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Prevalence of Upper and Lower Extremity Tinel Signs in Diabetics: Cross-sectional Study from a United States, Urban Hospital-based Population

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Abstract

Objective: To evaluate the prevalence of the Tinel Sign in the upper and lower extremities of patients with diabetes in an urban community.

Methods: An IRB-approved, prospective, cross-sectional, descriptive study was performed on patients with diabetes during their visit to the endocrinologist. Eighty-one consecutive patients (162 sides) were examined by a fellowship-trained Hand Surgeon, experienced in performing the "Tinel Sign". Mean duration of diabetes was 18.5 years. In the upper extremity known sites of anatomic entrapment were percussed; median nerve at the wrist (carpal tunnel), ulnar nerve at the elbow (cubital tunnel), radial sensory nerve in the forearm, and a negative control site. In the lower extremity, sites were tibial nerve at ankle (tarsal tunnel), proximal tibial nerve (soleal sling), common peroneal nerve at fibular neck (fibular tunnel), superficial peroneal nerve, deep peroneal nerve over dorsum of the foot, and a negative control site. Neuropathy was defined as a score greater than 4 on the Michigan Neuropathy Screening Instrument (MNSI). Statistical evaluation included linear regression, analysis of variance, and Tukey's post hoc test.

Results: 100% of the control sites had absent Tinel Sign. MNSI score and number of positive Tinel Signs were highly correlated ($r=0.94$, $p=0.001$). Upper extremity, prevalence of Tinel Sign in patients with neuropathy (i.e. MNSI >4) ranged from 46.2% to 65% compared to 2.4% to 19.5% without neuropathy (MNSI ≤ 4). Lower extremity prevalence ranges were 23% to 59% with neuropathy and 0% to 17.1% without neuropathy. The chances of having a positive Tinel Sign in the contralateral limb were 38.2%, 42.2%, 44.7% and 48.4% for carpal tunnel, cubital tunnel, fibular tunnel and tarsal tunnel, respectively.

Conclusion: Presence of a Tinel sign was highly correlated with presence of neuropathy in diabetics.

Keywords: Diabetes; Tinel sign; Neuropathy; Nerve compression

Introduction

Chronic nerve compression in patients with diabetes is estimated at 33% [1]. According to Vinik et al. [1], the most common nerve compressions are the median nerve at the wrist (i.e. carpal tunnel syndrome), the ulnar nerve at the elbow (i.e. cubital tunnel syndrome), and the common peroneal nerve at the knee (i.e. fibular tunnel syndrome). A Canadian, diagnostic prospective study, demonstrated the prevalence of chronic nerve compression, represented by carpal tunnel syndrome, to be 2% in non-diabetics controls, 15% in diabetic patients without neuropathy, and 30% in diabetic patients with neuropathy [2]. Due to the difficulty of establishing the presence of chronic nerve compression by electrophysiologic studies in diabetic patients with neuropathy, the same study [2] suggested that the presence of chronic nerve compression be based on the physical findings, such as a positive Tinel Sign. The purpose of this study is to document the prevalence of a positive Tinel Sign in the upper and lower extremity in the diabetic patients with and without neuropathy in a teaching community based practice of endocrinology in an urban city in the United States.

Research Design and Methods

An IRB-approved, prospective, cross-sectional study was done of a series of consecutive patients with diabetes having either an initial office visit or a follow-up visit with the endocrinology service at a teaching hospital located in the northeastern United States. Inclusion criteria included all consecutive patients with a diagnosis of diabetes, regardless of age or duration of diabetes. After the patient consented to the study,

they were initially seen by the senior endocrinologist followed by the hand surgeon. Exclusion criteria included the presence of confounding causes of neuropathy, such as hypothyroidism, hyperthyroidism, active alcoholism, vitamin deficiency, malnutrition, dementia, prior peripheral nerve surgery (i.e. those decompressed sites were excluded), amputation, stroke and history of small-fiber neuropathy. Patients with abnormal fasting glucose or impaired glucose during the oral glucose tolerance test were not included in the study.

