EMG Assisted Migraine Therapy

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Abstract-- In this term paper, I am going to discuss in detail the various parameters related to EMG migraine therapy. The various techniques used to deal with the migraine such as EMG biofeedback. Biofeedback is a means for gaining control of your body processes to increase relaxation, relieve pain, and develop healthier, more comfortable life patterns. Essentially, biofeedback equipment allows an individual to monitor their body's automatic activities, particularly their reactivity to stress. The idea behind biofeedback is that once an individual learns how to monitor their body's reactions, they can learn how to alter them. For example, the individual can consciously learn how to monitor and change their heart rate and skin temperature. There are many different types of biofeedback EMG biofeedback provides information regarding muscle tension, whereas thermal biofeedback (referred to as temperature biofeedback and handwarming biofeedback, interchangeably) and blood flow biofeedback both provide information regarding blood flow.

Introduction
Migraine is a basic chronic neurological disorder characterized by recurrent moderate to severe headaches often in association with a number of autonomic nervous system symptoms. The word derives from the Greek (hemikrania), "pain on one side of the head. Typically the headache affects one half of the head, is pulsating in nature, and lasts from 2 to 72 hours. Associated symptoms may include nausea, vomiting, and sensitivity to light, sound, or smell. The pain is generally made worse by physical activity. Up to one-third of people with migraine headaches perceive an aura: a transient visual, sensory, language, or motor disturbance which signals that the headache will soon occur. Headache is common in children and adolescents, such that by the age of 15, at least 75% of all juveniles have experienced at least one headache episode.

As with headaches in adults, pharmacological treatments tend to predominate. However, the empirical data to support the efficacy of medication with pediatric headache are sparse and limited mostly to migraine headache. Furthermore, medications which are used as prophylactic agents, such as calcium channel blockers, tricyclic anti-depressants, beta-blockers, or benzodiazepines, can have side effects which are often unpleasant and may even be dangerous in young people because the long-term effects on development are largely unknown. Thus, there is a clear need for other treatment options.

There are two main theories which explain the cause of migraine pain. The more prevalent theory is the vascular or blood flow explanation arteries within the head constrict (vasoconstriction), decreasing blood flow to some brain cells, which therefore affects sight and motor sensations. At the end of vasoconstriction the arteries dilate (vasodilation), creating a situation wherein the vessels press on the adjacent nerves, causing the intense pain of the migraine. A second, neurological theory, suggests that migraines are caused by changes in chemicals in the brain which engender changes in the vascular system. 80% of migraine sufferers have a family history of migraines, and women are three times more likely to suffer from migraines than men. This data implies that a genetic component or a predisposition for migraines may exist, and more research needs to be done to determine the concrete cause(s) of this condition. There are still many unanswered questions regarding the causes of migraines.
Methodology

Biofeedback
There are automatic functions in our body that occur outside of our conscious awareness. Biofeedback is a means for gaining control of your body processes to increase relaxation, relieve pain, and develop healthier, more comfortable life patterns. Essentially, biofeedback equipment allows an individual to monitor their body’s automatic activities, particularly their reactivity to stress. The idea behind biofeedback is that once an individual learns how to monitor their body’s reactions, they can learn how to alter them. For example, the individual can consciously learn how to monitor and change their heart rate and skin temperature. For individuals with migraines, biofeedback relates back to the vascular theory of the causes of migraines. The rationale behind biofeedback as a treatment for migraines is embedded in the vascular theory; that migraines are a result of the processes of vasoconstriction and vasodilation mentioned earlier.

Types
There are many different types of biofeedback. EMG biofeedback provides information regarding muscle tension, whereas thermal biofeedback (referred to as temperature biofeedback and handwarming biofeedback, interchangeably) and blood flow biofeedback both provide information regarding blood flow.

EMG Biofeedback therapy for migraine
A Satem biofeedback instrument was used for treatment and psychophysiological monitoring. After proper skin preparation, three circular metal-Alpaca reusable cup-type electrodes were applied to the forehead (the reference electrode was centered over the bridge of the nose, while the active electrodes were centered directly over each eye) and secured with paper tape. The raw signal was rectified and averaged using a 100 ms time constant. The bandpass was set to 100-1000 Hz. An IBM computer recorded and processed the information. The computer interface sampling rate was 20 S/s; the signal was averaged by the computer over 10-see intervals, with EMG values being recorded every second. The threshold of the auditory signal feedback to the patient was adjusted by the operator from session to session depending on the level of muscular tension. The operator’s task was to shape successively lower thresholds; the subject’s task was to go below threshold and turn off the auditory signal completely. With this procedure, subjects learned to reduce their muscle tension progressively. The therapist was instructed to adopt an encouraging attitude initially, but gradually to lessen involvement with subjects’ relaxation exercises. The patients were asked to rest with eyes closed during the sessions.

Fig.1

Types of Biofeedback

EMG Biofeedback

Thermal Biofeedback

Blood flow Biofeedback

Fig.1
Procedure

Patients were randomly assigned to one of two experimental conditions, BFB/REL or relaxation-placebo (REL/PLAC), with the constraint that subjects be over-sampled in BFB-REL treatment (2: 1 ratio) in order to make actual treatment available to as many children as possible.

