AANEM PRACTICE TOPIC

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ABSTRACT: This evidence-based review was performed to evaluate the utility of nerve conduction studies (NCSs) and needle electromyography (EMG) in the diagnosis of tibial neuropathy at the ankle (tarsal tunnel syndrome, TTS). A total of 317 articles on TTS were identified that were published in English from 1965 through April 2002, from the National Library of Medicine MEDLINE database. All articles were reviewed on the basis of six selection criteria. The results of this search revealed that four articles met five or more criteria. All four articles examined the use of electrodiagnostic (EDX) techniques for the evaluation of patients with clinically suspected TTS, and were included in this practice parameter. Each of these four studies was considered to meet Class III level of evidence. NCSs were abnormal in some patients with suspected TTS. Sensory NCSs were more likely to be abnormal than motor NCSs but the actual sensitivity and specificity could not be determined. The sensitivity of needle EMG abnormalities could not be determined. NCSs may be useful for confirming the diagnosis of tibial neuropathy at the ankle, recommendation Level C. Well-designed studies are needed to evaluate more definitively EDX techniques in TTS.
Muscle Nerve **32:** 236–240, 2005

USEFULNESS OF ELECTRODIAGNOSTIC TECHNIQUES IN THE EVALUATION OF SUSPECTED TARSAL TUNNEL SYNDROME: AN EVIDENCE-BASED REVIEW

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This practice parameter is an educational effort sponsored by the American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM, formerly AAEM), and is based on a systematic review of the published scientific literature to assess the usefulness of electrodiagnostic (EDX) techniques in the diagnosis of patients with involvement of the tibial nerve at the level of the medial ankle (i.e., tarsal tunnel syndrome, TTS). The TTS Task Force of the AANEM was charged by the AANEM Board to develop this practice parameter to provide recommendations for the appropriate use of EDX studies in TTS and to provide recommendations for future research.

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

Abbreviations: AANEM, American Association of Neuromuscular and Electrodiagnostic Medicine; EDX, electrodiagnostic; EMG, electromyography; NCS, nerve conduction study; TTS, tarsal tunnel syndrome

Key words: electrodiagnosis; electromyography; entrapment neuropathies; nerve conduction studies; tarsal tunnel syndrome; tibial nerve
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Published online 7 July 2005 in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mus.20393

JUSTIFICATION

The most common site of tibial mononeuropathy is at the level of the tarsal tunnel. The constellation of symptoms of pain and numbness in the sole of the foot, sensation of tightness, cramping pain, and worsening of symptoms with prolonged standing or walking has been associated with TTS.[5–7,9] The term was first coined by Keck and Lam in separate articles.[14,16] However, the first description of the clinical features of TTS is attributed to von Malaisé in 1918.[18,24] The tibial nerve is reported to be com-

pressed in the tarsal tunnel, posterior and inferior to the medial malleolus. No population-based studies exist to determine the incidence or prevalence of TTS.

EDX studies have been used in an effort to diagnose the condition more accurately. Unfortunately, the techniques used for these studies vary considerably and are not always clearly described in the literature. To determine the usefulness of EDX techniques in the evaluation of patients with suspected TTS, systematic review and analysis were conducted of the relevant literature to answer the following clinical questions: (1) In patients clinically suspected of having TTS, what are the best electrodiagnostic (EDX) studies to confirm the diagnosis? and (2) How can future clinical research studies be improved to evaluate the usefulness of laboratory studies, including EDX studies, to confirm the diagnosis of TTS?

PROCESS

The task force agreed upon a set of six criteria to evaluate the literature in the electrodiagnosis of TTS (adapted from AAEM Carpal Tunnel Syndrome criteria, 2002).[2] Published articles that met at least five of the following six criteria were included for further review:

1. The study was prospective.
2. The diagnosis of TTS was based on clinical criteria independent of the EDX procedures under evaluation.
3. The EDX procedure was defined, or the reference to a published technique was provided, sufficient to permit duplication of the procedure.
4. The limb temperature was monitored.
5. The reference values were reported.
6. The criteria for abnormality of results of the EDX procedures were clearly stated and defined.

DESCRIPTION OF THE REVIEW PROCESS

A MEDLINE search was conducted from January 1965 through April 2002. The following descriptions and key headings were utilized: electrodiagnosis; electromyography; entrapment neuropathies; nerve conduction studies; tarsal tunnel syndrome; and tibial nerve. The search identified a total of 319 articles, 2 of which could not be obtained. The articles and their bibliographies were reviewed for additional references and none were found. Articles that met the inclusion criteria were included for a second review process by all the task force members.