The presence of a Tinel Sign was determined by a fellowship-trained Hand Surgeon. The flexed middle finger was used to percuss the skin over the known anatomic site of chronic nerve compression. A reflex hammer was not used. After percussion, a positive Tinel Sign was defined as a distally radiating tingling or buzzing phenomena perceived by the patient. In the lower extremity, pain with palpation

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at the anatomic entrapment site with or without distal radiation was equivalent to a positive Tinel's Sign. For example, a positive Tinel's Sign would be noted if the patient experiences pain with palpation at the fibular neck (i.e. common peroneal nerve compression) even without distal radiation. The presence of neuropathy was determined by the score of the Michigan Neuropathy Screening Instrument [3], with the presence of neuropathy being defined as a score of >4.

Eighty-one consecutive patients (162 sites) were included in the study. Eighty patients had Type II diabetes (98.7%). In the upper extremity the known sites of anatomic entrapment were percussed; median nerve at the wrist, ulnar nerve at the elbow, radial sensory nerve in the forearm, and a control site 10 cm proximal to the ulnar styloid in the forearm. In the lower extremity, some of the known sites of anatomic entrapment were palpated: the tibial nerve at the ankle, proximal tibial nerve in the calf, the common peroneal nerve at the fibular head, superficial peroneal nerve 10 cm proximal to the lateral malleolus, deep peroneal nerve over dorsum of the foot, and a control site 10 cm proximal to the medial malleolus.

For the statistical methods, prevalence was determined for each site by the number of subjects with positive Tinel Signs at that site divided by the number of subjects. Ninety-five percent confidence intervals were determined for each prevalence. To determine the relationship

between the number of positive Tinel Signs in each subject and their MNSI scores a simple linear regression was determined as well as the correlation coefficient. To compare MNSI scores with the number of Tinel Signs (none, one limb, or both) for individual sites, an analysis of variance was performed. If this analysis was found to be significant ($p < 0.05$), a Tukey's post hoc test was done to determine pairwise differences.

Results

The control sites in the upper and in the lower extremity had 0% prevalence of a positive Tinel Sign.

Eighty of the eighty-one patients had Type II diabetes. The mean duration of diabetes was 18.5 years. The prevalence of a Tinel Sign in the upper and lower extremity is illustrated in figure 1. In the upper extremity sites of subjects with neuropathy (MNSI > 4), the range of prevalence for the individual sites ranged from 46.2% (left carpal tunnel) to 65% (left cubital tunnel). In subjects who presented without neuropathy (MNSI < 4) the range was between 2.4% for radial sensory nerve (both left and right) and 19.5% for the right cubital tunnel.

For the lower extremity, in subjects with neuropathy, the prevalence of positive Tinel Signs ranged from 23.1% (right superficial peroneal nerve) to 59.0% (for both right tarsal tunnel and fibular tunnel).

