

Electrophysiological Correlate of the Phalen Test

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Objective: To investigate whether flexing the wrists, as in the Phalen test, results in slowing of the median distal motor latency (DML) or distal sensory latencies (DSL) in comparison with the ulnar nerve, in patients with the carpal tunnel syndrome (CTS).

Design: We performed nerve conduction studies on the median and ulnar nerves of 54 hands. We studied the DML and DSL at rest and upon wrist flexion for 1 and 3 minutes. We compared the results of the median nerve to that of the ulnar nerve during the different test conditions. We correlated our results with the clinical presence or absence of the Phalen sign.

Settings: The study was performed at the clinical neurophysiology laboratory of the department of neurology, at the American University Medical Center in Beirut, Lebanon.

Participants: The participants were patients with the clinical diagnosis of CTS referred to the laboratory for the electrophysiological evaluation of the median nerve in the carpal tunnel.

Intervention: Not applicable.

Main outcome measure: The main outcome measures were the DML and the DSL in the median nerves across the carpal tunnel in comparison with the ulnar nerves.

Results: We concluded that flexing the wrist for 1 or 3 minutes does not change the distal motor or sensory latencies of the median nerve to any statistical significance in comparison with the ulnar nerve irrespective of the degree of median nerve compression, and that there is no correlation with the Phalen sign.

Conclusions: The significance of this study is that flexing the wrist as in the Phalen test does not correlate with compression of the median nerve neither in normal wrists nor in patients with different degrees of CTS.

Key Words: carpal tunnel syndrome, electrophysiology, median nerve, Phalen test

(*Neurosurg Q* 2014;24:237–239)

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The authors declare no conflict of interest.

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The Phalen test (PT) is a provocative test that helps in the clinical diagnosis of the carpal tunnel syndrome (CTS). It has been described and studied extensively in the literature, but no consensus has been reached concerning its clinical value in diagnosing the CTS.^{1–5} Studies to try to correlate the Phalen sign (PS) with electrophysiological results are contradictory and debatable. The question is whether the PT is misleading in overdiagnosing or underdiagnosing the CTS, or whether it has no clinical value in the fact that it is present only in severe cases where the classical sensory and motor disturbances are present and already have lead to the clinical diagnosis of CTS.² The aim of this study is to evaluate whether flexing the hand in performing the PT actually changes the electrophysiological parameters of the median nerve and whether these changes, if any, correlate with the clinical symptoms of the PT.

MATERIALS AND METHODS

Twenty-seven patients (22 females and 5 males), aged 30 to 58 years, with the clinical diagnosis of CTS in either hand, underwent nerve conduction studies (NCS) of the median and ulnar nerves at the wrist. The diagnosis of CTS was based on the presence of numbness, paresthesias, or pain limited to the lateral fingers, exacerbated at night, with or without weakness of the abductor pollicis brevis muscle. These patients had no clinical symptoms or signs of cervical root disease or polyneuropathy. The electrophysiologist who performed the NCS was blinded to which hand had the clinical symptoms of CTS. The distal motor latencies (DML) and distal sensory latencies (DSL) of the median and ulnar nerves were calculated at rest and after flexing the wrist at 90 degrees for 1 and 3 minutes. The temperatures of the hands were maintained at 32°C. No needle EMG was performed.

The compound muscle action potential of the median and ulnar nerves were studied with stimulation at the wrist and recording with surface electrodes from the abductor pollicis brevis and abductor digiti quinti muscles, respectively. The sensory nerve action potentials were recorded antidromically from the second and fifth digits.³ The recordings were performed similarly for both nerves at rest and after passive flexion of the wrist at 90 degrees for 1 and 3 minutes. The NCS were performed while the wrist was flexed.

Statistical analysis was performed to answer the hypothesis of whether wrist flexion, for 1 or 3 minutes, will delay the DML and/or DSL in the median nerves of

the hands with the clinical symptoms of CTS. The changes in these latencies were compared with the corresponding latencies in the ulnar nerve. Statistical analysis was performed to evaluate whether changes in latencies in symptomatic hands corresponded to the presence of the PS.

The Student *t* test, analysis of variance, and the χ^2 test were performed.

RESULTS

Fifty-four hands were studied. DML and DSL of the median and ulnar nerves were calculated at rest, and after wrist flexion for 1 and 3 minutes. The minimal, maximal, and mean latencies for both nerves in the different states were calculated (Table 1).

No electrophysiological evidence for CTS was found in 25 hands where the difference between the median and ulnar DML was < 1.5 msec and the difference in the DSL was < 1 msec. Fifty percent of the hands with normal latencies were reported to have a positive PT (Table 2).

Comparing the changes in the DML and DSL in the median and ulnar nerves for all the hands between the period of rest and after 1 and 3 minutes wrist flexion did not reveal any statistically significant difference.

