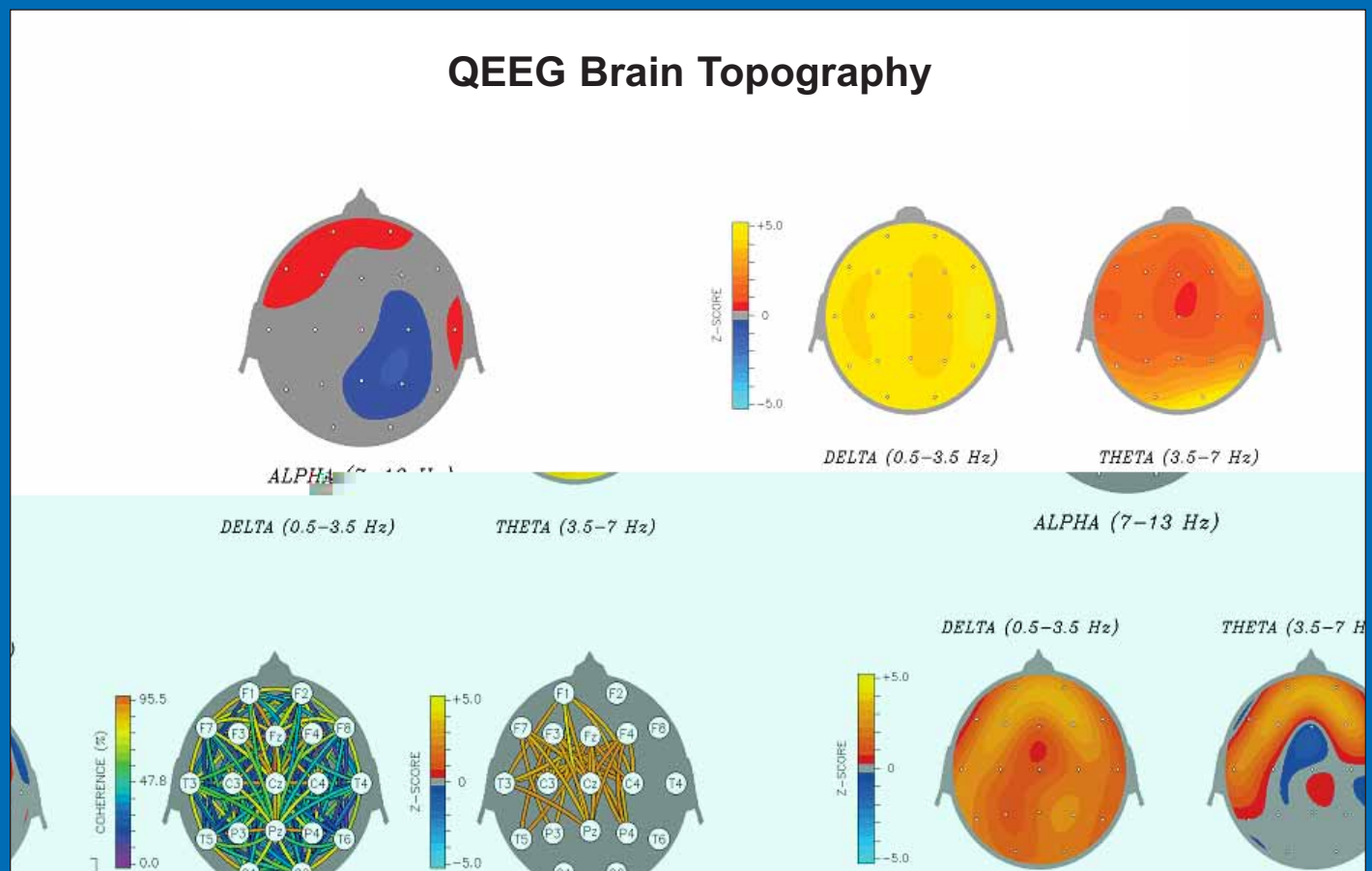


# QEEG Testing Can Discern Reason for Cognitive Disorder: Digital EEG Recordings of Brainwaves Can Determine TBI Etiology

By Gerald Tramontano Ph.D.



Brain mapping works by allowing a neuropsychologist to compare diagnostic and normal databases. Are the QEEG parameters, such as frequency, amplitude, coherence, and morphology, consistent with a traumatic brain injury? Or, are they consistent with a preexisting condition like lupus, dementia, attention deficit disorder, or schizophrenia? We can determine with a high probability—more than 95 percent—whether the disorder is due to one or the other.

