



## Evaluation of electrodiagnostic changes in patient with multiple sclerosis

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ARTICLE INFO	ABSTRACT
<p><b>Article type</b> Review article</p> <p><b>Article history</b> Received: 13 Jan 2014 Revised: 21 Jan 2014 Accepted: 4 Feb 2014</p> <p><b>Keywords</b> Electrodiagnostic assessment Multiple sclerosis Peripheral neuropathy</p>	<p>Although demyelination along the axons is the main manifestation of Multiple sclerosis (MS), peripheral nervous system (PNS) could be affected potentially too. In some studies PNS involvement is estimated to be more than 50 percent in MS patients. Accordingly, objective tests to confirm the severity of PNS involvement might be crucial in patients' management. Modern technological advances lead to innovation of computerized electrodiagnostic (EDX) techniques in recent years. Nerve conduction studies (NCS) provide reliable data about neuropathies. Although the frequency of PNS involvement varies in different population of MS patients, recognizing clinical and subclinical PNS impairments in MS patients is important for the treatment.</p>

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### Introduction

Among the central nervous system (CNS) demyelinating disorders, multiple sclerosis (MS) is a chronic inflammatory disease which is the most common form of neurologic impairments in young adults (1).

Myelin destruction is the main pathophysiology of MS which is an immune-mediated process and leads to plaque formation in patients' central nervous system (2). MS symptoms evaluation is

based on musculoskeletal dysfunction and stiffness. MS disease onset is almost in the third or fourth decade of patient's life. It is estimated that over 2 million people suffer from MS all around the world and half of the MS global population live in Europe (3). The International Panel on the diagnosis of MS defined the diagnostic criteria of MS in 2000 which was revised in 2010 (4,5). Although demyelination along the axons is

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the main manifestation of MS, peripheral nervous system (PNS) could be affected potentially in MS. PNS axonal destruction might occur in a considerable percent of MS patients (6).

Changes in nerve conduction velocity (NCV) parameters could demonstrate MS by electrodiagnostic assessment of peripheral nerve. About 5% of MS patients develop peripheral nerve impairment and changes in NCV (7). PNS involvement in MS might be associated with malnutrition or drug toxicity, so its diagnosis is important in patients with MS. Pathology studies about MS in recent years have shown that gray matter involvement and brain atrophy might happen in the early stages of the disease in addition to white matter demyelination (8). In the study of Pogorzelski et al. the rate of nerve impairment in MS patients PNS is estimated to be 74.2% (9). Warabi et al. demonstrated that 10.3% of MS patients reveal changes in NCV and about half of the patients with PNS disorders might have two involved nerves (10).

MS diagnosis has three parts; patient's history and information, clinical, and paraclinical examinations. These steps could raise the accuracy of diagnosis and result in narrowing the differential diagnosis (3).

In recent decades peripheral and generalized neuropathies have become common; neurological examinations in neuropathies are essential, but not enough and do not have sufficient diagnostic accuracy. Accordingly, objective tests that could confirm the severity of neuropathies might be crucial in patients' management. Modern technological advances lead to innovation of computerized electrodiagnostic (EDX) tools in recent years. Nerve conduction studies (NCS) provide reliable data about neuropathies (10).

Motor nerve conduction examinations have been performed on a mixed nerve with

motor and sensory axons. In these types of studies stimulations have been conducted on a specific part in each course (11). Depolarization induced with electrical pulse has produced action potentials in axons. Induced evoked potentials in motor axons move into distal and proximal direction from the stimulus point (12).

Action potentials would be transferred from neuromuscular junctions in milliseconds all over the muscular fibers. These electrical activities along muscles fibers have been detected as compound muscle action potential (CMAP) (13). Various variables could be measured from CMAP such as latency, amplitude, area under the curve, duration, and motor conduction velocity. By measuring the amplitude and area of CMAP, the frequency of induced action potentials in muscle's fibers could be estimated and thereby count of axons would be stimulated (14).

## Discussion

There are some suggestive nerve conduction criteria for axonal distraction, like decreased distal evoked CMAP or SNAP; proximal reductions might happen due to demyelination impairments (15).

