Triggering of Carpal Tunnel Syndrome Symptoms in Patients Using Urban Public Transportation

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Luiz Guilherme de Saboya Lenzi¹, Carlos Henrique Fernandes¹,
Lia Myamoto Meirelles¹, João Baptista Gomes dos Santos¹,
Flávio Faloppa¹, and Jorge Raduan Neto¹

Abstract

Background: Carpal tunnel syndrome (CTS) is the most common compressive neuropathy found in clinical practice. Recent studies evaluated which external factors could be involved in the CTS symptoms, including prolonged exposure to vibration, especially in the upper limb. This study investigated signs and symptoms in patients with CTS after using urban transport on (1) both upper limbs, (2) how long before these symptoms appear, and (3) the hands position or body reaction during the act of pressing the safety bars. **Methods:** The study was conducted from July 2012 to April 2013. A total of 205 (178 women and 27 men) patients were evaluated. CTS was diagnosed in 285 hands. All participants answered a questionnaire formulated by the authors. The questionnaire was applied by researchers who were single-blinded and not involved in the research. **Results:** Most of the participants (87%) were women, but there was no statistical significance in age between groups (women = 51.24 ± 8.47 years, men = 51.10 ± 6.52 years, $P > .05$). The symptoms appeared significantly in the first 15 minutes after boarding when compared with patients who had no symptoms during the journey. There was no difference between hands position along the journey and the onset of symptoms. **Conclusions:** The onset of symptoms in patients with CTS using urban public transportation most commonly occurred in the first 15 minutes after boarding. Public transport vibration seems to be, at least in part, directly related to the development of symptoms. Questionnaires for the assessment of paresthesia symptoms during the use of public transport may be useful for CTS diagnosis.

Keywords: carpal tunnel syndrome, neuropathy, vibration, paresthesia, urban transportation

Introduction

Carpal tunnel syndrome (CTS) is the most common neuropathy found in clinical practice. Although its reported prevalence varies from 0.1% to 9.2%, many cases are not accounted for due to lack of accurate diagnosis. Nevertheless, because CTS is responsible for considerable work absence, it is of great importance.^{7,9,10,13,14,16,19}

By definition, this syndrome refers to the compression of the median nerve in the carpal tunnel of the wrist. The most common symptoms include paresthesia, nocturnal paresthesia, hypoesthesia in the innervation of the median nerve territory,¹⁰ and pain.^{3,6}

Recent studies have attempted to evaluate external factors that trigger the symptoms of CTS. To prevent their appearance, Lukas, in a pioneering study, reported damage to the median and ulnar nerves in workers exposed to vibration.¹⁷ Prolonged exposure, especially on the upper limbs,

was associated with peripheral neuropathy¹² and secondary degeneration,¹⁵ inducing intraneural damage to peripheral nerves.

In our clinical practice, we have observed that some patients, attended at an ambulatory public hospital, often indicate an onset of paresthesia in the fingers, in the region of the median nerve territory, when using urban public transportation such as buses, trains, and subways.

Because exposure of the upper limb to mechanical vibration has been reported to exacerbate the symptoms of CTS,

¹Federal University of São Paulo, Brazil

Corresponding Author:

Luiz Guilherme de Saboya Lenzi, Departamento de Ortopedia e Traumatologia, Universidade Federal de São Paulo, Disciplina de Cirurgia da Mão e Membro Superior, Rua Borges Lagoa 786, Vila Clementino, São Paulo 04038-001, Brasil.
Email: lenzimedica@yahoo.com.br

Figure 1. Hand position when symptoms were experienced: (A) standing with hand down without holding the safety bar, (B) standing with hand up holding the safety bar, (C) standing with hand down holding the safety bar, (D) seated holding the safety bar, and (E) seated without holding the safety bar.

this study used questionnaires to quantitatively evaluate whether patients with CTS using urban transportation reported symptoms of paresthesia on one or both limbs, how long it took for symptoms to appear, and if hand or body position while holding the safety bars influenced symptom onset.

Materials and Methods

Inclusion criteria were patients with a clinical diagnosis^{8,18} CTS that used urban public transportation including bus, train, and subway. Patients with other complaints such as neck pain, tendinopathy, who had experienced any type of trauma, and who used bicycles or motorbikes for transportation were excluded from the study.

The study, conducted from July 2012 to April 2013, included 205 participants, 178 women and 27 men, for a total of 285 hands evaluated and diagnosed with CTS. CTS was diagnosed using the list of 6 clinical criteria as described previously.² Patients with 3 or more of the following clinical criteria were considered positive: (1) paresthesia and numbness in the median nerve territory, (2) nocturnal paresthesia, (3) thenar atrophy, (4) positive Phalen test, (5) positive Tinel sign, or (6) decreased 2-point discrimination.

All participants answered a questionnaire formulated by the authors and applied blindly by researchers not involved in the study (Appendix 1).

This questionnaire contained questions regarding the presence or absence of hand symptoms when using public transportation, as well as other questions such as type of transportation, time to symptom onset after boarding (<15, 15, 30, or 60 minutes), and hand position when symptoms were experienced (seated holding the safety bar, seated without holding the safety bar, standing with hand up holding the safety bar, standing with hand down without holding the safety bar, or standing with hand down holding the safety bar) as illustrated in Figure 1.

Statistical Analysis

Patient data were represented as percentage and expressed as means and standard deviations. After confirming normal distribution of variables using the Kolmogorov-Smirnov test, Student *t* test was used to compare the means of two continuous variables. A 5% significance level was used. A nonparametric chi-square test was used to test 2 nominal variables in the questionnaire.

Results

Most of the participants (87%) were women, but there was no statistical significance in age between groups (women = 51.24 ± 8.47 years, men = 51.10 ± 6.52 years, $P > .05$), with a normal data distribution (Kolmogorov-Smirnov test).