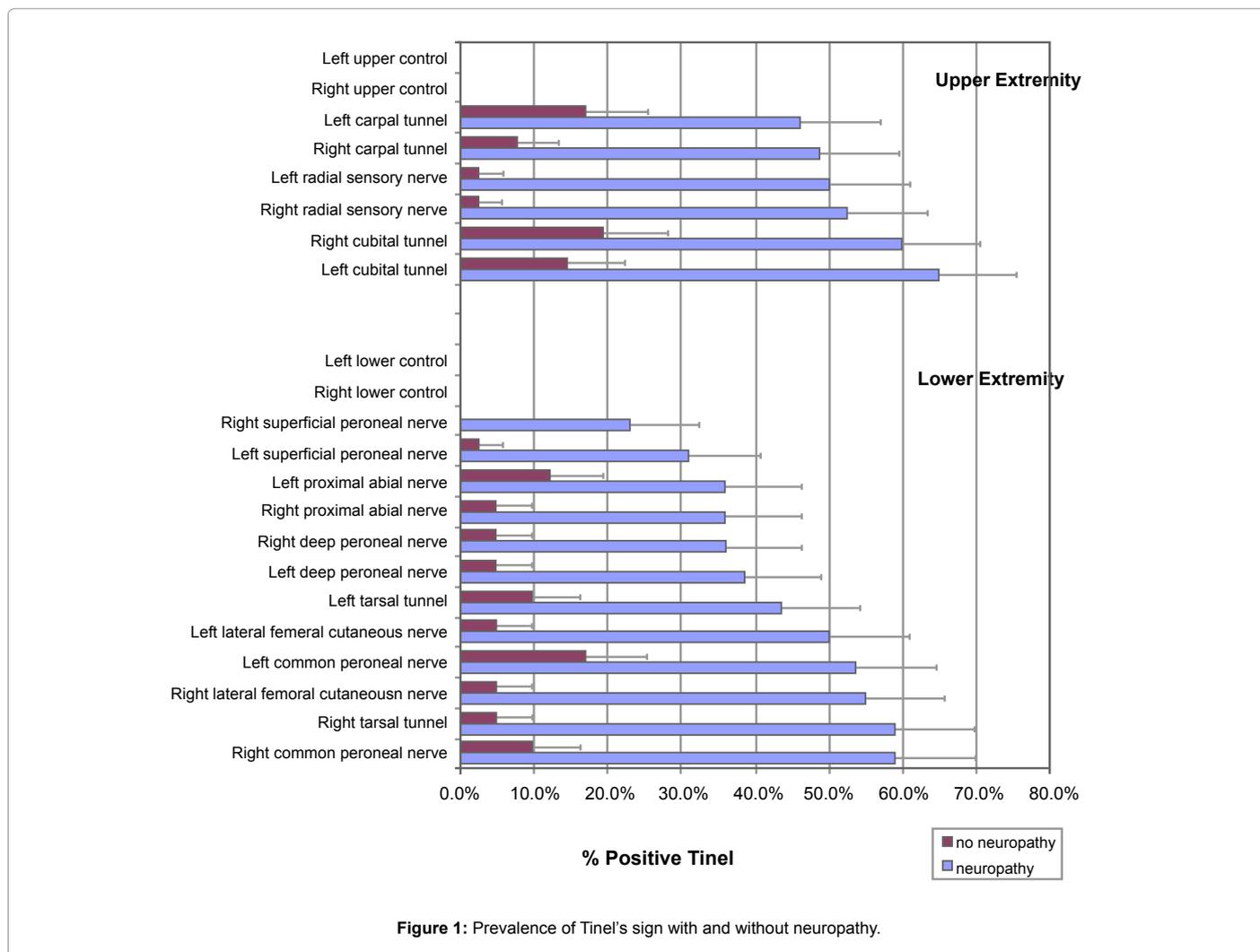


Figure 1: Prevalence of Tinel's sign with and without neuropathy.

Without neuropathy, the range was from 0 in the right superficial peroneal nerve to 17.1% in the left common peroneal nerve.

Table 1 indicates the chances of both right and left sites of having positive Tinel Signs if either limb has a positive sign. The chances are 38.2%, 42.2%, 44.7% and 48.4% for carpal tunnel, cubital tunnel, the common peroneal (i.e. fibular tunnel) and tarsal tunnel, respectively.

The number of positive sites found in each individual correlates highly with MNSI score ($r=0.94$, $p=0.001$) as shown in figure 2. Moreover, there is a significant difference ($p<0.001$) between MNSI scores and whether subjects had no positive Tinel Signs, a positive Tinel Sign on one side, or positive Tinel Sign on both sides for each of four sites as indicated in figures 3A-3D.