The following methodological characteristics were abstracted from each article: type of study; number of patients studied with TTS; demographic information (age, gender); method of patient assembly; clinical criteria for the diagnosis of TTS; assessment time relative to onset of symptoms; and the type of EDX procedures utilized. Based on the results of this data abstraction, the articles were rated using the diagnostic test strength-of-evidence scheme adopted by the AANEM. This information is located in Appendix 7 of American Academy of Neurology's (AAN) document on the Process for Developing Practice Parameters.[1]

ANALYSIS OF EVIDENCE

Study Characteristics. Four studies examined EDX techniques in the evaluation of patients with clinically suspected TTS. Three met six of the literature inclusion criteria while one met five criteria (this study did not meet criterion number 6). The methodological characteristics of these studies are listed in Tables 1 and 2, available electronically (http://www.aanem.org/practiceissues/practiceParameters/ttsTables.cfm.).

Clinical Diagnosis of Tarsal Tunnel Syndrome. The four studies described the clinical diagnosis of TTS in different ways. Table 1 summarizes the clinical symptoms noted in the articles. The most common aspects included symptoms of burning or tingling (or both) on the sole of the foot. Three studies also noted nocturnal exacerbation of symptoms. Objective findings consisted of a Tinel's sign, altered sensation, and weakness of foot muscles.

In Patients with Suspected Tarsal Tunnel Syndrome, Are Electrodiagnostic Studies Useful to Confirm the Diagnosis? ***Nerve Conduction Studies.*** A variety of nerve conduction techniques were used in the four studies reviewed (Table 2). All reported motor NCS, three included sensory NCSs, and one included mixed nerve studies.

In a case series report, Galardi and colleagues noted that only 3 of 13 patients had abnormal motor studies and those patients who had motor study abnormalities always had abnormalities of mixed and sensory nerves.[8] Lateral plantar nerve sensory conduction abnormalities were observed in all limbs. Absence of the sensory nerve action potential was the most frequent abnormality, representing 92.8% of the abnormalities in the lateral plantar nerve and 76.9% in the medial plantar nerve. Sensory nerve action potentials were also absent from two unaf-

fected limbs. Mixed NCSs were abnormal in 85.7% of TTS limbs, but normal in all asymptomatic limbs and control subjects. Mixed NCS abnormalities were always associated with abnormal sensory NCSs. Only 21.5% of TTS limbs had significantly prolonged distal motor latencies to the abductor hallucis.

In a case series study, Oh and colleagues described the use of near-nerve sensory nerve conduction in the medial and plantar nerves in 25 cases in which TTS was suspected.[20] They found abnormal sensory nerve conductions in 24 cases (96%). The most common abnormalities were slow nerve conduction velocities and dispersion phenomena. They noted that these findings displayed the most prominent abnormalities in sensory NCSs for TTS evaluation.

In a case control study, Kaplan and colleagues described a study using motor NCSs in the assessment of TTS.[12] No differences in nerve conduction parameters were noted between the control group and the nondiagnostic group or between the control group and the uninvolved side of the patients with TTS. The involved side showed prolonged distal latencies both to the abductor hallucis as well as the abductor digiti minimi. Amplitude and duration were more likely to be affected than the distal latency.

In another case series study, Oh and colleagues described the use of sensory NCSs assessing 17 patients (21 nerves) with TTS.[21] Responses were obtained by averaging anywhere from 32 to 256 stimuli. They found that, compared with the medial plantar nerve, the lateral plantar sensory nerve conduction velocity was slower and the response amplitude smaller. They also noted that prolonged distal motor latency (11 of 21 cases, 52.4%) was less sensitive than abnormal sensory nerve conduction velocity or amplitude (19 of 21 cases, 90.5%). Sensory nerve conduction was abnormal in all nerves in which the distal motor latency was prolonged.

Needle Electromyography. None of the studies used needle electromyography (EMG) in the assessment of patients with TTS. Based on this information, further comments with regard to the utility of needle EMG in TTS cannot be made.

Can Electrodiagnostic Techniques Be Used to Assess the Prognosis in Patients with Clinically Suspected Tarsal Tunnel Syndrome? No studies were found that evaluated the impact of EDX testing on the outcomes or treatment in the TTS patient population.

SUMMARY OF EVIDENCE

The review of these articles shows some association between abnormal nerve conduction parameters in patients who present with clinical symptoms suggestive of TTS. It appears that sensory NCSs are more sensitive than motor NCSs but at the expense of specificity. However, there are significant methodological flaws in the studies. The limitations of these studies include: (1) the absence of blinding procedures; (2) the absence of a reference standard clinical definition of TTS; and (3) the variability in the timing of assessments relative to symptom onset.

