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## AANEM POSITION STATEMENT



**American Association of Neuromuscular & Electrodiagnostic Medicine**  
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## PROPER PERFORMANCE AND INTERPRETATION OF ELECTRODIAGNOSTIC STUDIES

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The American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) has developed the following position statement in response to inquiries about: (1) physicians interpreting NCS data without any direct patient contact and without providing direct oversight over the performance of nerve conduction studies (NCSs); and (2) NCSs being utilized to diagnose patients without a complementary needle electromyography (EMG) study. The AANEM believes that electrodiagnostic studies should be performed by physicians properly trained in electrodiagnostic medicine, that interpretation of NCS data alone absent face-to-face patient interaction and control over the process provides substandard care, and that the performance of NCSs without needle EMG has the potential of compromising patient care. It is the AANEM's opinion that it is in the best interest of patients, in the majority of situations, for the needle EMG and the NCS examination to be conducted and interpreted at the same time.

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**This article was prepared and reviewed by the AANEM and did not undergo the separate review process of *Muscle & Nerve*.**

This position statement is provided as an educational service of the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) and is provided for informational purposes only. Specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on the individual facts and circumstances involved in each case. This position statement is not intended to be used as a basis for reimbursement decisions.

Approved by Board of Directors of the American Association of Neuromuscular & Electrodiagnostic Medicine, September 2005.

**Key words:** electrodiagnostic studies; interpretation of electrodiagnostic studies; performance of electrodiagnostic studies

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### APPROPRIATE PERFORMANCE OF ELECTRODIAGNOSTIC STUDIES

As discussed in more detail below, in most cases, a properly performed electrodiagnostic consultation involves using both NCS and needle EMG. The AANEM's *Recommended Policy for Electrodiagnostic Medicine* outlines the necessary steps for an appropriate electrodiagnostic consultation as follows:

1. Development of a differential diagnosis by the electrodiagnostic physician, based upon an appropriate history and physical examination performed by this physician.
2. Completion of indicated NCSs.
3. Completion of indicated needle EMG studies to evaluate the differential diagnosis and to complement the NCSs.
4. Synthesis by the electrodiagnostic physician of the patient's history and physical examination with the NCS and needle EMG data to reach the diagnosis.<sup>1</sup>

It is the AANEM's position that, in order to perform the steps outlined above and to ensure quality patient care, the individual performing these steps must be a physician with special training in the diagnosis and treatment of neurological and neuromuscular diseases and in the application of particular neurophysiological techniques to study these disorders.<sup>1</sup> The AANEM believes that physicians should receive training in neurology and/or physical medicine and rehabilitation residencies and/or fellowships that provide detailed medical education including anatomy, pathology of muscle and nerve, neuromuscular physiology, electrophysiology, and clinical aspects of neurological and musculoskeletal conditions, with particular emphasis on diagnosis and treatment of neuromuscular diseases as they

pertain to clinical electrodiagnostic medicine. The AANEM's position statement *Who Is Qualified to Perform Electrodiagnostic Medicine?* outlines the AANEM's complete educational requirements for an electrodiagnostic consultant. This document is available on the AANEM website at: [www.aanem.org/practiceissues/positionstatements/Who%27s\\_Qualified.cfm](http://www.aanem.org/practiceissues/positionstatements/Who%27s_Qualified.cfm).

#### **APPROPRIATE PERFORMANCE OF NERVE CONDUCTION STUDIES**

Nerve conduction studies are one diagnostic test used by an electrodiagnostic physician. Nerve conduction studies are performed to assess the integrity and diagnose diseases of the peripheral nervous system. Specifically, they assess the speed (conduction velocity and/or latency), size (amplitude), and shape of the response. Electrodiagnostic physicians utilize their medical training to determine which nerves to study utilizing NCSs and whether additional diagnostic testing is necessary. It is the AANEM's position that the standard of care in clinical practice dictates that using a predetermined or standardized battery of NCSs for all patients is inappropriate. It is inappropriate in the AANEM's opinion because it may be possible to obtain an accurate diagnosis with fewer studies, and a prespecified battery may not include the appropriate NCSs to determine the diagnosis.

When properly performed, the waveforms from the NCSs should be reviewed as they are obtained (on-site) prior to the patient being dismissed. This is necessary to assess whether further NCSs should be performed, as well as to determine what other diagnostic tests are necessary. It is also important that the physician review the waveforms to ensure the quality of the waveforms. Before results can be interpreted as normal or abnormal, it is important that the physician consider other factors that could be causing an apparent abnormality, such as electrical interference, improper setting, or even whether the room was too cold.

