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NERVE CONDUCTION STUDIES OF THE TIBIAL NERVE ACROSS THE TARSA TUNNEL IN LEPROSY PATIENTS

ESTUDOS DE CONDUÇÃO NERVOSA NO NERVO TIBIAL ATRAVÉS
DO TÚNEL DO TARSO EM PACIENTES DE HANSENÍASE

ABSTRACT

The authors assessed all tibial nerve conduction studies (NCS) of the patients suspicious of acute or subacute leprosy neuropathy, who have been attended the Leprosy Ambulatory Clinic of the ILSL during a period of two years. Seventy-five patients have been included as follows: 52 male and 23 female, between 21 and 73 years old, with the mean age of 44.5 totaling 150 nerves. The medial plantar (MP) and lateral plantar ((LP) branches were studied separately. The most involved was the LP with 57.4%, followed by the MP with 42.6%. The most frequent injury among the abnormal nerves was the axonal lesion with 66%, followed by the myelin lesion with 28.7%. The most frequent and disproportional involvement of the PL branch not only demonstrates the compressive character of the tibial nerve injury in the tarsal tunnel but also indicates a *multiple entrapment mononeuropathy* in the lower limbs. The high prevalence of the tibial nerve injury was considered a hallmark of the disease, as well as the ulnar neuropathy.

Key words: leprosy, tibial nerve, tarsal tunnel syndrome, neural conduction

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INTRODUCTION

The tarsal tunnel syndrome (TTS) is characterized by the compression of the tibial nerve at the tarsal tunnel, under the flexor retinaculum muscle. The tunnel contains, besides the tibial nerve, the tendons of the following muscles: posterior tibial, flexor hallucis longus, flexor digitorum longus and the vascular bundle, composed of the posterior tibial artery and vein¹. The sensitive complaints on the distribution territory of the nerve are more relevant than the motor ones. During physical examination one can find thickening, Tinel's sign and pain upon palpation of

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the tibial nerve at the medial retromalleolar region of the ankle². Among known causes, the most frequent are the traumatic and idiopathic. Traumatic injuries result from scarring after sprains, tenosynovitis of the flexor tendons and bone alterations due to fractures. The most common alterations, either external or internal to the tarsal tunnel, are: varicose veins, ganglia (synovial cysts), lipomas, bone exostosis and nerve sheath tumors – neurilemmomas¹. Opposite to carpal tunnel syndrome, TTS is less commonly associated with systemic diseases. Among systemic causes, TTS is associated more frequently with diabetes, rheumatoid arthritis and leprosy, and may occur in systemic lupus erythematosus and hyperlipidemia^{1,3,4}. In a sample of 265 leprosy patients evaluated with the Semmes-Weinstein monofilament (Kit-SORRI Bauru), the frequency of the tibial nerve involvement was found to be the highest (82%) among all cranial and spinal nerves assessed³. During the reaction stages of leprosy compressive phenomena occur, due to a great volume expansion caused by edema of the nerves at the osteoligamentous tunnels at the elbow, wrist, knee and ankle joints^{3,5,6}. Electrophysiological demonstration of focal alterations at compression sites suggest the presence of compressive syndromes. Although compressions will initially course with focal demyelination, in leprosy, a chronic inflammatory neuropathy, they may progress to pronounced focal axonal injury. The complexity of this process in leprosy has motivated the authors of this study.

OBJECTIVE

To assess the motor involvement of the medial plantar (MP) and lateral plantar (LP) branches of the tibial nerve in leprosy patients under suspicion of acute or subacute neuropathy, who have been submitted to neurophysiological examination. To study the frequency of neurophysiological findings of motor conduction of the MP and LP through the tarsal tunnel, and the late responses of the MP. To characterize the types of injury regarding physiopathology, if axonal or myelinic.