CONCLUSIONS

Symptoms and signs, operative findings, and response to therapy define most cases of TTS reported in the literature. The precise clinical criteria used in the individual studies are inconsistent. It is impossible to compare the sensitivity and specificity of individual EDX tests for TTS in the absence of independent standardized clinical diagnostic criteria. Moreover, all of the studies have been unblinded studies or retrospective. Because of these limitations, the best evidence regarding EDX studies for the evaluation of TTS are considered Class III.

The current lack of definitive recommendations is not due to the presence of research that refutes the value of EDX studies in TTS, but rather because of the absence of high-quality evidence-based research on the validity and usefulness of the electrophysiologic techniques in TTS. When the data were insufficient to reach a conclusion, consensus was sought by the author panel and the Practice Issues Review Panel of the AANEM to formulate recommendations.

Before making the recommendations regarding the use of NCSs in the assessment of TTS, the panel of investigators further studied the issue of specificity of medial and lateral plantar NCSs. A separate literature review was carried out and 10 articles were identified. These studies assessed plantar NCSs in normal or asymptomatic subjects. Eight of these studies used surface recordings and two used near-nerve recording of the response at the ankle. Table 3, available electronically (http://www.aanem.org/practiceissues/practiceParameters/ttsTables.cfm.), summarizes the NCS findings in nine of these studies. One of the studies did not provide the exact number of absent responses from each of the nerves and hence was not used in the determination of the specificity of medial and lateral plantar NCSs.[4] The investigators reported that most of the subjects had both a medial plantar and lateral plantar sensory

response, and that all the subjects had at least one response. Based on the other studies, the specificities of medial and lateral plantar NCSs using surface recording are as follows: medial plantar sensory, 98%; medial plantar mixed, 99%; lateral plantar sensory, 92%; and lateral plantar mixed, 91%. The specificity of medial plantar sensory NCSs using near-nerve recording is 99%.

RECOMMENDATIONS

The recommendations are based upon the assumption that the clinical situation, as evaluated through the history and physical examination and testing, including other NCSs and needle EMG examination, has excluded the possibility of polyneuropathy, radiculopathy, and other conditions that might be responsible for the patient's symptoms. The following EDX tests are recommended for confirming the presence of tibial mononeuropathy at the level of the tarsal tunnel in the ankle/foot in patients with clinically suspected TTS:

1. Tibial motor NCSs, with responses recorded over the abductor hallucis and abductor digiti minimi pedis muscles, demonstrating prolonged distal onset latency (Level C, Class III).
2. Medial and lateral plantar mixed NCSs, demonstrating prolonged peak latency or slowed conduction velocity across the tarsal tunnel (Level C, Class III).
3. Medial and lateral plantar sensory NCSs, demonstrating slowed conduction velocities across the tarsal tunnel and/or small amplitude or absent responses (Level C, Class III).
4. The utility of needle EMG in the assessment of TTS is unclear (Level U, data insufficient).

RECOMMENDATION FOR FUTURE RESEARCH STUDIES

The AANEM recommends that future clinical research studies evaluating the usefulness of EDX testing to confirm the diagnosis of clinically suspected TTS meet all of the criteria that were used to evaluate the literature in the diagnosis of TTS. In addition, it is recommended that the studies be performed in a blinded fashion and that EDX determination be obtained in a mixed population of those meeting a case definition, normal control subjects, and those with similar complaints but not meeting the case definition of TTS.

In addition, it is recommended that: (1) consensus criteria be developed and tested to form a standard case definition of TTS; (2) future clinical research studies include needle EMG to determine its utility in the assessment of patients with clinically suspected TTS; and (3) outcome studies be performed to assess the risks, benefits, and cost of NCSs and needle EMG in patients with clinically suspected TTS.

DISCLAIMER

This report is provided as an educational service of the AANEM. It is based on an assessment of the current scientific and clinical information. It is not intended to include all possible methods of care for a particular clinical problem, or all legitimate criteria for choosing to use a specific procedure. It is not intended to exclude any reasonable alternative methodologies. This statement is not intended to address all possible uses of, or issues regarding, the evaluation of tarsal tunnel syndrome and in no way reflects upon the usefulness of electrodiagnostic studies in those areas not addressed. The AANEM recognizes that specific patient-care decisions are the prerogative of the patient and their physician and are based on all of the circumstances involved. These guidelines are not a substitute for the experience and judgment of a physician. This review was not written with the intent that it be used as a basis for reimbursement decisions.

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