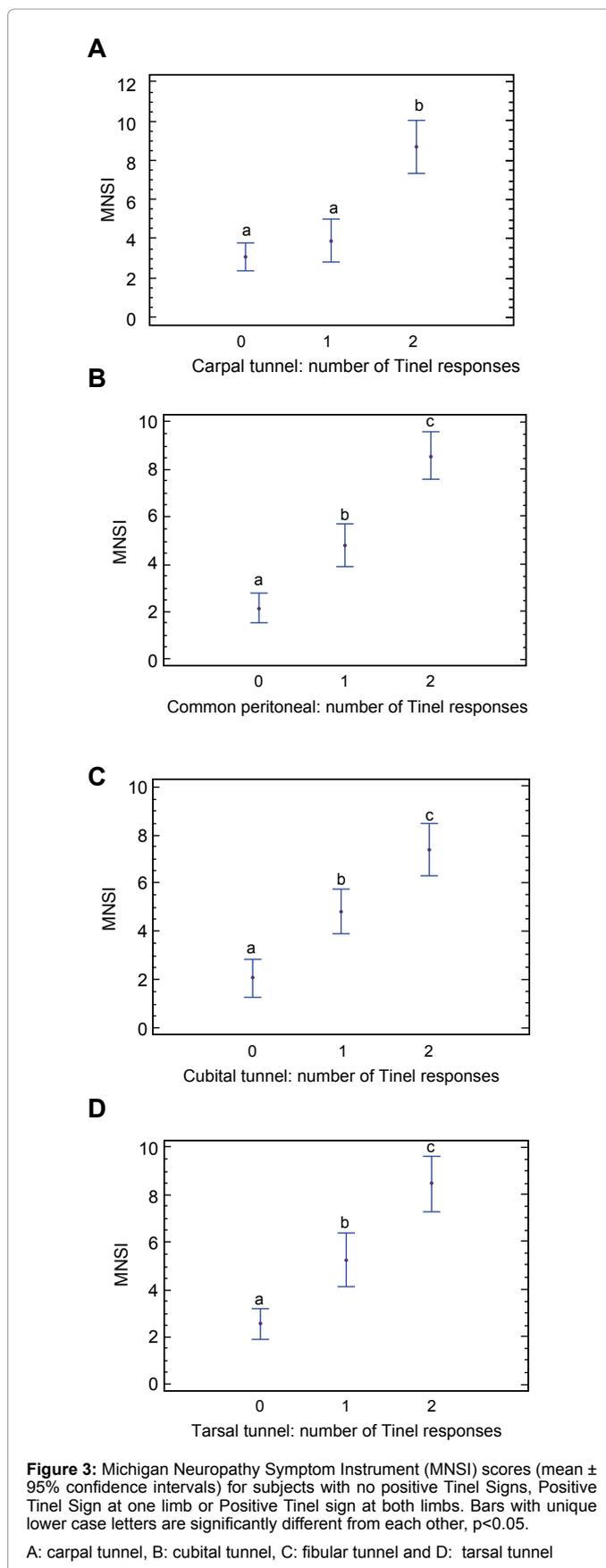
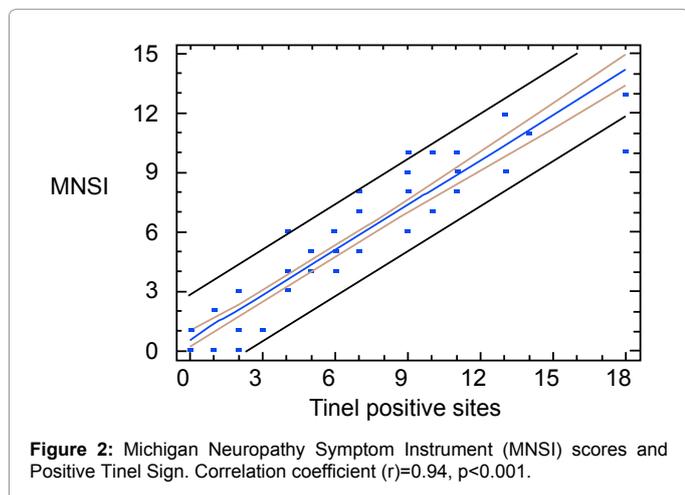
Discussion

This study documents the prevalence of the Tinel Sign in the upper and lower extremity of patients with diabetes and demonstrates that the high positive correlation of Tinel Sign with the degree of neuropathy ($r=0.94$). This correlation was stratified according to the site for entrapment neuropathy, at individual and aggregate sites. In our study, the presence of neuropathy was determined by the Michigan Neuropathy Screening Instrument, which recently has been demonstrated again to be reliable and to correlate well with neuropathy as defined electrophysiologically in a cohort of patients with diabetes [4]. In this recent study, the prevalence of neuropathy was found to be 33% by electrodiagnostic criteria and 31% by the MNSI being >4 , the criteria used in our study.