BFB/REL patient attended two sessions per week, for a total of 10 sessions, with at least 2 days intervening between any consecutive sessions. Patients were seated in comfortable recliners and were encouraged to close their eyes to enhance relaxation effects. The first four sessions were devoted to progressive muscle relaxation training, adapted from the approach of Bernstein and Borkovec, which focused primarily on relaxation exercises for eight muscle groups (lower arms, upper arms, legs, abdomen, chest, shoulders, eyes, and forehead). Each relaxation session lasted approximately 20 min. EMG BFB was introduced at the fifth session and this treatment remained the focus for the remaining sessions (6 in all). Each BFB session lasted 21 min and consisted of the following: 7 min baseline (for the purpose of setting the auditory signal threshold), 7 min of auditory feedback, and 7 min of self-control (feedback signal turned off, while subject was instructed to continue attempting to relax).

REL-PLAC. Patients in this control condition also embarked on a lo-session program (2 visits per week for 5 weeks total). Although EMG activity was recorded throughout, no feedback was provided. Subjects were merely instructed to remain calm and attempt to become more and more relaxed, by whatever means possible. This condition was designed to control for attention, expectations for improvement, and effects from sitting quietly for an extended period.

Clinical Outcome

mean percentage improvement for each follow-up interval. In order to provide the most sensitive statistical test possible, these values were subjected to a 2 (group: treatment vs control) x 4 (trials: 1-, 3-, 6, and 12-month follow-up) ANCOVA, wherein baseline values served as the covariate.

![Graph showing mean Pain Total Index scores (covariate adjusted) for BFB-REL (••••) and REL-PLAC (---) during follow-up.](image)
This analysis revealed a significant effect for group only (F(1,25) = 4.68, p = 0.04). Follow-up contrasts, comparing the two groups at each follow-up assessment, revealed statistically significant differences at 6 months (F(1,15) = 7.86, p = 0.01) and 12 months (F(1,25) = 6.79, p = 0.02). Thus, effects became more pronounced over time. These findings are depicted in Fig. 1, wherein the PTI values have been adjusted for the covariate. Mean values for State and Trait anxiety scores are presented in Table 2. Separate ANCOVAs, of the form indicated above, revealed the following. No significant effects occurred for any factor for State anxiety. The ANCOVA for Trait anxiety revealed a significant effect for follow-up period only (F(3,72) = 2.99, p = 0.04). Inspection of the mean values reported in Table 2 suggests that although the changes over time were statistically significant they are not of great clinical importance. Clinical outcome Psycho physiological measure

**Lifestyle changes**

1. Adequate fluid hydration, with limited use of caffeine
2. Regular exercise
3. Adequate nutrition through regular meals and a balanced diet
4. Adequate sleep
5. The patient and parents must understand that these objectives are lifetime goals that can control the effect of migraines and minimize the use of medication.
6. Lifestyle changes may result in an overall long-term improvement in quality of life and may reverse any progressive nature of the disease.
7. Maintain consistent biological rhythms
8. Reduce anxiety and depression
9. Recognize triggers
10. Locus of control/self-efficacy
11. Functional capacity/disability

**Follow up**

Important to assess regularly the morbidity of headaches and effectiveness of treatment

Regular measurement of both disability and quality of life are helpful in assessing treatment strategies and improvement in outcomes.

**Disability**

Pediatric Migraine Disability Assessment (PedMIDAS) uses a patient-based disability scale.

**Quality of Life**

Pediatric Quality of Life Inventory version 4.0 (PedsQL 4.0) uses both parent and child input. Evaluates functioning in health, emotional, social, and school domains

Headaches have been found to substantially affect emotional development and school functioning.

![Figure 3](image)

**Transformed Migraine Sufferer**
Conclusion

Biofeedback as Self-Regulation
Enhances internal locus of control

Learn a non-specific “low arousal” physiologic response and use as a coping skill

Encourage generalization to the natural environment
Integrate into “action plans” to better manage exacerbations of pain or fear

Non-threatening environment to begin to explore psychological issues

Biofeedback Program
Step 1. Clinical interview and assessment
Patient begins headache diary

Step 2. Teach body awareness of tension and overarousal
Introduce diaphragmatic breathing
Make progressive relaxation tape while EMG is monitored

Step 3. Use EMG biofeedback to discriminate between relaxed and tense muscles of the body

Step 4. Introduce passive relaxation using imagery and breathing as relaxation cues for the ease

Step 5. Continue EMG training until patient can reliably decrease muscle tension by approximately 50%
Emphasize scalp, facial, neck, and shoulder relaxation

Step 6. For migraine sufferers, use passive and autogenic training with thermal biofeedback
Goal is to increase finger temperature to 95 F, or 1 F per minute

Step 7. Conduct frequent short generalization exercises
Identify prodromal signs and use techniques early

Bibliography
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