

## Clinical Utility of Dorsal Sural Nerve Conduction Studies in Patients with Polyneuropathy and Normal Sural Response

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**Background:** The most distal sensory fibers of the feet are often affected first in polyneuropathy. However, they are not evaluated in routine nerve conduction studies. Thus we evaluated the dorsal sural sensory nerve in patients with sensorimotor polyneuropathy with normal sural response, in order to assess the usefulness in electrodiagnostic practice.

**Methods:** In this study, 53 healthy subjects and 27 patients with clinical evidence of sensorimotor polyneuropathy were included. In all subjects, peripheral motor and sensory nerve studies were performed on the upper and lower limbs including dorsal sural nerve conduction studies. On electrodiagnostic testing, all patients had normal sural responses.

**Results:** The dorsal sural sensory nerve action potentials (SNAPs) mean amplitude was  $13.12 \pm 5.68$   $\mu$ V, mean latency was  $3.12 \pm 0.43$  msec, and mean sensory conduction velocity (SCV) was  $36.50 \pm 3.40$  m/s in healthy subjects. In 7 of 27 patients, the dorsal sural nerve SNAPs were absent bilaterally, and in 20 patients, the mean dorsal sural nerve distal latency was longer ( $3.40 \pm 0.48$  ms,  $P=0.006$ ), and mean SCV was slower than in healthy subjects ( $35.08 \pm 4.59$ ,  $P=0.043$ ). However, dorsal sural nerve amplitude was not different between the groups ( $P=0.072$ ).

**Conclusions:** Our findings suggest that dorsal sural nerve conduction studies should be included in the routine electrodiagnostic evaluation of patients with suspected polyneuropathy and normal sural nerve responses.

**Key Words:** Dorsal sural nerve, Polyneuropathy, Nerve conduction studies

### Introduction

Electrodiagnostic testing is an important part of the evaluation of polyneuropathy. However, the approach for patients with mild polyneuropathy is not standardized.<sup>1,2</sup> The most distal sensory fibers in the lower extremities are generally affected first in polyneuropathy. However, they are not evaluated in routine sural and superficial per-

oneal nerve conduction studies. We evaluated the dorsal sural nerves in patients with clinical evidence of polyneuropathy with normal sural nerve responses, in order to assess their relative diagnostic usefulness in electrodiagnostic practice.

### Subjects and methods

#### 1. Subjects

Fifty-three healthy subjects (18 men, 35 women; mean age  $50.3 \pm 13.8$  years; range 22~76 years) and 27 patients with clinical evidence of sensorimotor polyneuropathy (13 men, 14 women; mean age  $51.56 \pm 14.3$  years; range 22~76 years) were included in the study. The neurologic examina-

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tions of the healthy subjects were normal. All patients had clinical evidence of polyneuropathy with sensory complaints of either distal numbness, tingling, or paresthesia of the feet for more than 3 months and one or two of the following clinical findings: distal sensory loss in a stocking distribution and diminished or absent tendon reflexes.

## 2. Methods

The study protocol was in accordance with the Helsinki declaration of human rights, and was approved by the local ethics committee and the written informed consent from each patient was obtained. Routine nerve conduction studies were performed. In addition, dorsal sural nerve conduction studies were obtained. Recordings were performed on Nicolet EMG machine. Latency, amplitude and sensory conduction velocity (SCV) values of the motor and sensory nerves were compared with the our laboratory values. The skin temperature was above 31.80C in all subjects.

## 3. Dorsal sural nerve recording

We evaluated the dorsal sural nerve according to the previous methods.<sup>3</sup> In brief, surface recording electrodes which had active-reference electrode distance of 2 cm were used to test dorsal sensory nerve action potentials (SNAPs). Recording electrodes were placed over the lateral dorsal surface of the foot, with the distal electrode at the origin of digits 4 and 5 and the proximal active electrode 2 cm from the distal electrode. The stimulation site was posterior to the lateral malleolus, with the cathode placed 7-10 cm proximal from the recording electrode. Low filters were set at 20 Hz and high filters at 2 kHz. Sweep speed was 1 ms per division, sensitivity was adjusted between 5 and 20 mV per division, and stimulus duration was 0.2 ms at a stimulus rate of 0.5 Hz. Distal latency was measured from stimulus onset to the negative peak of the SNAP. SNAP amplitudes were measured from baseline to peak.