Nerve conduction study reports should document the nerves being evaluated, the distance between stimulation and recording sites, the conduction velocity, latency values, and amplitude. The electrodiagnostic physician interpreting the studies should understand each of these report components. It is important that these measurements are obtainable by the physician and that the physician understand the significance of these components in reaching a diagnosis.<sup>1</sup>

#### **APPROPRIATE INTERPRETATION OF DATA FROM NERVE CONDUCTION STUDIES**

The AANEM is concerned about physicians interpreting NCS data without face-to-face patient interaction, without making a decision about the nerves to be tested, and without providing direct oversight over the performance of the NCSs. As described above, to reach a diagnosis based on NCSs it is imperative that the physician should have examined the patient, designed the study based on the information obtained, in most circumstances obtain EMG results, and then integrate information from each of the above components. Individuals who interpret NCSs without any patient interaction or who rely on studies that have a delayed interpretation or have the interpretation made off-site, or individuals who interpret NCS results without the complementary information obtained from needle EMG, in the AANEM's opinion, are not meeting the standards outlined in the AANEM's *Recommended Policy for Electrodiagnostic Medicine*. As described more thoroughly below, the interpretation of NCSs separately from that of the needle EMG component of the test should clearly be the exception (e.g., when testing an acute nerve injury) rather than an established practice pattern for a given practitioner.<sup>1</sup>

#### **PERFORMANCE OF NERVE CONDUCTION STUDIES WITHOUT NEEDLE ELECTROMYOGRAPHY**

The AANEM is concerned that there has been a significant increase in the number of NCSs performed without a companion needle EMG test. Nerve conduction studies increased by over 30% in 1 year based on Center for Medicare and Medicaid (CMS) information.<sup>2</sup> Nerve conduction studies are only one component of an appropriate electrodiagnostic consultation.

When NCSs are performed without needle EMG, the additional and complementary information provided by the needle EMG results (except in limited circumstances) is not available. Without the information provided by the needle EMG examination, valuable data that may be essential in establishing an accurate diagnosis is missing. For example, performing both studies together is critically important when evaluating patients with suspected radiculopathy, plexopathy, and motor nerve or motor neuron disease. Quite often, patients with radiculopathy may have normal NCSs.<sup>3</sup> Some reports have indicated that a radiculopathy can be determined by F waves. However, if even a few of the large myelinated motor fibers are intact, the F-wave results will appear normal. Therefore, a patient may have a normal study

when, in fact, a radiculopathy is present.<sup>3</sup> Although a few articles may be cited in an attempt to justify the use of F waves in the diagnosis of radiculopathy, the current body of evidence (substantiated by multiple studies published in well-respected peer-reviewed medical journals) does not support the use of F waves in isolation to diagnose radiculopathy. The AANEM's *Recommended Policy* states that a minimal evaluation for radiculopathy should include one motor and one sensory NCS *and needle EMG* (emphasis added) of the involved limb.<sup>1</sup> Radiculopathy is just one example in which NCSs alone should not be used to reach a diagnosis. Patients with myopathy, plexopathy, or motor neuron disorders may have more widespread abnormalities that are only detectable by needle EMG.

Additionally, patients typically need to have both NCSs and needle EMG to ensure that an underlying medical condition is not missed. For example, in patients with carpal tunnel syndrome (CTS), other disorders can coexist, such as a radiculopathy, brachial plexopathy, or underlying peripheral neuropathy. Alternatively, there may be a problem involving the median nerve but localized at a site more proximal than the wrist. These other problems are far more likely to be misdiagnosed or missed completely if the needle EMG is not performed, and if a physician without the proper skill and training is interpreting the data, making a diagnosis, and establishing a treatment plan. Surgical release of the median nerve at the wrist, a treatment for CTS, would be an inappropriate and unnecessary procedure if the patient does not have CTS. Additionally, NCSs may be normal, but the needle EMG examination may demonstrate abnormalities that identify a more proximal nerve lesion that produces symptoms such as numbness in the hand and that may mimic CTS. For this reason, most electrodiagnostic consultants perform needle EMG in cases of suspected CTS to detect the presence of an underlying radiculopathy or other disease process.

