



## **PRACTICE PARAMETER: THE ELECTROENCEPHALOGRAM IN THE EVALUATION OF HEADACHE**

### **(Summary Statement)**

Report of the Quality Standards Subcommittee of the American Academy of Neurology

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**Overview.** The Quality Standards Subcommittee (QSS) of the American Academy of Neurology (AAN) develops practice parameters for neurologists to use in evaluating clinical disorders, particularly with regard to selecting diagnostic procedures and treatment. In choosing topics for practice parameters, the QSS considers several factors--prevalence of disease, frequency of procedures, costs, membership requests, controversy, urgency, external constraints, and others. AAN members requested a practice parameter on the use of the electroencephalogram (EEG) in the evaluation of patients with headache.

**Justification.** Practice variations have created the need for development and use of practice parameters. The neurologist has long been a resource for patients with headache by excluding serious underlying causes, confirming a correct diagnosis, and planning an effective management strategy. If the EEG is used for patients with headache in some geographic areas or clinical settings and not in others, patient outcome from the use of this test and how it relates to the neurologist's role in headache management must be explored.

**Description of the process.** We performed a MEDLINE search for articles published between 1966 and 1994 using the key words "electroencephalography" and "headache." Search terms were exploded as appropriate. We also performed text word searches using these terms. Additionally, we did a secondary search of the bibliographies of these articles to identify articles published before 1966. Using this strategy, we found 90 articles in which authors discussed the EEG and headache diagnosis or management. After excluding case reports, case series of subjects selected because of abnormal EEGs, abstracts with insufficient information for analysis, and reviews without original data, 40 articles remained. We reviewed these articles in their entirety.<sup>1</sup>

*Literature classification criteria.* In general terms, a test may be considered clinically more useful than competing modalities if it effectively (ie, with adequate sensitivity and/or specificity) or efficiently (ie, with acceptable risk and cost) separates patients into distinct diagnostic groups or provides prognostic or therapeutic information. We compared the literature on EEG in headache patients against the following generally accepted criteria for determining the clinical usefulness of a diagnostic test:

1. A comparison of the test with accepted *independent diagnostic criteria* (ie, a "gold standard"). Potential diagnostic criteria against which to compare the EEG in headache patients include clinical criteria for the diagnosis of headache disorders, the state of the patient after follow-up, and the results of head-imaging studies.
2. A comparison that includes normal *matched controls*, patients with a spectrum of disease (eg, mild to severe), and individuals with commonly confused disorders. Ideally, the EEG studies should include normal subjects without headache, patients with different headache subtypes (eg, migraine with aura, migraine without aura, tension headaches), and individuals with structural cause of headache.
3. A *description of the setting* in which the comparison is done, so that a judgment of potential biases can be made.
4. A *blinded* interpretation of the EEG as well as a measure of the reproducibility and observer variation of the test. Disagreement between EEG interpreters is common.

5. A sensible *definition of normal* as applied to the test. Many EEG findings formerly thought to be abnormal have subsequently been shown to be normal variants.
6. A *description of the techniques* that permits exact replication. Standard techniques for performing an EEG, including the number of channels and recording electrodes, accepted montages, and computer interpretation, have changed.

**Results. Summary.** Headache disorders are clinical syndromes defined by historical criteria. The EEG is not included in the diagnostic criteria of the International Headache Society for migraine or other major headache categories. The majority of headache sufferers do not have an identifiable structural lesion that explains their pain. An EEG could be considered useful in the evaluation of headache if abnormalities were observed that (1) separate persons with and without headache, potentially shedding light on the underlying pathophysiology of headaches; (2) define subgroups associated with different natural histories or responses to therapy; or (3) effectively identify patients with a definable structural etiology.

The articles reviewed ranged in publication date from 1941 to 1994. One article met all six of the literature criteria described in the preceding section, three articles met five criteria, 11 met four, nine met three, seven met two, seven met one, and two met none.

Many of these studies have major flaws, including (1) biases such as referral bias (not population-based) or verification bias (selecting controls after a normal EEG); (2) poorly controlled (most studies were uncontrolled or, when controlled, were not age-/sex- matched); (3) not blinded; (4) high observer variability (similar abnormality rates, different abnormalities); and (5) archaic criteria for normalcy (patterns originally considered abnormal subsequently described in normal subjects, eg, posterior slow waves of youth). In addition, the EEG had different rates of abnormality in headache subtypes but was not helpful in distinguishing them. Authors could not relate EEG findings to headache severity or response to proposed treatment. These studies fail to show an association of EEG with a malignant cause for headache, different response to treatment, or difference in prognosis.

Is there an increased prevalence of EEG abnormalities in headache patients? Studies designed to determine whether headache patients have an increased prevalence of EEG abnormalities report conflicting results. The only well-matched controlled studies to address this question either found that there was no increased prevalence of EEG abnormalities in patients with headache or found that there was a prominent photic driving response.

