronic headache who were treated with relaxation therapy plus noncontingent feedback or EMG biofeedback/relaxation therapy for 8 weeks. EMG biofeedback/relaxation therapy was more effective than relaxation therapy alone.

EMG biofeedback/relaxation therapy has also been studied in a reduced therapist contact framework, where less than 6 treatment sessions are provided and home practice of relaxation is emphasized. Meta-analysis of 10 studies in which EMG biofeedback/relaxation therapy with limited therapist contact was used found a 48% decrease in headache.[21] Reducing therapist time with no loss of efficacy has important cost implications for primary care.

Two reviews are mentioned here to serve as a summary of the data on EMG biofeedback in tension-type headache. An assessment was conducted by a National Institutes of Health (NIH) panel on efficacy of behavioral and relaxation therapies in chronic pain. EMG biofeedback was found to be more effective than psychological placebo but equivalent to relaxation therapy for tension-type headache.[22] In a meta-analytic review of 78 articles with 2866 patients, cognitive therapy, relaxation therapy, or EMG biofeedback alone or combined with relaxation therapy were superior to no treatment or to pseudo placebo therapy.[23]

Maintenance of therapeutic effects after the end of formal treatment is an important consideration in recommending EMG biofeedback to patients.[20] Nine tension-type headache patients treated with EMG biofeedback/relaxation therapy were followed for 5 years after treatment using a headache index computed from a 4-week headache diary. Seventy-eight percent of the tension-type headache patients remained improved.[24] Stability of improvement in patients treated with reduced therapist contact was similar.[25]

In children, adolescents, and the elderly, investigations of biofeedback or relaxation therapy are more limited, but available data support the efficacy of various nonpharmacologic treatments in children and adolescents.[26–28] Preliminary results in the elderly are also promising,[29,30] but further research is needed to substantiate efficacy.

Migraine Headache

The NIH panel also reviewed the literature on migraine headache and found biofeedback to be better than relaxation therapy and no treatment, but the advantage of biofeedback over psychological placebo was less clear for migraine than for tension-type headache.[22] In a large study (N = 392),[19] patients were assigned to relaxation therapy, transcutaneous nerve stimulation, thermal biofeedback, or 2 therapies combined. Thermal biofeedback was most effective in decreasing headache. Clinically and statistically significant reductions in pain intensity and frequency were based on the daily headache diary kept by patients.

Biofeedback has been contrasted with medical therapy in migraine. The effects of thermal biofeedback/relaxation therapy with minimal therapist contact in 18 patients were compared to results of abortive ergotamine tartrate combined with compliance training in 19 patients.[31] Patients were diagnosed with migraine or mixed migraine and tension headache. A headache index, indicating frequency, intensity, and duration of headache, was the outcome measure. Medical therapy produced a 30% decrease in the first month and 11% more later. Biofeedback yielded a 26% reduction within the second month and 26% more at posttreatment. Furthermore, 78% of the patients in the biofeedback and 40% in the medication group decreased analgesic use by at least 50% at the posttreat-

ment assessment.[31] In another study, thermal biofeedback was compared with biofeedback combined with propranolol in a minimal therapist contact format. The combined therapy yielded a 79% improvement rate, while biofeedback alone produced a 54% decrease in headache.[32]

Data from 25 clinical trials evaluating propranolol and 35 trials evaluating thermal biofeedback/relaxation therapy in a total of 2445 subjects with migraines were integrated for meta-analysis. Controls either received placebo medication or only monitored headaches. Based on subjects' diary, 43% improvement in headache was observed in both the propranolol and biofeedback groups; based on physician/therapist assessment, 63% improvement was documented. Placebo resulted in 14% improvement, and no improvement occurred with monitoring.[33]

A controlled comparison tested the effect of thermal biofeedback (16 sessions in 8 weeks) in 116 patients divided into 4 groups: thermal biofeedback and progressive relaxation, thermal biofeedback and cognitive therapy, pseudomeditation, and monitoring only.[34] The biofeedback groups had a significantly reduced number of headaches compared with controls and maintained these improvements at 3 months. The thermal biofeedback and cognitive therapy groups also reduced their intake of medication.[34] Most of the empirical headache studies on biofeedback/relaxation therapy include patients who are taking medication. Patients participating in research studies are not required to discontinue analgesic use or other prescribed medicine in order to participate. An important conclusion from the studies of combined pharmacotherapy and psychophysiologic interventions is that biofeedback/relaxation therapy can be utilized concomitantly and successfully in medicated patients.[35]