## 4. Statistical Analysis

Independent samples 't'-test was used for comparing between two groups. The level of significance in all statistical analysis was set at  $P < 0.05$ .

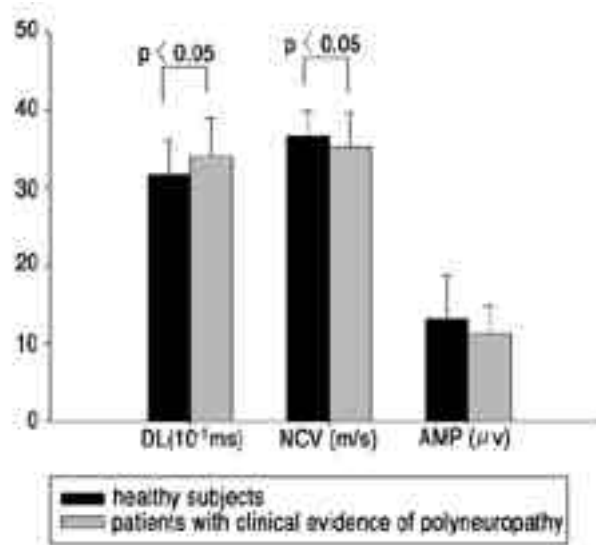
## Results

### 1. Normal controls

All 53 control subjects underwent dorsal sural conduction studies. The mean distal latency of the dorsal sural nerve response was  $3.12 \pm 0.43$  ms (range 2.3-4.3 ms). Mean distal amplitude was  $13.12 \pm 5.68$   $\mu$ V (range 3.0-33.3  $\mu$ V). Mean SCV measured to peak of the sensory nerve action potential (SNAP) was  $36.50 \pm 3.40$  m/s (range 28.0-45.0 m/s). In sural nerve conduction studies, mean distal latency was  $2.92 \pm 0.35$  ms (range 2.1-4.2 ms), mean amplitude  $21.8 \pm 8.76$   $\mu$ V (range 6.7-50.3  $\mu$ V), and mean SCV  $39.76 \pm 3.09$  m/s (range 34.0-47.6 m/s).

### 2. Patient with clinical evidence of peripheral neuropathy with normal sural response

All 27 patients underwent dorsal sural conduction studies. In 7 of 27 patients, the dorsal sural nerve SNAPs were bilaterally absent. In 20 of 27 patients, the mean distal latency of the dorsal sural nerve response was  $3.40 \pm 0.48$  ms (range 2.6-4.4 ms), mean distal amplitude  $11.4 \pm 3.54$   $\mu$ V (range 4.5-19.7  $\mu$ V), and mean SCV measured to peak of the SNAP  $35.07 \pm 4.59$  m/s (range 20.6-43.0 m/s). In sural nerve conduction, all values were within normal limits of our laboratory data.



**Figure 1.** Results of nerve conduction study of dorsal sural nerve in healthy subjects and patients with clinical evidence of sensorimotor polyneuropathy with normal sural response. DL and NCV had statistical significance. DL means distal latency, NCV nerve conduction velocity, and AMP amplitude.

The results of sural and dorsal sural SNAPs in control subjects and patients are compared in Fig. 1, and Fig. 2.

In patients, the mean distal latency of the dorsal sural nerve response was longer ( $P=0.006$ ), and the mean SCV was slower ( $P=0.043$ ) than in healthy subjects. However, there were no differences between two groups for dorsal sural SNAP amplitude.