Comparing the changes in the DML and DSL in the median and ulnar nerves between the period of rest and after 1 and 3 minutes wrist flexion did not reveal any statistically significant difference between the hands diagnosed to be normal or those suffering from mild, moderate, or severe CTS at rest.

Furthermore, comparing the changes in the DML and DSL in the median and ulnar nerves between the different periods in patients who had or lacked clinically a PS did not reveal any statistical difference with all *P*-values > 0.05.

DISCUSSION

The PT is a clinical maneuver that is performed in patients suspected of suffering from the CTS. The PT is considered positive if the patient develops numbness of the lateral 3 digits during the process of flexing the wrist. The degree of numbness usually correlates with the degree

TABLE 2. Percentage of Patients With Positive or Negative Phalen Sign in the Different Diagnostic Categories of Carpal Tunnel Syndrome

Phalen Sign	Electrophysiological Diagnosis				Total
	Normal	Mild	Moderate	Severe	
Negative					
N	14	10	2	0	26
%	51.9	90.9	22.2	0	
Positive					
N	13	1	7	7	28
%	48.1	9.1	77.8	100	
Total	27	11	9	7	54

The Fisher exact test < 0.05.

of compression of the median nerve in the carpal tunnel. Severe compression is associated with a positive PT and mild compression does not provoke numbness upon wrist flexion.²⁻⁴ The correlation of the PT and median nerve compression depends on the method of diagnosing the latter. Some studies diagnosed the CTS clinically, whereas others based the diagnosis on different electrophysiological criteria.⁴⁻¹²

Compression of the median nerve in the carpal tunnel results in delay of the DSL and DML. The delay is diagnosed in relation to the normal values in the laboratory where the study is performed as well as in comparison with the DSL and DML of the ipsilateral ulnar nerve. The reason for the discrepancy of the values between these nerves lies in the anatomic fact that the median nerve passes through the carpal tunnel, whereas the ulnar nerve lies outside the tunnel. Compression of the motor and sensory fibers of the median nerve passing in the carpal tunnel causes a delay in conduction in comparison with more proximal segments. When the volume of the carpal tunnel becomes small secondary to structural changes or edema of the tissue going through the tunnel then further flexion of the wrist, as the PT entails, causes further decrease in the volume of the tunnel, and further increase in the pressure inside the canal which results in further delay in motor and sensory conduction.^{13,14} The delay in distal motor or sensory conduction is not due to focal demyelination only, but is also attributed to ischemia of the nerve.¹⁵ Studies in the literature could not always confirm this hypothesis with some studies observing a delay in conduction with wrist flexion, whereas others finding no change.¹⁶⁻²⁴

The value of our study is that we compared the results of the median nerve to the ipsilateral ulnar nerve in the symptomatic and asymptomatic hands, we extended the flexion to 3 minutes, we evaluated the DML and DSL, we compared the results in the different degrees of entrapment diagnosed by the routine NCS, and we compared the results with patients with a PS.

We concluded that wrist flexion for up to 3 minutes does not significantly delay the DML or DSL of the median nerve in comparison with the ipsilateral ulnar nerve. Furthermore, we concluded that patients who have

TABLE 1. The Values of the Median (M) and Ulnar (U) Distal Motor Latencies (DML) and Distal Sensory Latencies (DSL) in Milliseconds for All Patients at Rest, and Upon Flexion of the Wrist for 1 and 3 Minutes

	Rest		1 min		3 min	
	M	U	M	U	M	U
DML						
Min.	3.0	2.2	3.2	2.1	3.0	2.1
Max.	6.5	3.6	6.5	4.0	6.7	3.9
Mean	4.9	2.8	4.1	2.9	4.1	2.8
DSL						
Min.	2.0	1.9	2.3	1.9	2.3	1.7
Max.	5.0	3.1	5.0	3.2	5.1	3.3
Mean	3.2	2.3	3.3	2.4	3.2	2.4

a PS do not have any change in their distal latencies upon wrist flexion concluding that the symptoms produced by wrist flexion are not caused by further delay in conduction or further entrapment of the median nerve in the carpal tunnel. Moreover, 50% of the hands with normal NCS had a PS.

We therefore conclude that the PT does not have an electrophysiological correlate, that is to say, it may be present without evidence for compression on the median nerve, and its presence does not indicate further compression of an already entrapped nerve. We therefore recommend that all patients with the clinical suspicion of CTS undergo electrophysiological study of the median nerve across the carpal tunnel irrespective of whether they have or do not have a PS.

The primary limitation of this study is the small sample size and unequal sex distribution making the statistical analysis weak. We therefore suggest this work to be a pilot study for further research on this topic.

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