A 12-session combination of EMG biofeedback/relaxation therapy (4 sessions) and thermal biofeedback/relaxation therapy (8 sessions) was tested in 48 patients in 2 randomized controlled studies.[36,37] Controls relaxed on their own with no instructions. Cerebral blood flow was measured with transcranial Doppler ultrasonography in both groups. A headache index and medication log were used as outcome measures. Biofeedback/relaxation therapy provided a significant advantage over self-relaxation in decreased pain and medication usage. Improvements in pain were related to decreases in cerebral blood flow velocity in the middle cerebral artery, but no changes were observed in blood flow velocity in the basilar or ophthalmic arteries.[36,37] Minimal therapist contact biofeedback/relaxation therapy treatment is also effective in migraine.[27] A meta-analysis was conducted of 9 studies in which patients received an average of 3 sessions. Headache activity decreased by an average of 51%, a similar percent improvement to that found in longer protocols.[21] Long-term follow-up studies of migraine patients treated with biofeedback/relaxation therapy suggest that improvements made during treatment are maintained.[38]

Thermal biofeedback/relaxation therapy has been studied in children, adolescents, and the elderly with migraine. In pediatric migraine, a recent meta-analysis based on effect size reflected pretreatment-to-posttreatment changes in headache activity with various pharmacologic and nonpharmacologic treatments.[39] Nonpharmacologic treatments were compared with one another, pharmacologic prophylactic approaches were compared with one another, and the 2 types of treatment were compared with each other. Outcomes for thermal biofeedback/relaxation therapy exceeded those obtained by multicomponent treatments (3 or more behavioral treatments combined), calcium-channel blockers and serotonergic agents, psychological and drug placebos, and wait-list controls. Both active medications exceeded drug placebo. Behavioral treatments of childhood migraine have been shown to be adaptable to less intensive delivery models, without any loss in effectiveness, making them more cost-effective and cost-competitive.[27,28,40] Thus, treatment approaches incorporating behavioral components can be valuable to young migraine patients; in fact, children may be particularly well suited to nonmedical approaches.[41] Research in the elderly shows promise, but more extensive investigations are necessary to document efficacy.[42]

Efforts to characterize headache patients most likely to respond to biofeedback/relaxation therapy are not prolific. Besides children, pregnant women[43] and women of childbearing potential[44] may benefit from nonpharmacologic therapy for pain control. A review of psychophysiologic headache therapy results performed in Italy suggests that the best candidates for biofeedback are young motivated patients with a brief history of headache who have not previously received extensive pharmacotherapy.[45] The presence of psychopathology in migraine patients would require additional assessment and treatment.

In summary, over 100 empirical studies are available with which to judge the efficacy of the most widely used behavioral therapies for migraine and tension-type headache. Recent meta-analyses of this literature have shown that biofeedback/relaxation therapy and stress-management training (i.e., cognitive-behavioral) therapies have yielded, on average, about a 50% reduction in headache activity from pretreatment to posttreatment.[46,47] These improvement scores have proved significantly better than those reported for wait-list control groups (which yield on average less than 5% improvement) and medication placebo groups (yielding about a 15% improvement for migraine).[46–48] Longer term studies, though less numerous, suggest that improvements are stable over time.

In 1994, the Agency for Health Care Policy and Research (AHCPR) commissioned a new meta-analysis of this literature to serve as the scientific basis for their Headache Treatment Guideline Project. This project was designed not only to update the previous meta-analyses, but

to provide a highly rigorous new analysis of the published literature. The AHCPR final report[49] considers only migraine headache and concluded that behavioral treatments have a consistent body of research supporting their efficacy. Thermal biofeedback, relaxation therapy, and cognitive-behavioral therapy were found to be at least moderately effective in alleviating migraine when compared with wait-list control (standardized effect size scores ranging from 0.6 to 1.3). For tension headache, other meta-analysis showed that EMG biofeedback, relaxation therapy, and cognitive-behavioral therapy were at least moderately effective in alleviating tension-type headache relative to wait-list controls (effect size scores from 0.7 to 1.1).[50]