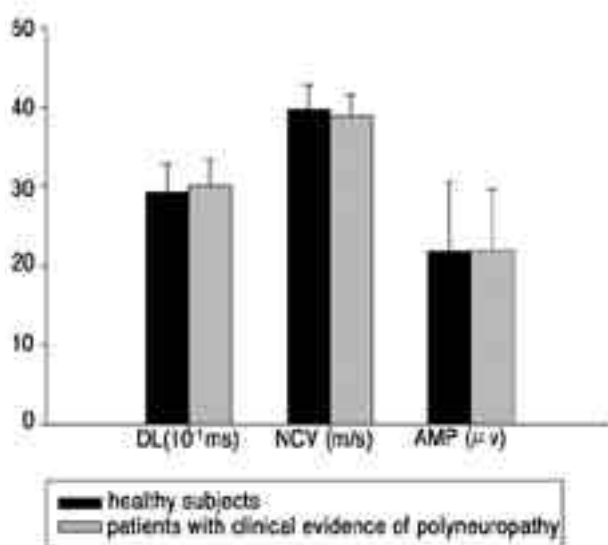
## Discussion

We studied the dorsal sural nerve in the evaluation of patients with clinical evidence of polyneuropathy, who had normal finding of routine nerve conduction study including sural nerve, and found that distal latency and nerve conduction velocity of dorsal sural nerve may have value to determine neuropathy in the early stages. In patients with peripheral neuropathies, the most distal sensory fibers in the feet are often affected first. Generally, sural and superficial peroneal nerve conduction studies are used routinely for the diagnosis of polyneuropathy, but the most distal sensory fibers in the lower extremities cannot be evaluated with these nerves<sup>3</sup>.

Plantar sensory conduction studies for evaluation of the most distal nerves of the lower

extremities have been performed in diabetic patients, and it was suggested that the absence of the SNAP of the medial plantar nerve was a good indicator of neuropathy.<sup>4,5</sup> However, plantar sensory conduction studies are uncomfortable and it was demonstrated in many studies that this nerve was usually involved in local neuropathic conditions.<sup>5</sup> Interdigital nerve conduction study of the foot using near-nerve needle technique could identify nerve conduction abnormalities in the early stage of diabetic polyneuropathy.<sup>6</sup> However, this technique is also uncomfortable and invasive. The dorsal sural nerve conduction studies were evaluated in patients with peripheral neuropathy and in normal subjects.<sup>3</sup> Patients in their series had different causes for peripheral neuropathy including diabetes, alcohol, arteritis, drugs, autoimmune disorders and unknown etiology. In their patients with polyneuropathy, dorsal sural SNAP was absent in 97%, whereas only 77% showed abnormalities of sural sensory conduction. In children, dorsal sural nerve conduction studies were performed to assess the clinical utility of this method in diabetic children who have no clinical signs of peripheral neuropathy.<sup>7</sup> The mean distal latency was longer and mean SCV was slower than in healthy subjects. Recently, medial dorsal superficial peroneal (MDSP) nerve studies in patients with polyneuropathy and normal sural response were performed and MDSP nerve amplitude was the sensitive for detection of mild chronic symmetric axonal sensorimotor polyneuropathy.<sup>8</sup>

However, there is no study of dorsal sural nerve conduction in patients with clinical evidence of polyneuropathy with normal sural response. In our studies, the values of the sural nerve studies in normal subjects and patients were within normal limits, and those were not significantly different between two groups. However, in the dorsal sural nerve conduction studies, the distal latency and SCV had significant difference. Therefore, the dorsal sural nerve conduction studies may have value to determine neuropathy in the early stage. In 7 of 27 patients who participated in this study, the dorsal sural SNAPs were absent bilaterally. Anatomic variations in sural nerve distribution are possible. However, considering of the finding that their clinical symptoms and signs are relatively more severe than other



**Figure 2.** Results of nerve conduction study of sural nerve in healthy subjects and patients with clinical evidence of sensorimotor polyneuropathy with normal sural response. There were no differences between two groups. DL means distal latency, NCV nerve conduction velocity, and AMP amplitude.

patients, absent sural SNAPs may be associated with clinical severities.

In conclusions, the evaluation of the dorsal sural nerve conduction may improve the diagnostic yield and it should therefore be included in the routine evaluation of patients with mild sensorimotor polyneuropathy.

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