**A** young woman was referred to us by her attorney, who wanted to prove that his client's dysexecutive syndrome—a cognitive disorder marked by a limited ability to problem solve, retrieve, and organize information, which impaired her ability to function both at work and home—was the result of the mild traumatic brain injury (TBI) she suffered in a car accident.

The attorney, a savvy litigator, knew that opposing counsel would readily accept the findings of earlier neuropsychological testing that revealed a brain disorder, i.e., cortical pathology. However, he was convinced that his adversary would challenge whether or not the auto accident was the cause, contending that the woman's confusion was just as likely to be the result of her ongoing battle with systemic lupus erythematosus (SLE) as the head trauma she ostensibly received in the auto accident.

This is exactly where the use of an effective but underemployed test called QEEG, or Quantitative EEG (also known as brain mapping), becomes critical. While hardly a new modality—the observation of electrical signals from the brain first occurred in the mid-nineteenth century and the electroencephalograph (EEG) dates back to the 1920s—it was the advent of digital computers in the late 1960s and early 1970s that first gave experts the ability to detect the subtle and unique patterns in the brainwaves associated with different psychiatric and neurological conditions for the purposes of both treatment and diagnosis.

QEEG is an extremely sensitive measure of the physiological changes of the brain. According to the American Academy of Neurology, it is defined as the “mathematical processing of digitally recorded EEG in order to highlight specific waveform components, transform the EEG into a format or domain that elucidates relevant information, or associate numerical results with the EEG data for subsequent review or comparison.” Studies have shown that the very earliest changes associated with Alzheimer's dementia, such as retention and naming deficits, will correlate with a specific QEEG profile unique to the brain pathology due to a dementia of the Alzheimer's type. This is the kind of sensitivity that can help differentiate among neurological dis-

orders such as Alzheimer's disease, lupus, a head injury, or multiple sclerosis.

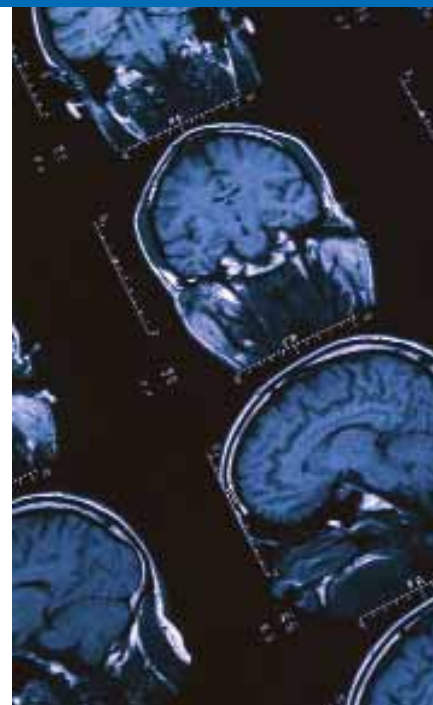
QEEG provides a digital reading from the scalp based on electrical patterns of the cortex, which measures cortical electrical activity or brainwaves. It can help determine whether a cognitive injury is due to trauma or some preexisting neurological or psychiatric illness by taking the EEG information and transforming every little wave and wiggle through a computer program into binary numbers or metrics. These are then run through databases to see what the probability of the overlap is with patients suffering from a specific disorder.

Though easy-to-use, non-invasive, affordable, and hardly an obscure test (with plenty of available literature), QEEG is probably not widely used in forensics for the simple reason that it is not found in every brain injury clinic or neuropsychology practice. In fact, I first came across QEEG quite accidentally ten or twelve years ago while directing the brain injury program at Kessler Rehabilitation Center, a renowned brain injury center that did not offer this kind of testing at the time. We needed to explore baseline metrics for an intervention called “neurofeedback” and, through my research, learned of the benefits of QEEG.

The test is reimbursed by virtually all major insurance companies as part of a comprehensive central nervous system assessment. Clients can be referred by their attorney for a QEEG workup as part of a neuropsychology evaluation. Note that even without insurance coverage the cost of the testing is quite reasonable, on average \$450.

QEEG is admissible in court by virtue of the Daubert criteria of the scientific method, which replaced the Frye standards of “general acceptance” in establishing the standards for admissibility of evidence in federal court in a 1993 Supreme Court decision. Since 1923, the Frye test had held that expert testimony that is based upon a scientific testimony is inadmissible unless the technique is “generally accepted in the scientific community.”

The Daubert guidelines for scientific validity are 1) hypothesis testing, 2) estimates of error rates, 3) peer-reviewed publication, and 4) general acceptability in the scientific community. The peer-reviewed literature of Quantitative EEG meets all of the Daubert standards of scientific knowledge.