PSYCHOSOCIAL FACTORS RELEVANT TO HEADACHE

In addition to the demographic variables discussed earlier,[1,3,8,9] psychosocial risk factors have been empirically associated with incidence of headache. These include affect, social support, life events, hypnotizability, and negative thinking. Trait negative affectivity refers to the predisposition to a wide range of aversive mood states, like anxiety or depression, that are stable across time, independent of objective stress,[51] and partially genetically determined.[52,53] Trait negative affectivity is elevated in chronic headache[54] and has been related to overreporting of somatic symptoms like headache pain independent of organic disease.[55–57]

Catastrophizing is marked by an overlearned and automatic conscious tendency to become cognitively absorbed in negative anticipations and negative self-statements about specific sensory events. Catastrophizing verbalizations amplify the threatening properties of even minimally aversive sensory cues[58] and similarly can maximize the experience of acute or chronic headache pain.[59–61]

Hassles, or minor but frequent stressors, are associated prospectively[62,63] and retrospectively[62,64,65] with migraine and other types of chronic headache pain. Major life events such as divorce, surgery, and deaths of close family members induce negative affect and require adjustment to change. Those events in the prior year have been modestly related to the persistence of headache.[64]

Social support is the degree of emotional help and information received from formal or informal social contacts with persons or groups.[61,66] Paradoxically, but consistent with operant conditioning theory, social support can amplify chronic pain behaviors,[67,68] but may attenuate other forms of sympathetic reactivity to stressful events.[69,70]

High hypnotizability, the ability to be hypnotized, and deep absorption in sensory or imagined experiences were correlated with a greater experience of chronic pain.[61,71–76] Healthy, highly hypnotizable college students, outside of hypnosis, were more sensitive to acute sensory pain than a matched control group.[77] A positive correlation between pretherapy migraine pain intensity and high hypnotizability has also been proposed.[78] Thus, it is important to consider not only demographic but also psychosocial factors in determining the risk for headache and choosing the most appropriate therapy.

Table 1. Biofeedback/Relaxation Program[a]

Step 1	Clinical interview and assessment Begin daily headache log
Step 2	Develop awareness of overarousal and tension Diaphragmatic breathing Presentation of progressive muscle relaxation Begin home practice with audiotapes and script
Step 3	EMG biofeedback to learn difference between relaxed and tense muscles
Step 4	Presentation of passive relaxation utilizing imagery and breathing as relaxation cues
Step 5	For tension-type headache, continue EMG feedback until patient can reliably decrease tension by about 50%; emphasize facial, neck, and shoulder relaxation For migraine headache, utilize thermal biofeedback and passive relaxation; continue until patient reliably can warm hands to 95°F
Step 6	Generalize relaxation through frequent short relaxation exercises Utilize techniques at headache onset
Step 7	Decreased frequency of sessions. Terminate.

[a]Abbreviation: EMG = electromyographic.

PROTOCOL FOR PSYCHOPHYSIOLOGIC THERAPY IN PRIMARY CARE (Table 1)

A typical program comprises between 8 and 15 sessions of biofeedback/relaxation therapy, each about 40 minutes long, the exact number determined by clinical judgment and patients' progress.[79,80] The clinical interview is performed to determine symptom history and past treatment, daily activities, lifestyle, and pain-coping strategies. The evaluation already performed by the primary care physician need not be duplicated, but can be briefly reviewed by the practitioner. Patients begin to keep a daily headache diary to record throughout treatment the frequency, intensity, and duration of headache and medication utilized. Patients maintain pharmacotherapy as prescribed by the physician, until reductions in pain have occurred. Short questionnaires are utilized to assess the psychosocial risk factors. If there are indications of overt psychopathology, particularly of depression, further in-depth assessment and treatment by a mental health professional are recommended. A psychophysiologic profile, consisting of measurements of forehead muscle tension by electromyograph and peripheral skin temperature by thermal device, is conducted under resting and stress conditions. Blood pressure and pulse rate can be retrieved from the patient's chart if these are appropriate indicators of stress. Therapeutic goals, such as learning control of

physiologic responses related to overarousal, are explained to the patient. Better control of headache is conceptualized as occurring through learning lower arousal, which translates into decreased muscle contraction and increased skin blood flow.[81] Sensors are placed on the forehead, back of neck or shoulders,[82] and index finger.