METHODS

Prospective neurophysiological study of patients attended at the Leprosy Ambulatory of ILSL, between November 2009 and December 2011, under suspicion of acute or subacute neuropathy – neuritis – due to leprosy in all its forms of disease, focusing on the

tibial nerve at the ankle. Patients were excluded from this study in case of any difficulty in completing the neurophysiological examination due to edema or ulcers, or if presenting with another disease that could potentially cause peripheral neuropathy. The motor conduction technique was chosen for being specifically suited to study the conduction through the flexor retinaculum. Sensory conduction was not eligible since leprosy is mainly a sensory neuropathy, and most cases were multibacillary and advanced, making it less viable to perform these studies distal and proximal to the flexor retinaculum.

Motor conduction of the MP and LP branches of the tibial nerve through the tarsal tunnel was studied in all patients, bilaterally. The technique used was similar to the one described by Felsenthal and colleagues (1992), with the exception that the distance between the stimulation points was smaller (80 mm) and, additionally to the analysis of the proximal and distal latencies, the conduction velocity was also calculated at this segment. The setup was made of skin electrodes: the active one at the muscle bellies and the reference one at the base of the proximal phalanges of the first and fifth toes for the MP and LP, respectively; the stimuli was given below the tarsal tunnel, 80 mm proximal to the active electrode and again 80 mm above that point. Stimuli, fired at a frequency of 1.0 Hz and with a duration of 0.2 ms, were progressively increased until reaching the supramaximal level, defined as 10-15% above the amplitude of the last stimuli at which there could not be obtained any rise on the CMAP. The CMAP of the MP branch was registered at the flexor hallucis brevis and at the abductor digiti minimi for the LP branch⁷. Therefore, there were assessed the CMAP below and above the tarsal tunnel, conduction velocity, presence of conduction block and temporal dispersion at both MP and LP branches, and late responses F and A-waves, only at the MP branch. A-Waves are observed during the recording of late responses, especially F-Waves. These responses present constant latencies and morphology, possibly occurring before or after F-Waves. They are attributed to the effect of ectopic discharges between axons, and are correlated with nerve injury, either myelinic or axonal. Normal values were CMAPs ≥ 3 mV for both MP and LP, and velocity ≥ 38 m/s⁸. The normal values for the F-Waves ranged between ≤ 47.6 ms and ≤ 58.6 ms, according to age and height⁸. The type of injury was defined as axonal or myelinic, with the following variants: axonal predominance (axonal > myelinic) and myelinic predominance (myelinic > axonal). An injury was classified as axonal if it had a reduction in amplitude of > 50% of the normal values for the CMAP, or compared with the contralateral side⁹. **Figure 1.**