The presence of a positive Tinel Sign correlates well with the presence of chronic nerve compression. Experimental models of chronic nerve compression in the lower extremity of the rat [5] and primate [6] have demonstrated demyelination after 6 months of mild compression. Diabetic rats have been demonstrated electrophysiologically to be

	Carpal	Cubital	Common peritoneal	Tarsal
No Tinel (n)	47	36	43	50
One Tinel (n)	21	26	21	16
Both Tinel (n)	13	19	17	15
Total Tinel (n)	34	45	38	31
Total Subjects (n)	81	81	81	81
% with any Tinel	42.0%	55.6%	46.9%	38.3%
% both if one Tinel*	38.2%	42.2%	44.7%	48.4%

Table 1: Chance of Positive Tinel Signs in Contralateral limb.



susceptible to chronic compression using this same model [7]. Using more sophisticated evaluation techniques, it has been demonstrated that the earliest changes with this model are in the Schwann cells and associated with axon sprouting [8,9], providing the neurophysiologic basis for the clinically elicited Tinel sign. Recently, a positive Tinel sign has been correlated with electrodiagnostic studies for ulnar nerve compression at the elbow [10], and a positive Tinel sign has been demonstrated to be of positive predictive value in the response of tibial nerve decompression at the medial ankle in diabetics with neuropathy [11]. In our study, the areas that revealed the greatest number of positive Tinel Signs (i.e. from greatest to least) for the upper extremity were the ulnar nerve at the cubital tunnel, radial sensory nerve in the forearm, and median nerve at the wrist. For the lower extremity, these sites were the tibial nerve at the tarsal tunnel, common peroneal nerve at the knee, deep peroneal nerve at dorsum of the foot, tibial nerve in the calf, and, finally the superficial peroneal nerve in the leg (Table 1).

The results of this study suggest that patients with diabetes who complain of numbness and tingling (paresthesias) or muscle weakness in the upper or lower extremities should undergo a physical exam which consists of Tinel Sign evaluation at the known sites of anatomic entrapment of peripheral nerves. The differential diagnosis should include peripheral neuropathy, polyneuropathy, radiculopathy, and chronic nerve compression at one or more locations. Electrodiagnostic testing should be considered to distinguish among these potential diagnostic possibilities. We also suggest that the presence of a mononeuropathy, such as carpal tunnel syndrome in the upper extremity, should trigger the caregiver to search for entrapment neuropathy in the lower extremity.

The limitations of this study include: (1) the Tinel Sign is not compared with the electrodiagnostic evaluation of the same peripheral nerve in our patient population, and (2) pre-diabetic patients are not evaluated. In order to establish the clinical diagnosis of tibial nerve compression at the medial malleolus (Tarsal tunnel syndrome), the American Academy of Neurology recommends completing a history and physical examination, including the presence of a positive Tinel sign, and carefully excluding radiculopathy and polyneuropathy [12]. Then, the Academy advises the following confirmatory tests: (A) Tibial motor Nerve Conduction Studies (NCSs) (B) Medial and Lateral Plantar mixed NCSs, (C) Medial and Lateral plantar sensory NCSs, and (D) the utility of needle electromyography is unclear. Recent electrophysiologic studies have demonstrated specific tests for early diagnosis of neuropathy [13], and for the presence of superimposed chronic nerve compression, at least for the median nerve in the carpal tunnel [14].

Conclusion

Chronic nerve compression, as assessed by the presence of Tinel's Sign at eighteen anatomic sites of potential nerve compression, was detected in a cohort of patients with diabetes, and the prevalence of the positive Tinel sign increased in the presence of neuropathy.

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Author S. Shar Hashemi, MD wrote the IRB, examined the patients for the presence of a Tinel sign and helped with the data evaluation, and manuscript preparation. Second author Isaam Cheikh, MD identified the patients to be included, examined patients, obtained the history necessary for the neuropathy symptom score, and participated in manuscript preparation. Finally, author A. Lee

Dellon, MD, PhD, created the study design, evaluated the data, and assisted in the manuscript preparation.

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