From different studies it can be concluded that in most of the axonal and demyelinating polyneuropathies there is statistical correlation between slow conduction in motor or sensory nerves and amplitude reduction (16).

SNAP/CMAP amplitude in some cases could be distinct between axonal and demyelinating polyneuropathies (12). In Table 1 electrodiagnostic assessment of PNS in MS patients is shown.

In various studies, electrodiagnostic tests have been established as reliable methods to detect the subclinical peripheral nerve conduction disorders. Significant amplitude F-wave disturbance might be related with hand spasticity in secondary progressive

**Table 1.** Electrodiagnostic assessment of peripheral nervous system in MS patients

Author Year Reference	Title	Sample size	MS type	Mean age (year)	EDSS*	Outcome
<b>Boerio 2007 (17)</b>	Alteration of motor nerve recovery cycle in multiple sclerosis	20	Relapsing remitting Secondary progressive Primary progressive	46.6±12.5	3.8±2.3	Prolonged the absolute and relative refractory periods (ARP, RRP) and increased refractoriness
<b>Ayromlou 2013 (18)</b>	Electrodiagnostic Evaluation of Peripheral Nervous System Changes in Patients with Multiple Sclerosis	75	Relapsing remitting secondary progressive	32.3±11.3	3.8±1.9	Motor amplitude of peroneal and tibial and median nerve was reduced and Sensory amplitudes were not significantly different
<b>Misawas 2008 (19)</b>	Peripheral nerve demyelination in multiple sclerosis	60	Relapsing remitting	38	3	Decreased SNAP** amplitudes and slowed Sensory nerve conduction velocities
<b>Hidasi 2008 (20)</b>	Peripheral nerves are progressively involved in multiple sclerosis- A hypothesis from a pilot study of temperature sensitized troneurographic screening	26	Relapsing remitting	—	4.3±2.3	Prolonged motor latencies
<b>Gartzen 2011 (21)</b>	Peripheral nervous system involvement in multiple sclerosis	54	Relapsing remitting Primary progressive	40.2±9.3	2.5±1.2	Motor amplitude of peroneal and tibial nerve was reduced and sensory amplitude of sural nerve was reduced

\* EDSS: Expanded disability status scale; \*\* SNAP: Sensory nerve action potential

multiple sclerosis (22).

Some studies demonstrated the presentation of PNS involvement in MS as sensory abnormalities, whereas others consist on both sensory and motor disorders.

It seems that peripheral neuropathy in MS affects motor neurons particularly and peripheral abnormalities might be result from central demyelination (18). On the other hand the role of peripheral

demyelination events in MS peripheral signs and symptoms has not been identified completely.

Number of factors could explain the changes in nerve stimulation responses in MS patients. Delayed recovery cycle might lead to impairment in supernormality. Gender, age, temperature, and immunomodulatory treatments in MS might have an impact on nerve stimulation responses. Na<sup>+</sup>/K<sup>+</sup>

ATPase pump dysfunction result from metabolic changes could lead to axonal membrane depolarization and recovery cycle disturbance. Change in temperature has a great impact on sodium channel kinetics and impress the action potential duration and amplitude (19).

In feys et al. study sensory conduction velocity was normalized after cooling, but motor conduction velocity was remained impaired after 20 minutes (23).

Another theory for PNS involvement in MS is antigenic cross-reactivity, which might happen due to peripheral demyelination. It is obvious that gross demyelination in PNS does not occur in MS, and peripheral myelin has structural impairment in most cases and this could lead to create a resistant zone and intermodal leakage. Anti chondroitin sulphatase antibody, anti myelin associated glycoprotein antibody, and anti gangliosides antibody have been described in PNS involvement in MS (21).

Electrodiagnostic tests for PNS involvement in MS patients could find evidence of minor PNS or fiber pathology in early stages (22).

Although PNS involvement frequency in MS varies in different population, recognizing clinical and subclinical PNS impairments in MS patient is important.

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### Conflict of Interest

The authors declare no conflict of interest.

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