For patients of low or moderate hypnotic ability, biofeedback should be used first to induce physiologic relaxation,[83,84] while for those high in hypnotizability, verbal instruction procedures, self-hypnosis, or relaxation are most effective.[73,85,86] Later, patients' cognitions can be shaped to improve recognition of negative affect and the contributory role of negative mood to the perception of pain. Deep breathing, concentrating on relaxing self-statements, or progressive relaxation is coupled with biofeedback.[87,88] Clearly written scripts can be obtained, modified for individual patients, tape-recorded, and provided to them.[89] Patients are encouraged to practice relaxation daily with the audiotapes and scripts. The headache diary is reviewed at each session, and biofeedback data from each session are used to document and reinforce progress. Generalization is promoted by the use of short periods of relaxation throughout the day to heighten body awareness and reduce physiologic arousal when it develops. Cognitive-behavioral therapies are incorporated in therapy as necessary to improve coping, alter pain perception,[78] and reduce tendencies toward catastrophizing.[61,73,90] During the termination process, the headache log is reviewed by the physician and recommendations for adjustments in medication are transmitted to the patient. Limited therapist paradigms are appropriate for motivated patients with uncomplicated headache, without psychopathology, who do not overuse analgesics and who are generally adherent to physician recommendations.

CONCLUSION

Psychophysiologic therapy is effective for tension-type and migraine headache either as sole therapy for mild-to-moderate headache or combined with pharmacotherapy. The combined treatment is currently underutilized in primary care.[44] Biofeedback/relaxation therapy services are most likely to be used by primary care patients if they are offered within an outpatient primary care service.[73,74] Biofeedback emphasizes the physiologic aspects of patients' symptoms, later incorporating the psychological or stress-related aspects. The sensations of physiologic relaxation (heaviness and warmth) occurring in a secure medical setting facilitate acceptance of mind-body interactions. Locating psychophysiologic services within primary care instead of a psychiatric practice reduces the association of psychophysiologic therapy with mental illness and increases the probability that patients will follow through with the referral for psychophysiologic services.

Drug names: ergotamine tartrate (Ergomar and others), propranolol (Inderal and others).