Table 1. Relevant Study Results According to Analyzed Variables.

(Bus × subway/train)	t statistic	P value	SE	Interpretation at 5% significance
Symptom	0.071	.828	0.043	There is no difference between the percentage of patients with symptoms in the different means of transport
Onset of symptoms < 15 min	-1.995	.009	0.055	There is a difference between the percentage of patients with symptoms within 15 min of boarding
Hand position on the safety bar	-0.791	.330	0.029	There is no difference between the percentage of patients with different hand positions regardless of transportation types

Note. t test on the equality of means for independent samples.

There was no statistical difference between types of public transportation among patients who developed symptoms ($P = .828$, $SE = 0.043$), suggesting that the type of urban transportation (bus/train/subway) had no effect on the onset of symptoms.

Based on questionnaire responses, the only significant time to onset of symptoms in patients with CTS was in the first 15 minutes after boarding, compared with patients with no symptoms during the journey ($P = .009$, $SE = 0.055$).

There was no statistical significance between hand position and symptom onset during the journey ($P = .33$, $SE = 0.029$), as shown in Table 1.

Discussion

The observation that CTS affected women more often than men matches previous reports² and reinforces the reliability of this study sample.

Gold standard, a term often used in clinical medicine to refer to a diagnostic method, implies a criterion for definitive diagnosis. However, a gold standard only exists if there are several clinical studies with similar findings obtained in a relevant manner. If no consensus exists for criteria used to diagnose a disease, then there is no gold standard for diagnosis. Often, the electromyography (EMG) test is considered the gold standard for diagnosis of CTS, but there has been no consensus. Different techniques are used to perform the test and the results are operator-dependent.

The addition of a clinical sign, such as the triggering of symptoms by vibration in urban transportation, can enrich the set of diagnostic tools used to assess CTS. It is a sign easily understood by the patient and can help physicians diagnose the syndrome.

This study showed that vibration transmitted during the use of urban transportation had a significant effect in triggering CTS symptoms. These findings are concordant with studies that show that CTS can be triggered in workers experiencing vibration actions.²⁰ This vibration, which can be caused by work tools, causes repetitive nerve stimulation in areas already affected and compressed by fibrotic

nodules, which can trigger symptomatic responses such as paresthesia.^{1,4,5,20}

The replication of symptoms caused by vibration can be used for diagnostic assessment of CTS. Hubbard et al used a vibrometer to evaluate the triggering of CTS symptoms in patients exposed to the vibration.¹¹ Their results support our findings, further underscoring the usefulness of this factor for CTS diagnosis.

This study found a predominance of symptoms in patients using buses for transportation, and although this difference was not statistically significant compared with other methods of urban transport, there was a rising trend. This observation is probably due to the fact that buses are the most widely used form of transportation in the city of São Paulo.

The onset of symptoms (usually paresthesia) appeared before 15 minutes of vibration induction; this finding is consistent with other studies reported in the literature.¹¹⁻¹³

Despite the importance of this subject, we found no other studies that describe the emergence of symptoms in patients with CTS using urban transportation. This study suggests directions for new medical research regarding this disease and its main symptoms, offering a simple, low-cost tool easily understood by patients that facilitates contact with clinicians and allows earlier and more accurate intervention.

In conclusion, the onset of symptoms in patients with CTS using urban public transportation most commonly occurred in the first 15 minutes after boarding. Onset was not related to the means of transport (bus, train, or subway). The type of hand support also did not affect this symptomatic response. Public transport vibration seems to be, at least in part, directly related to the development of symptoms in patients diagnosed with CTS. Questionnaires for the assessment of paresthesia symptoms during the use of public transport may be useful for CTS diagnosis.

Limitations

Although we used a simple and practical questionnaire to assess the influence of transport vibration on symptoms of

patients with CTS, considering the most common positions adopted, we recognize some limitations such as the following: (1) We could not control all hands positions adopted by patients during the journey, and (2) we did not evaluate other factors on different days that could influence the findings. For instance, we did not assess similar position of the hands without any vibration such as in the examination room. This is an interesting topic for future investigation.

Appendix I

Name:

Age: Gender: () M () F

Date: ____/____/____ Evaluated side: () Right () Left

- (1) Which urban public transportation do you usually use?
() Train/Subway () Bus () None (ends questionnaire)
- (2) How long do you stay in this mode of transport?
() 1h () 1-2h () 2-3h () 3-4h () >4h
- (3) Do you feel any symptoms in your hands when you use TRAIN/SUBWAY?
() Do not use () No () Yes, which one? Answer:
- (4) How long after boarding these symptoms appear?
() < 15 min () 15 min () 30 min () 60 min
- (5) What is your hands' position when these symptoms arise?
(Do not read the options for the patient)
() Seated holding the safety bar
() Standing with hand up holding the safety bar
() Standing with hand down without holding the safety bar
() Seated without holding the safety bar
() Standing with hand down holding the safety bar
- (6) Do you feel any symptoms in your hands when using BUS?
() Do not use () No () Yes, which one? Answer:
- (7) How long after boarding these symptoms appear?
() < 15 min () 15 min () 30 min () 60 min
- (8) What is your hands' position when these symptoms arise?
(Do not read the options for the patient)
() Seated holding the safety bar
() Standing with hand up holding the safety bar
() Standing with hand down without holding the safety bar
() Seated without holding the safety bar
() Standing with hand down holding the safety bar

Ethical Approval

This study was a prospective observational cohort study conducted in the ambulatory hand surgery group of the Department of Orthopedics and Traumatology (University Hospital) under approval of the ethics committee (34450614.6.0000.5505).

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (Federal University of São Paulo, UNIFESP; Brazil) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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