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Furthermore, the science and technical aspects of QEEG in measuring the effects of neurological and psychiatric dysfunction also match the Supreme Court standards of “technical” and “other specialized” knowledge. Finally, it has been shown that QEEG scientific knowledge and “technical” and “other specialized” knowledge meet the standards of Supreme Court rulings in support of QEEG's admissibility as a clinically valid method in the evaluation of the nature and extent of neurological and psychiatric disorders.

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tion like lupus, dementia, attention deficit disorder, or schizophrenia? We can determine with a high probability—more than 95 percent—whether the disorder is due to one or the other.

## Neuropsychological Testing: A Prerequisite for QEEG

In my opinion, a QEEG is to be used as part of a comprehensive neuropsychological assessment. Neuropsychological testing assesses cortical functions largely through computerized and paper-and-pencil tests of various cognitive functions. Although there is overlap with traditional neurological and psychiatric exams, neuropsychological examinations are much more sensitive to cortical pathology, even when there is little if any cognitive impairment or memory loss. For instance, neuropsychological testing may reveal extensive personality, interpersonal, and behavioral changes that are consistent with an injury to certain brain structures or systems, such as the orbital frontal structures of the brain. In fact, this is the part of the brain most responsible for controlling emotion and social functioning, an area where virtually no cognitive networks exist. Since cognition often remains intact, it cannot be diagnosed by traditional cognitive tests.

Attorneys need to be aware that the victim of a mild TBI may suffer not only from cognitive disorders, such as dysexecutive syndrome or memory loss, but also from non-cognitive disorders like “Organic Personality Syndrome,” (OPS) which, simply put, means that they don’t regulate their emotions or interpersonal world well or make appropriate social judgments like they did before their injury. Depending on the extent of brain damage, OPS can occur with or without cognitive dysfunction. The typical OPS patient post-injury usually experiences a loss or decreased sense of smell, impulsivity, low frustration tolerance, mood swings, and sometimes attention deficits.

In the case of the young woman mentioned above, the results of her neuropsychological testing were consistent with a probable mild TBI from a motor vehicle accident manifesting as a moderate to severe dysexecutive syndrome. However, as previously indicated, she also suffers from SLE. Patients with this condition can present with a dysexecutive syndrome even without any past history of acute encephalopathy from lupus. The question in her case was whether the dysexecutive syndrome was due to the accident, the preexisting condition, or both.

## The QEEG Test

In this woman’s case, neuropsychological testing had been positive, showing a cognitive disorder. We then administered a QEEG, which takes no more than sixty minutes and involves the patient putting on what looks like a bathing cap with electrodes. We recorded the patient’s brain activity with her eyes open and closed and conducted various cognitive-challenging tasks that provided additional information. The computer compared her abnormal activity against databases for different clinical populations. We determined that the probability that the abnormality had been caused or at least significantly exacerbated by a TBI, rather than lupus, to be 99 percent. This made for a very compelling piece of evidence.

Hospitals and clinics offering QEEG testing can be found online. Finding expert witnesses schooled in QEEG will be more difficult.

Documentation of the reliability of

QEEG testing is critical in any evidentiary hearing regarding its admissibility. Plaintiff or defense attorney should ask that expert witnesses produce documents showing the reliability of the QEEG samples. According to an April 2003 article in *Clinical Electroencephalography*, “An attorney should ask any expert witness as to his or her familiarity with the peer-reviewed scientific research in support of QEEG and TBI. The expert must be familiar with the peer-reviewed literature, and preferably, also by publishing peer-reviewed papers him/herself and having first-hand experience.”<sup>1</sup>

Attorneys can search the National Library of Medicine Web site<sup>2</sup> using the keyword “QEEG” to find a printed listing and determine the expert’s knowledge of these articles.

## Summary

QEEG and other growing database approaches used to assess cortical functioning together with neuropsychological testing have come a long way and continue to evolve in diagnostic sensitivity and specificity. Together, QEEG and neuropsychological testing permit us to detect subtle changes in central nervous system (CNS) functioning associated with different psychiatric and neurological conditions. Not only have these advances helped clinicians in diagnosing and treating patients, but these cortical assessment tools can also help attorneys litigate and defend for their clients. **CL**

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## Notes

1. Thatcher, Robert W.; Biver, Carl J.; North, Duane M.; “Quantitative EEG and the Frye and Daubert Standards of Admissibility,” *Clinical Electroencephalography*, April 2003.
2. The National Library of Medicine Web site search is available at [www.ncbi.nlm.nih.gov/entrez/query.fcgi](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi).



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