REFERENCES

1. Silberstein SD, Lipton RB. Epidemiology of migraine. Neuroepidemiology 1993;12:179–194
2. Barrett EJ. Primary care for women: assessment and management of headache. Nurse Midwifery 1996;41:117–124
3. Stewart WF, Lipton RB. Migraine headache: epidemiology and health care utilization. Cephalalgia 1993;12:42–46
4. Lipton RB, Stewart WF. Migraine in the United States: a review of epidemiology and health care use. Neurology 1993;43(suppl 3):S6–S10
5. Evans RW. Diagnostic testing for the evaluation of headaches. Neurol Clin 1996;14:1–26
6. Stand PE, Von Korff M. The diagnosis of headache in primary care: factors in the agreement of clinical and standardized diagnoses. Headache 1994; 34:138–142
7. Smith R. Chronic headaches in family practice. J Am Board Fam Pract 1992;5:589–599
8. Stewart WF, Lipton RB, Celentano DD, et al. Prevalence of migraine headache in the United States: relation to age, income, race, and other sociodemographic factors. JAMA 1992;267:64–69
9. Stewart WF, Staffa J, Lipton RB, et al. Familial risk of migraine: a population-based study. Ann Neurol 1997;41:166–172
10. Andrasik F, Blake DD, McCarran MS. A biobehavioral analysis of pediatric headache. In: Krasnegor NA, Arasteh JD, Cataldo MF, eds. Child Health Behavior: A Behavioral Pediatrics Perspective. New York, NY: John Wiley & Sons; 1986:394–433
11. Bille B. Migraine in school children. Acta Ped Scand 1962;51(suppl 136): 1–151
12. Bille B. Migraine in children and its prognosis. Cephalalgia 1981;1:71–75
13. Hockaday JM, Barlow CF. Headache in children. In: Olesen J, Tfelt-Hansen P, Welch KMA, eds. The Headaches. New York, NY: Raven Press; 1993:795–808
14. Brantley PJ, Applegate BW. Training behavior therapists for primary care. Behav Ther 1998;21:74–76
15. Doing the right thing: a research plan for healthy living. Washington, DC: American Psychological Society. APS Observer April 1996:5–27
16. National Committee for Quality Assurance. Health Plan Employer Data and Information Set (HEDIS 3.0). Washington, DC; 1996
17. Schwartz M. Headache, assessment and treatment. In: Schwartz M, ed. Biofeedback. New York, NY: Guilford; 1995
18. Holroyd KA, Andrasik F, Noble J. A comparison of EMG biofeedback and a credible pseudotherapy in treating tension headache. J Behav Med 1980; 3:29–39
19. Reich BA. Noninvasive treatment of vascular and muscle contraction headache: a comparative longitudinal clinical study. Headache 1989;29: 34–41
20. Cott A, Parkinson W, Fabich M, et al. Long-term efficacy of combined relaxation: biofeedback treatments for chronic headache. Pain 1992;51: 49–56
21. Rains JC, Penzien DB, Holroyd KA. Metanalysis of alternative behavioral treatments for recurrent headache. Headache 1993;33:271–272
22. NIH Technology Assessment Panel. Integration of behavioral and relaxation approaches into the treatment of chronic pain and insomnia. JAMA 1996;276:313–318
23. Bogaard MC, ter Kuile MM. Treatment of recurrent tension headache: a meta analytic review. Clin J Pain 1994;10:174–190
24. Blanchard EB, Appelbaum KA, Guarnieri P, et al. Five year prospective follow-up on the treatment of chronic headache with biofeedback and/or relaxation. Headache 1987;27:580–583
25. Blanchard EB, Appelbaum KA, Guarnieri P, et al. Two studies of the long-term follow-up of minimal therapist contact treatments of vascular and tension headache. J Consult Clin Psychol 988;56:427–431
26. Bussone G, Grazzi L, D'Amico D, et al. Biofeedback-assisted relaxation training for young adolescents with tension-type headache: a controlled study. Cephalalgia 1998;18:463–467
27. Haddock C, Rowan AB, Andrasik F, et al. Home-based behavioral treatments for chronic benign headache: a meta-analysis of controlled trials. Cephalalgia 1997;17:113–118
28. Rowan AB, Andrasik F. Efficacy and cost-effectiveness of minimal thera-

