

## Tarsal tunnel syndrome in patients with lumbar disc degeneration: a preliminary study

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### ABSTRACT

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**Purpose:** An idea of "double-crush syndrome", introduced by Upton and McComas, is a concept considered for cervical disc disease and the carpal tunnel syndrome. Similar hypothesis can be put forward for lumbar disc disease and the tarsal tunnel syndrome, though the occurrence of the latter has not been studied up to date. The aim of this study was to examine the occurrence of the tarsal tunnel syndrome among patients surgically treated for lumbar disc disease.

**Material and methods:** Electroneurographical examination was performed in 53 in-patients of the Department of Neurosurgery, Medical University of Białystok, who were admitted for surgical treatment of lumbar disc herniation.

**Results:** In 9 of 53 patients, (17%) the terminal latency of the response in the tibial nerve was

elongated and the amplitude was depressed to exceed the normal reference range of these parameters, thus diagnosing the tarsal tunnel syndrome. The occurrence of the tarsal tunnel syndrome on the side affected by disc disease was much higher than on the unaffected side (13.2% vs. 7.5%, respectively).

**Conclusions:** A significant sub-group of patients with lumbar disc disease subject to surgical treatment suffer also from impairment of the tibial nerve at the level of the tarsal tunnel. This is likely to affect the results of surgical treatment of disc disease: failed back surgery ought to be considered in respect of this finding.

**Key words:** tarsal tunnel syndrome, electroneurography, lumbar disc disease, double-crush syndrome

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Received: 26.12.2012

Accepted: 31.12.2012

Progress in Health Sciences

Vol. 2(2) 2012 pp 75-78.

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## INTRODUCTION

The concept of "double crush syndrome" states that compression at the distal part of a nerve (often without any anatomical cause related to the source of pain) may be affected by fiber damage at a higher level, resulting in disruption of axonal transport [1]. The idea of double crush of a nerve was put forward by Upton and McComas, who demonstrated that up to 70% of patients with the syndromes of carpal tunnel and ulnar nerve compression had also signs of damage to the cervical nerve roots [2].

In contrast to the carpal tunnel syndrome and cervical disc, the occurrence of this phenomenon in lumbar disc disease and the tarsal tunnel syndrome has not yet been sufficiently investigated [3]. A term of "tarsal tunnel syndrome" describes a condition in which the trunk or branches of the tibial nerve are compressed within the course of the flexor retinaculum around the medial malleolus [4-9]. In this preliminary study, we used electroneurography to investigate the occurrence of tarsal tunnel syndrome in surgically treated patients with lumbosacral disc disease.

## MATERIAL AND METHODS

Fifty three patients (24 women and 29 men) were included in the study. All were in-patients of the Department of Neurosurgery, Medical University of Białystok, admitted due to lumbar degenerative disc disease and qualified for surgery. All subjects were informed of the purposes of the study and gave written informed consent. Four patients had diagnosed pathology at the level L<sub>3</sub>-L<sub>4</sub>, 22 patients had pathology at the level L<sub>4</sub>-L<sub>5</sub> and 16 patients at the level L<sub>5</sub>-S<sub>1</sub>. In 11 patients, two levels were affected, mostly L<sub>4</sub>-L<sub>5</sub> and L<sub>5</sub>-S<sub>1</sub>. In 28 patients, symptoms appeared on the right-side, in 20 on the left-side and in 5 – bilaterally.

Electroneurography of both sides tibial and peroneal nerves was performed. At the time of assessment, the patient was lying down on the couch in the supine position. Surface electrodes were used. The skin was wiped with an alcohol swab, and the gel was applied topically in order to enhance the electrical conductivity of the skin. During the examination of the tibial nerve receiver electrodes were placed over the abductor halucis muscle (cathode distal, anode proximal - orthodromal direction). Tibial nerve stimulation was performed over the flexor retinaculum and in the popliteal fossa. During the examination of the peroneal nerve receiving electrodes were placed over the short toes extensor. Stimulation was performed in the area of extensors retinaculum and over the head of the fibula. Examination protocol was clarified to the patient at the beginning. Stimulation was started at low intensity stimulus

(habituation to the test) ending with supramaximal values (to elicit responses in all nerve fibers) causing muscle response M. The distance between recipient electrodes and stimulation sites were entered to the electroneurograph. Rectangular pulses were applied with duration of 0.1 ms, and frequency of 2 Hz. Latency, amplitude, conduction velocity, F-wave and its quantity was assessed [4-6, 10-15].

## RESULTS

Table 1 summarizes the values of the neurophysiological parameters found in the group of patients examined.