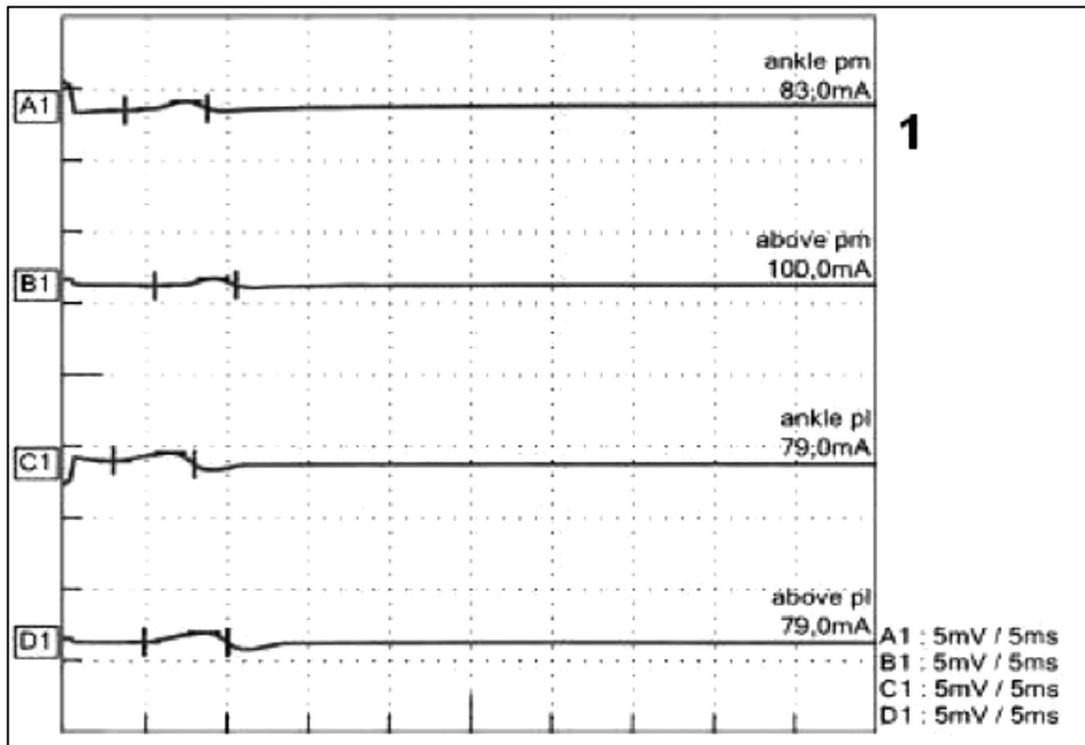


Figure 1 – Axonal injury of the tibial nerve, stimuli A1 below and B1 above the ankle at the medial plantar branch; and stimuli C1 below and D1 above the ankle at the lateral plantar branch. Observe the low amplitude of the motor potentials.

In order to define demyelination, the criteria used were temporal dispersion of CMAP above 50% and conduction velocity below 70% of the inferior normal values^{10,11}. Conduction blocks were also considered

as acute demyelination due to compression and not because of axonal causes, and defined as a reduction of amplitude greater than 50%, in the absence of temporal dispersion⁹. **Figures 2 and 3.**

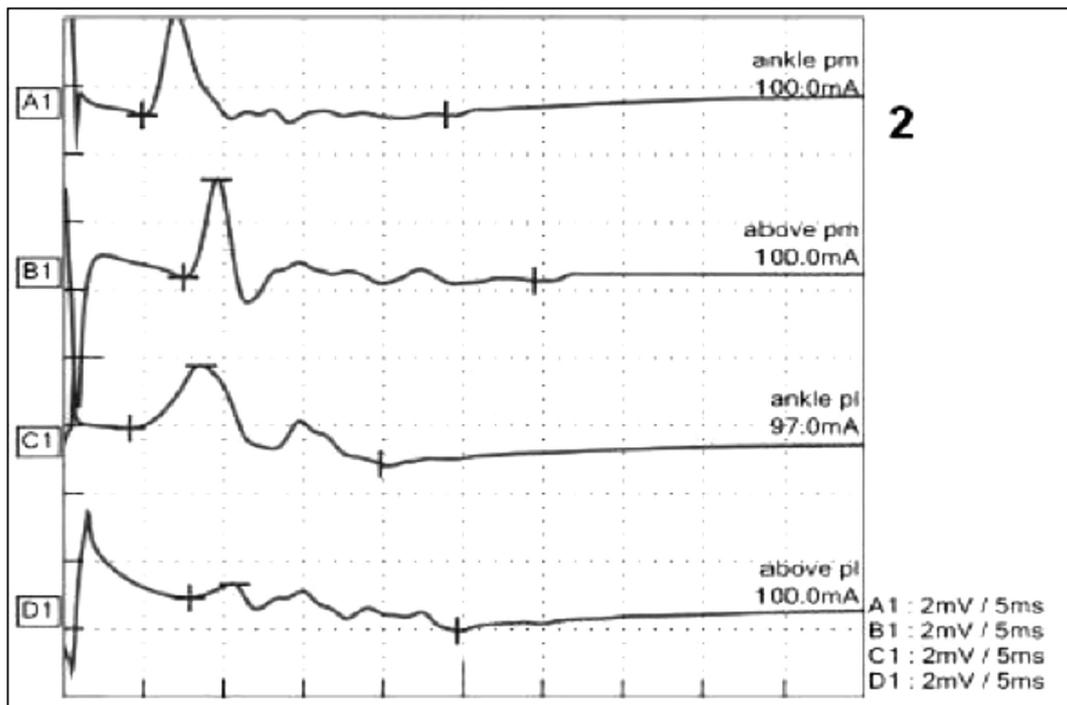


Figure 2 – Myelinic injury of the tibial nerve, stimuli A1 below and B1 above the ankle at the medial plantar branch; and stimuli C1 below and D1 above the ankle at the lateral plantar branch. Observe the important temporal dispersion of the motor potentials.