pist contact treatments of chronic headaches: a review. Behav Ther 1996; 27:207–234
29. Kabela E, Blanchard EB, Appelbaum KA, et al. Self-regulatory treatment of headache in the elderly. Biofeedback Self Regul 1989;14:219–228
30. Arena JG, Hannah SL, Bruno GM, et al. Electromyographic biofeedback training for tension headache in the elderly: a prospective study. Biofeedback Self Regul 1991;16:379–390
31. Holroyd KA, Holm JE, Hursey KG, et al. Recurrent vascular headache home-based treatment versus abortive pharmacological treatment. J Consult Clin Psychol 1988;56:281–223
32. Holroyd KA, France JL, Cordingly GE, et al. Enhancing the effectiveness of relaxation-thermal biofeedback training with propranolol hydrochloride. J Consult Clin Psychol 1995;63:327–330
33. Holroyd K, Penzien D. Pharmacological versus non-pharmacological prophylaxis of recurrent migraine headache: a meta-analytic review of clinical trials. Pain 1990;42:1–13
34. Blanchard EB, Appelbaum KA, Radnitz CL, et al. A controlled evaluation of thermal biofeedback and thermal biofeedback combined with cognitive therapy in the treatment of vascular headache. J Consult Clin Psychol 1990;58:216–224
35. Blanchard EB, Diamond S. Psychological treatment of benign headache disorders. Prof Psychol: Res Pract 1996;6:541–547
36. McGrady A, Wauquier A, McNeil A, et al. Effect of biofeedback assisted relaxation on migraine headache and changes in cerebral blood flow velocity in the middle cerebral artery. Headache 1994;34:424–428
37. Wauquier A, McGrady A, Aloe L, et al. Changes in cerebral blood flow velocity associated with biofeedback-assisted relaxation treatment of migraine headaches are specific for the middle cerebral artery. Headache 1995;35:358–362
38. Andrasik F, Blanchard EB, Neff DF, et al. Biofeedback and relaxation training for chronic headache: a controlled comparison or booster treatments and regular contacts for long-term maintenance. J Consult Clin Psychol 1984;52:609–615
39. Hermann C, Kim M, Blanchard EB. Behavioral and prophylactic pharmacological intervention studies of pediatric migraine: an exploratory meta-analysis. Pain 1995;20:239–256
40. Andrasik F. Behavioral management of migraine. Biomed Pharmacother 1996;50:52–57
41. Attanasio V, Andrasik F, Burke EJ, et al. Clinical issues in utilizing biofeedback with children. Clin Biofeedback Health 1985;8:134–141
42. Reid GJ, McGrath PJ. Psychological treatments for migraine. Biomed Pharmacother 1996;50:58–63
43. Hickling EJ, Silverman DJ, Loos W. A nonpharmacological treatment of vascular headache during pregnancy. Headache 1990;30:407–410
44. Cady RK. Prophylactic therapy of migraine in primary care. Headache Q Curr Treatment Res 1996;(suppl 1):6–12
45. Grazzi LM, D'Amico MF, Bussone G. A review of the treatment of primary headaches, 1: migraine. Ital J Neurol Sci 1995;16:577–586
46. Blanchard EB. Psychological treatment of benign headache disorders. J Consult Clin Psychol 1992;60:537–551
47. Holroyd KA, Penzien DB. Psychosocial interventions in the management of recurrent headache disorders, I: overview and effectiveness. Behav Med 1994;20:53–63
48. Holroyd KA, Penzien DB, Cordingley GA. Propranolol in the prevention of recurrent migraine: a meta-analytic review. Headache 1991;31: 333–340
49. Goslin RE, Gray RN, McCrory DC, et al. Behavioral and Physical Treatments for Migraine Headache. Technical Review 2.2 February 1999. (Prepared for the Agency for Health Care Policy and Research under Contract No. 290-94-2025. Available from the National Technical Information Service; NTIS Accession No. 127946.)
50. McCrory DC, Penzien DB, Rains JC, et al. Efficacy of behavioral treatments for migraine and tension-type headache: meta-analysis of controlled trials [abstract]. Headache 1996;36:272
51. Watson D, Clark LA. Negative affectivity: the disposition to experience aversive emotional states. Psychol Bull 1984;96:465–490
52. Tellegen A, Lykken DT, Bouchard TJ Jr, et al. Personality similarity in twins reared apart and together. J Pers Soc Psychol 1988;54:1031–1039
53. Lesch KP, Bengel D, Heils A, et al. Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. Science 1996;274:1527–1532
54. Blanchard EB, Andrasik F. Management of Chronic Headache: A Psychological Approach. Elmsford, NY: Pergamon Press; 1985
55. Cohen S, Gwaltney JM Jr, Doyle WJ, et al. State and trait negative affect as predictors of objective and subjective symptoms of respiratory viral infections. J Pers Soc Psychol 1995;68:159–169
56. Costa PT Jr, McCrae RR. Hypochondriasis, neuroticism, and aging: when are somatic complaints unfounded? Am Psychol 1985;40:19–28
57. Watson D, Pennebaker JW. Health complaints, stress, and distress: exploring the central role of negative affectivity. Psychol Rev 1989;96:234–254
58. Spanos NP, Perlini AH, Robertson LA. Hypnosis, suggestion, and placebo in the reduction of experimental pain. J Abnorm Psychol 1989;98:285–293