**Table 1.** Summarizes the values of the neurophysiological parameters in examined patients

Nerve	Not affected side N=53	Affected side N=53	t-test
Latency – peroneus (ms) (SD)	6.06 (2.49)	5.65 (2.43)	ns
Amplitude – peroneus (mV) (SD)	2.71 (1.57)	2.7 (2.1)	ns
Conduction velocity – peroneus (m/s) (SD)	46.9 (10.6)	46.5 (6.9)	ns
Latency – tibialis (ms) (SD)	4.89 (1.43)	5.76 (3.57)	ns
Amplitude – tibialis (mV) (SD)	5.82 (3.47)	5.3 (3.4)	ns
Conduction velocity – tibialis (m/s) (SD)	46.5 (12.5)	44.9 (14.6)	ns

SD-standard deviation, ns- not significant

No significant differences was found between the affected and non-affected extremity in any of the parameters. Nevertheless the terminal latency of the response in the tibial nerve was longer in the extremity affected by disc disease than in the non-affected side. This was in contrast to the latency in the peroneal nerve (which, unlike the tibial nerve, courses freely and therefore, can serve as a control). The same holds true for the amplitude of the response, which was smaller on the affected side in the tibial nerve but not in the peroneal nerve.

The above signs of asymmetry of the response in the tibial (but not in the peroneal) nerve suggests that among the patients with lumbar disc disease, there is a sub-set of patients in whom the conductivity in the peripheral segment of the tibial nerve is affected. To identify this sub-set of

patients, the neurophysiological parameters in the tibial nerve on the affected side was compared to their normal reference range, which have been previously established in our laboratory (Table 2).

**Table 2** Normal reference, established in healthy subjects in our laboratory

Nerve	terminal latency		conduction velocity		response amplitude	
	ms	SD	m/s	SD	mV	SD
Peroneal	4.8	0.8	48	6	5.4	2.5
Tibial	4.6	0.8	46	6	11.8	4.1

SD-standard deviation

In this manner a subgroup of 9 patients was identified in whom tarsal tunnel syndrome could be diagnosed basing on neurophysiological examination. It is of interest to add that among them there were 2 patients who had neurophysiological signs of the tarsal tunnel syndrome in the limb not affected by disc disease and two other patients in whom signs of tarsal tunnel syndrome were bilateral.

## DISCUSSION

The concept of "double crush syndrome" states that clinical signs and symptoms of a compression at the distal part of a nerve may be affected by fiber damage at a higher level. In particular, compression of the nerve roots can disrupt their axonal transport, resulting in increased susceptibility of the distant segments of the nerve to external stimuli, including mechanical compression [1,2]. In such situation even minor nerve entrapment can lead to clinically expressed compression neuropathy with nerve conduction velocity compromise, sensory disturbances, pain and other complaints.

Our study indicates that among patients with lumbar disc disease subject to surgical treatment there is a substantial sub-set of subjects who suffer also from tibial nerve compression at its peripheral segment –this running within the tarsal tunnel. The exact figure amounted to 17% which is rather a unexpectedly considerable share.

Moreover, the occurrence of the tarsal tunnel syndrome on the side affected by disc disease is much higher than on the unaffected side (13.2% vs. 7.5%, respectively).

The predominance of the "affected" side suggests that the compression of the sciatic nerve root by a disc pathology can make the peripheral segment of the nerve more vulnerable to mechanical compression and/or irritation at the level of the tarsal tunnel. This seems to confirm the

concept of double crush syndrome also as to the sciatic nerve. Nevertheless the occurrence of this syndrome in the lower extremity, as found in our study, is significantly smaller than a relevant figure reported in patients with cervical disc disease and the carpal tunnel syndrome [3, 5, 6, 16, 17].

Nowadays, the stunning advance of techniques like computer tomography and magnetic resonance has directed the clinical diagnosis onto the neuroimaging, at the cost of functionally oriented methods of diagnosis, headed by electroneurophysiology. Our study suggests that important and clinically relevant diagnostic information can be missed with such biased and unilateral approach [4, 7, 12, 15].

The results of our study suggest that a complete diagnosis of patients with lumbar disc disease can only be obtained when neuroimaging is supplemented with neurophysiological methods. This is especially important in patients in whom surgical treatment is planned. There is no doubt that such decomposed, multilocal compression of the sciatic nerve can affect the results of surgical treatment of disc disease. In particular, failed back surgery ought to be considered in the respect of this condition.

## CONCLUSIONS

A significant sub-group of patients with lumbar disc disease subject to surgical treatment suffer also from impairment of the tibial nerve at the level of the tarsal tunnel.

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