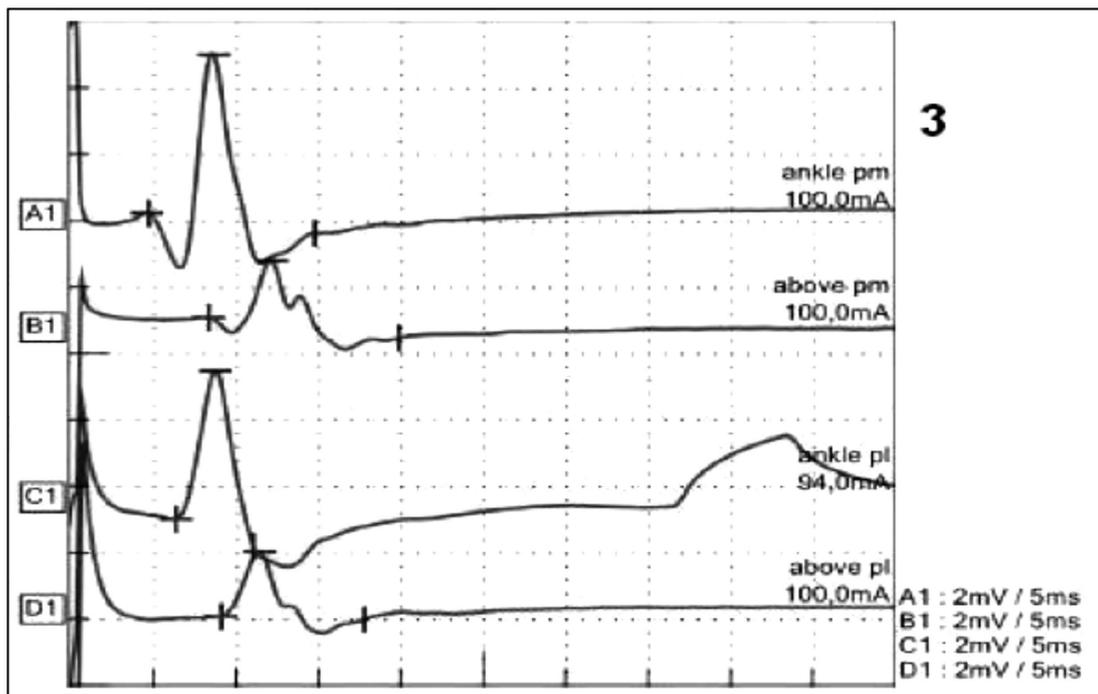


Figura 3 – Conduction block of the tibial nerve, stimuli A1 below and B1 above the ankle at the medial plantar branch; and stimuli C1 below and D1 above the ankle at the lateral plantar branch. Observe the reduction of the amplitude of the motor potentials proximal to the tarsal tunnel.

All examinations were revised by another researcher in order to reduce bias and diagnosis errors.

Frequency of involvement of the tibial nerve was calculated in this series of patients, as well as which of its branches was more commonly and precociously affected.

RESULTS

Eighty-three patients with a suspicion of leprosy neuritis were attended at the Leprosy Ambulatory of ILSL, during the period of November 2009 and December 2011. Eight patients were excluded for presenting comorbidities. Seventy-five patients were included, 52 male and 23 female, ages 21 to 73 years and a mean age of 44.5 years. Regarding clinical presentation, the distribution of patients was as follows: borderline lepromatous and lepromatous 38.6%; mid-borderline 30.6%; borderline tuberculoid