59. Jensen MP, Turner JA, Romano JM, et al. Coping with chronic pain: a critical review of the literature. Pain 1991;47:249–283
60. Keefe FJ, Crisson J, Urban BJ, et al. Analyzing chronic low back pain: the relative contribution of pain coping strategies. Pain 1990;40:293–301
61. Wickramasekera I. Somatization: concepts, data and predictions from the high risk model of threat perception. J Nerv Ment Dis 1995;183:15–23
62. Kohler T, Haimerl C. Daily stress as a trigger of migraine attacks: results of thirteen single-subject studies. J Consult Clin Psychol 1990;58: 870–872
63. Levor RM, Cohen MJ, Naliboff BD, et al. Psychosocial precursors and correlates of migraine headache. J Consult Clin Psychol 1986;54:347–353
64. DeBenedittis G, Lorenzetti A. The role of stressful life in the persistence of primary headache: major events vs. daily hassles. Pain 1992;51:35–42
65. Sternbach RA. Pain and "hassles" in the United States: findings of the Nuprin pain report. Pain 1986;27:69–80
66. House JS, Landis KR, Umberson D. Social relationships and health. Science 1988;241:540–545
67. Paulsen JS, Altmaier EM. The effects of perceived versus enacted social support on the discriminative cue function of spouses for pain behaviors. Pain 1995;60:103–110
68. Gil KM, Keefe FJ, Crisson JE, et al. Social support and pain behavior. Pain 1987;29:209–217
69. Kamarck TW, Manuck SB, Jennings JR. Social support reduces cardiovascular reactivity to psychological challenge: a laboratory model. Psychosom Med 1990;52:42–58
70. Lepore SJ, Mata KA, Evans GW. Social support lowers cardiovascular reactivity to an acute stressor. Psychosom Med 1993;55:518–524
71. Remler H. Hypnotic susceptibility, suggestion and compliance with treatment in patients with chronic pain [dissertation]. Norfolk, Va: Virginia Consortium for Professional Psychology; 1990
72. Stam H, McGrath P, Brooke R, et al. Hypnotizability and the treatment of chronic facial pain. Int J Clin Exp Hypn 1986;34:182–191
73. Wickramasekera I. A model of the patient at high risk for chronic stress related disorders: do beliefs have biological consequences? In: Proceedings of the Annual Convention of the Biofeedback Society of America; San Diego, Calif; 1979
74. Wickramasekera I. Clinical Behavioral Medicine: Some Concepts and Procedures. New York, NY: Plenum; 1988
75. Wickramasekera I. Assessment and treatment of somatization disorders: the high risk model of threat perception. In: Handbook of Clinical Hypnosis. Washington, DC: American Psychological Association; 1993:587–621
76. Wickramasekera I. Secrets kept from the mind but not the body or behavior: the unsolved problems of identifying and treating somatization and psychophysiological disease. Adv Mind-Body Med 1998;14:81–98
77. Debenedittis G, Paneral AA, Villamirqa MA. Effects of hypnotic analgesia and hypnotizability on experimental ischemic pain. Int J Clin Exp Hypn 1989;37:55–69
78. Andreychuk T, Skriver C. Hypnosis and biofeedback in the treatment of migraine headaches. Int J Clin Exp Hypn 1975;13:172–183
79. Penzien DB, Holroyd KA. Psychosocial interventions in the management of recurrent headache disorders, 2: description of treatment techniques. Behav Med 1994;20:64–73
80. Rapoport AR, Sheftell FD. Headache Disorders: A Management Guide for Practitioners. Philadelphia, Pa: WB Saunders; 1996
81. Compas BE, Haaga DA, Keefe FJ, et al. Sampling of empirically supported psychological treatments from health psychology: smoking, chronic pain, cancer and bulimia nervosa. J Consult Clin Psychol 1998;66: 89–112
82. Arena JG, Bruno GM, Hannah SL, et al. A comparison of frontal electromyographic biofeedback training, trapezius electromyographic biofeedback training and progressive muscle relaxation therapy in the treatment of tension headache. Headache 1995;35:411–419
83. Zillmer EA, Wickramasekera I. Biofeedback and hypnotizability: initial treatment considerations. Clin Biofeedback Health 1987;10:51–57

84. Wickramasekera I. On attempts to modify hypnotic susceptibility: some psychophysiological procedures and promising directions. Ann N Y Acad Sci 1977;296:143–153
85. Qualls PJ, Sheehan PW. Electromyograph biofeedback as a relaxation technique: a critical appraisal and reassessment. Psychol Bull 1981;90:21–42
86. Wickramasekera I. Biofeedback, Behavior Therapy and Hypnosis: Potentiating the Verbal Control of Behavior for Clinicians. Chicago, Ill: Nelson Hall; 1976
87. Bernstein DA, Borkovec TD. Progressive Relaxation Training: A Manual for the Helping Professionals. Urbana, Ill: Research Press; l973
88. Luthe W. Autogenic Therapy, vols 1–6. New York, NY: Grune & Stratton; 1969
89. Davis M, Robbins EE, McKay M. The Relaxation and Stress Reduction Workbook. 4th ed. Oakland, Calif: New Harbinger Publications; 1996
90. Spinhoven P, Linssen ACG. Behavioral treatment of chronic low back pain, I: relation of coping strategy use to outcome. Pain 1991;5:29–34