Prominent photic driving at high flash frequencies (H-response) in migraine patients is the most consistently reported difference between headache patients and controls. All the studies describing the photic driving response used specialized EEG techniques, including wave analyzers and spectral analysis. The reported sensitivity of the H-response varied from 26% to 100%, and the specificity from 80% to 91%. Although the relatively high sensitivities and specificities reported suggest that the H-response may be effective at distinguishing migraine patients from controls, and possibly migraineurs from tension headache sufferers, it is important to recall that in all these studies the H-response was compared with established clinical criteria. One cannot conclude from any of these studies that the H-response, or any other EEG abnormality, is more effective or efficient than the neurologic history and neurologic examination at determining whether a patient has headaches. Thus, although the presence of the H-response may have interesting implications for the underlying pathogenesis of migraine, it adds nothing to the diagnostic evaluation of the headache patient.

Does the EEG define headache subgroups? A few of the studies attempted to define headache subgroups based on the EEG. Some only identified findings that by modern criteria would be considered normal, while others failed to provide convincing evidence that EEG can discern headache type.

Migraine and epilepsy may coexist in some patients. Postictal headache in patients with epilepsy may have many of the same clinical features as idiopathic migraine headaches. Most patients with epilepsy and headache do not present a diagnostic dilemma. In patients presenting with headache in whom atypical

associated symptomatology makes a seizure disorder reasonably probable, epileptiform activity on an EEG would significantly raise the probability of epilepsy. Even though little information is available, it is reasonable to assume that some of the symptoms that increase the probability of a seizure disorder are *atypical* migrainous aura and episodic loss of consciousness.

Does the EEG identify patients whose headaches have a structural cause? The paucity of literature that addresses this question suggests that the EEG does not effectively identify headache patients with underlying structural lesions and should not be considered an effective screen for a malignant headache etiology. The sensitivity of EEG is considerably less than that of head CT or MRI in identifying patients with brain tumors. Assuming the availability of CT or MRI, there is little justification for the use of EEG when an intracranial structural lesion is suspected.

*Conclusion.* No study has consistently demonstrated that the EEG improves diagnostic accuracy for the headache sufferer. The EEG has not been convincingly shown to identify headache subtypes, nor has it been shown to be an effective screening tool for structural causes of headache.

**Recommendation.** We therefore recommend the following:

The EEG is not useful in the routine evaluation of patients with headache (*guideline*). This does not exclude the use of EEG to evaluate headache patients with associated symptoms suggesting a seizure disorder, such as atypical migrainous aura or episodic loss of consciousness. Assuming head-imaging capabilities are readily available, EEG is not recommended to exclude a structural cause for headache (*option*).

**Future research.** Numerous interesting and potentially fruitful areas of research on the EEG in the setting of chronic headache remain. Studies comparing the effectiveness of EEG with that of head imaging in screening for intracranial pathology in patients with headache, taking cost and patient preferences into account, would be worthwhile. Additionally, studies designed to determine whether specific EEG characteristics, such as prominent photic driving, identify subsets of headache patients with distinctive responses to therapy would be useful.

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The following professional associations reviewed and commented on this practice parameter: American Association for the Study of Headache, American EEG Society, American Medical EEG Association, American Academy of Family Physicians, American College of Physicians, and American Society of Internal Medicine.

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**Note.** This statement is provided as an educational service of the American Academy of Neurology. It is based on an assessment of current scientific and clinical information. It is not intended to include all possible proper methods of care for a particular neurologic problem or all legitimate criteria for choosing to use a specific procedure. Neither is it intended to exclude any reasonable alternative methodologies. The AAN recognizes

that specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on all of the circumstances involved.

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#### Definitions for classification of evidence

**Class I.** Evidence provided by one or more well-designed randomized controlled clinical trials, including overviews (meta-analyses) of such trials.

**Class II.** Evidence provided by one or more well-designed clinical studies such as case-control studies, cohort studies, and so forth.

**Class III.** Evidence provided by expert opinion, nonrandomized historical controls, or one or more case reports.

#### Definitions for strength of recommendations

**Standards.** Generally accepted principles for patient management that reflect a high degree of clinical certainty (ie, based on class I evidence or, when circumstances preclude randomized clinical trials, overwhelming evidence from class II studies that directly addresses the question at hand or from decision analysis that directly addresses all the issues).

**Guidelines.** Recommendations for patient management that may identify a particular strategy or range of management strategies and that reflect moderate clinical certainty (ie, based on class II evidence that directly addresses the issue, decision analysis that directly addresses the issue, or strong consensus of class III evidence).

**Practice options or advisories.** Other strategies for patient management for which the clinical utility is uncertain (ie, based on inconclusive or conflicting evidence or opinion).

**Practice parameters.** Results, in the form of one or more specific recommendations, from a scientifically based analysis of a specific clinical problem.

#### Reference

1. Gronseth GS, Greenberg MK. The utility of the electroencephalogram in the evaluation of patients presenting with headache: a review of the literature. *Neurology* 1995; 45:1263-1267.

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