and tuberculoid 17.3% and unclassified 13.5%. Medial plantar branch (n = 150) was within normal values in 57.4% of nerves and presented an injury in 42.6%, thus distributed: axonal 24%, axonal predominance 3.3%, myelinic 11.3% and myelinic predominance 4%. Lateral plantar branch (n = 150) was normal in 47.3% and injured in 52.7%, distributed as follows: axonal 36%, axonal predominance 3.3%, myelinic 8.7% and myelinic predominance 4.7%. Considering an alteration of the tibial nerve as an injury in any of its branches, 58.7% of the nerves presented an alteration. Among injuries of myelinic predominance, conduction block was found in 39.1% of the MP branches and 50% of the LP branches. For these same injuries temporal dispersion was observed in 17.4% of the MP branches and 15% of the LP branches. F-Wave was recorded only at the MP branch, and found altered in 55.3% of the nerves in which it was possible to record it. The presence of A-Wave was observed during the recording of F-Wave, being present in 12% of those nerves. **Table 1.**

Type of injury	Medial plantar branch n =150	Lateral plantar branch n =150
Normal	57,4%	47,3%
Axonal	24%,	36%
Axonal > myelinic	3,3%	3,3%
Myelinic	11,3%	8,7%
Myelinic> axonal	4%	4,7%
Conduction block	39,1%	50%
Temporal dispersion	17,4%	15%
Increased F-Wave	55,3%	
A-Wave present	12%	

Tabela 1: Frequency of involvement of the tibial nerve at the medial plantar and lateral plantar branches according to the type of injury regarding electrophysiological findings of motor conduction through the tarsal tunnel, i.e., axonal, myelinic or predominance of either form, conduction block and temporal dispersion and late responses: F-waves and A-waves.

DISCUSSION

The frequency of involvement of the tibial nerve was high, as demonstrated by a previous study³, reaching more than half of the examined tibial nerves, considering the alterations found in the LP branch. LP branch was the most commonly compromised at 52.7%, when compared to MP branch at 42.6%, as well as the most intensely affected, finding that suggests earlier injury. Axonal and axonal predominance injuries occurred at a higher frequency than myelinic or myelinic predominance ones. At the LP branch 39.3% of injuries were axonal and 13.4% myelinic; at the MP branch 27.3% were axonal and 15.3% myelinic. Even though leprosy is an initially demyelinating neuropathy, it will evolve to axonal loss. Since in this sample there is a high number of lepromatous, borderline lepromatous and mid-borderline forms, i.e., multibacillary cases in which a longer time of disease without treatment is presumed, advanced stage neuropathies with more serious axonal loss are expected. F-wave, a feature that indicates nerve pathology, either axonal or myelinic, was prevalent in this group of nerves in which axonal injuries prevailed. Conduction blocks, that could be harder to confirm due to the difficulty of evaluating strength at the foot muscles¹², were confirmed through the analysis of the F-waves, from which a lower persistence is expected in the case of a conduction block.

A hypothesis to explain the higher involvement of the LP branch is that it is exposed to more compression sites, either at the tarsal tunnel under the flexor retinaculum as through the fibromuscular

tunnel between the muscle layers of the foot, entering medially through the abductor hallucis and lateral to the quadratus plantae, and exiting at the mid-foot between the flexor digitorum brevis and the abductor digiti minimi^{1,4,13}.

CONCLUSIONS

1. Considering the high frequency of neurophysiological alterations exhibited at this series of patients, the involvement of the tibial nerve must be considered as one of the hallmarks of the disease, as has been the case with the involvement of the ulnar nerve.
2. The most prevalent involvement of the LP branch demonstrates the compressive character of the involvement of the tibial nerve at the tarsal tunnel, since this branch is subject to more compression zones, being more intensely and precociously injured. The disproportional spatial and temporal injury to the LP branch also reveals the structure of a multiple entrapment mononeuropathy in the lower limbs, the main hallmark of the leprosy neuropathy.
3. Early and more frequent involvement of the LP branch makes it an eligible nerve, to be included in the routine of the neurophysiological examination for the investigation of TTS in leprosy and other diseases, including in the absence of a specific clinical complaint. As for the cases of TTS from other diseases, sensory conduction at the MP and LP branches should naturally be included in the investigation protocol.

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