Many patients have variations of normal innervation that cause abnormal nerve conduction values. A physician trained in electrodiagnostic medicine can recognize situations in which these seemingly abnormal values are due to normal variant innervation and can plan other NCSs to confirm the suspicion. These difficult and not uncommon clinical questions are best addressed by thorough and detailed electrodiagnostic studies that are designed, performed, and interpreted by a physician who is properly trained in electrodiagnostic medicine. If a physician trained in electrodiagnostic medicine is physically present, in-

correct diagnoses and unnecessary treatments can potentially be avoided.

#### **IMPORTANCE OF A UNIFIED PROCEDURE**

It is important that the NCSs and the needle EMG examination be performed together and their results integrated into a unifying diagnostic impression. As stated above, the performance or interpretation of NCSs separately from the needle EMG component of the testing should clearly be the exception. In some cases, an NCS study will be conducted by someone who is not a trained electrodiagnostic physician (or a trained technician under the direct supervision of a trained electrodiagnostic physician) and the patient is then referred to a trained electrodiagnostic physician for assistance in diagnosing the patient. In such cases, the physician trained in electrodiagnostic medicine will usually need to repeat the NCS prior to performing needle EMG to ensure a quality study. Retesting will also be necessary to conform to the AANEM policy that only one attending physician should perform or supervise all of the components of the electrodiagnostic testing (i.e., history taking, physical evaluation, supervision or performance of the electrodiagnostic test, and interpretation) for a given patient and that in most cases all testing should occur on the same date of service. This necessary repetition of testing ensures patients receive quality care, but it wastes scarce health-care dollars and subjects the patient to unnecessary discomfort and inconvenience.

#### **SUMMARY**

The AANEM strongly recommends that electrodiagnostic procedures be performed by physicians with comprehensive knowledge of neurological and musculoskeletal disorders to assure accurate interpretation and diagnosis. Individuals without medical education in neuromuscular disorders and without special training in electrodiagnostic procedures typically are not qualified to interpret the waveforms generated by NCSs and needle EMGs or to correlate the findings with other clinical information to reach a diagnosis. It is also the AANEM's position that the same physician should directly supervise and interpret the NCSs including those performed by an electrodiagnostic technician.<sup>1</sup> The AANEM believes that interpreting NCSs without performing a focused history and physical and having oversight over the design and performance is inappropriate.

Nerve conduction studies performed independent of needle EMG studies may only provide a

portion of the information needed to diagnose muscle, nerve root, and most nerve disorders. For this reason, it is the position of the AANEM that, except in unique situations, NCSs and needle EMG should be performed together in a study design determined by a trained neuromuscular physician.<sup>1</sup> There are common diagnoses that depend on performing a needle EMG and combining the needle EMG data with the NCS data. Needle EMG studies are a necessary part of the evaluation in the diagnosis of myopathy, radiculopathy, plexopathy, disorders of the motor neuron, and most disorders of the peripheral motor nerves. When the NCS is used on its own without integrating needle EMG findings or when an individual relies solely on a review of NCS data, the results can often be misleading, and important diagnoses may be missed. Patients may thus be subjected to incorrect, unnecessary, and potentially harmful treatment interventions.

The AANEM is concerned that utilizing only NCSs to make health-care decisions provides incomplete diagnostic information, leading to inadequate or inappropriate therapy for some patients, and may waste scarce health-care dollars.

Further information about electrodiagnostic medicine may be found in the AANEM's *Guidelines in Electrodiagnostic Medicine (Muscle & Nerve 22, Supplement 8)*. In addition, the following brochures may be obtained through the AANEM Executive Office: *What Is Electrodiagnostic Medicine? An Information Brochure for Patients Undergoing Electrodiagnostic Medicine Testing* and the *Electrodiagnostic Medicine Consultation: AANEM Resource Guide for Referring Physicians*.

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## REFERENCES

1. AANEM Recommended Policy for Electrodiagnostic Medicine. Available at: [http://www.aanem.org/practiceissues/recPolicy/recommended\\_policy\\_2.cfm](http://www.aanem.org/practiceissues/recPolicy/recommended_policy_2.cfm) Accessed September 13, 2005. Approved by the American Association of Neuromuscular & Electrodiagnostic Medicine: September 1997; updated 1998, 1999, 2000, 2001, 2002, and 2004. Endorsed by the American Academy of Neurology: February 1998, February 2002, and June 2004. Endorsed by the American Academy of Physical Medicine & Rehabilitation: June 1998, March 2002, and June 2004.
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