

# An Evaluation of Provocative Diagnostic Tests for the Carpal Tunnel Syndrome

PANUPAN SONGCHAROEN, M.D., ORACHAT TOSAYANONT, M.D., CHAROEN CHOTIGAVANICH, M.D.

*Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital,  
Mahidol University, Bangkok 10700, Thailand.*

**ABSTRACT:** A prospective study was carried out on sixty five individuals in order to evaluate the usefulness of provocative tests (wrist-flexion test, wrist extension test, nerve percussion test, and tourniquet test) in the diagnosis of carpal tunnel syndrome. All the tests were found to have a moderate to substantial degree of interobserver agreement. The sensitivity and specificity of each test were calculated. The wrist flexion (Phalen's) test was found to be the most sensitive (76.1%). The nerve percussion (Tinel's) test was the most specific (95%). The other two tests were less sensitive and not very specific.

Of all the nerve entrapment syndromes, compression neuropathy of the median nerve in the carpal tunnel is the most frequently encountered.<sup>1,2</sup> The pathological changes of the median nerve was first described in 1913, but it has been only in the past two decades that the carpal tunnel syndrome has attained its rightful place as the primary cause of numbness and tingling in the fingers. Since Marie and Foix first recommended sectioning the transverse carpal ligament to decompress the median nerve for carpal tunnel syndrome, many tests have been advocated for diagnosis.<sup>3-13</sup> There has been a considerable lack of agreement on the reliability of these tests for the accurate clinical assesment of the median nerve compression at the wrist. Among the most popular laboratory and clinical diagnostic tests in use today are the so called provocative tests. These are based on the premise that stress on a damaged median nerve will increase the symptoms of pain or paresthesia, or both.

The purpose of this study was to evaluate the usefulness and the reliability of the wrist-flexion (Phalen's) test, wrist-extension (reverse Phalen's) test, nerve percussioin (Tinel's) test and tourniquet's test in diagnosing carpal tunnel syndrome.

## MATERIALS AND METHODS

From October 1984 to January 1988, prospec-

tive studies were carried out on sixty-five individuals of both sexes (107 involved hands) at the Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University. The subjects had no history of diabetes, alcoholism, hand trauma, or peripheral neuropathy. Forty-five of these subjects (67 hands) had not only symptoms and signs characteristic of carpal tunnel syndrome but also definite abnormalities of nerve conduction study with a terminal motor latency of affected median nerve of more than 4.5 millisecond or of one millisecond more than on the opposite (asymptomatic) side, or a distal motor conduction velocity across the carpal tunnel of less than 49 m/sec. or of 1 m/sec. less than on the opposite (asymptomatic) side. Twenty of these subjects were healthy volunteers who had no history and symptoms of carpal tunnel syndrome, diabetes, alcoholism, hand trauma, or peripheral neuropathy.

After physical examination was done, the provocative tests were performed by two independent examiners as follows.

Tinel's (median-nerve percussion) test. The examiner gently tapped the area over the median nerve at the flexor retinaculum or just proximal to it by a hammer or a finger. The test result was considered positive if this produced transient tingling sensation in the distribution of the nerve.

Tourniquet's test. A pneumatic blood-pressure cuff, applied proximal to the elbow, was inflated to a pressure 10 mmHg higher than the patient's systolic pressure. If the patient experienced paresthesia or numbness in the thumb or in the index or long finger within sixty seconds of inflation, the test result was considered positive.

Phalen's (wrist-flexion) test. The patient actively placed the wrist in complete flexion. If numbness and tingling were produced or exaggerated in the median-nerve distribution of the hand within sixty seconds, the test result was considered positive.

Reverse Phalen's (wrist-extension) test. The patient actively placed the wrist in full extension. If numbness and tingling were produced or exaggerated in the median-nerve distribution of the hand within sixty seconds, the test result was considered positive.

The results of the provocative tests from two observers were analysed for interobserver agreement by Kappa statistics. The results of the provocative tests in the first group (with definite signs and symptoms and positive result of electrodiagnostic study) of 45 subjects were then compared with the results in the control group. All of the data were then evaluated to determine the sensitivity and specificity.

## RESULTS

The measurement of interobserver agreement on the result of the provocative tests was performed by using Kappa statistics.<sup>14</sup> The K value of the Tinel's, tourniquet, Phalen's and reversed Phalen's test were 0.758, 0.70, 0.68 and 0.55 respectively which showed that the strength of interobserver agreement was substantial in the Tinel's, tourniquet, and Phalen's test, and moderate in the reversed Phalen's test. (Table 1)

In the control group of 40 hands, 2 positive results (false positive) of Tinel's test, 7 of tourniquet test, 5 of Phalen's test, and 3 of reverse Phalen's test were found.

In the group with median carpal tunnel syndrome of 67 hands, there were 19 false negative re-

sults of Tinel's test, 18 of tourniquet test, 16 of Phalen's test, and 20 of reverse Phalen's test.

A measure of the usefulness of the provocative tests was carried out by calculating the sensitivity and specificity rates. The results are shown in Table 2.

From this study, Tinel's test was found to be most specific, Phalen's test was found to be most sensitive.

## DISCUSSION

The carpal tunnel syndrome is the most common and the most important of all the nerve entrapment neuropathy. A patient presenting with any numbness or tingling in the fingers or with any weakness or atrophy of the thenar muscles must be considered as having carpal tunnel syndrome. Although the patient's history is described as mostly typical of a gradual onset of numbness and paresthesia in the median distribution of the hand, Phalen found that less than 85% of the patients having sensory disturbance, and only 36% presenting with thenar atrophy. There are reports<sup>15,16</sup> of the carpal tunnel syndrome appearing with uncharacteristic clinical presentations, several diagnostic tests and investigations were described in order to make early and accurate diagnosis of this condition. Of all the tests and investigations described, the electrodiagnostic tests seem to be the most sensitive and specific tests for diagnosing compression of the median nerve in the carpal canal.<sup>3</sup>

However, electrodiagnostic tests are not infal-

TABLE 1  
The Measurement of Interobserver Agreement.

Test	Tinel's	Tourniquet	Phalen's	Rev. Phalen's
K value	0.758	0.70	0.68	0.55
Strength of Agreement	Substantial	Substantial	Substantial	Moderate

TABLE 2  
The Provocative Test Results

	Tinel's	Tourniquet	Phalen's	Rev. Phalen's
Carpal Tunnel Group*	19/67	18/67	16/67	20/67
Control Group**	2/40	7/40	5/40	3/40
Sensitivity (%)	71.64f	73.13	76.11	68.65
Specificity (%)	95	82.5	87.5	92.5

\*Number of false negative results/Total number tested

\*\*Number of False positive results/Total number tested

libile. A small percentage of patients with carpal tunnel syndrome have normal electrodiagnostic studies. Grundberg reported an 8% false-negative rate with the use of electrodiagnostic testing in a group of thirty-two hands.<sup>17</sup> For this reason, it is important to evaluate other clinical tests for their usefulness as adjuncts in the diagnosis of carpal tunnel syndrome, or even as substitutes for electrodiagnostic testing when such facility is not available.

For a test to be useful for diagnosis of a condition, it should be both sensitive and specific for the disease being studied, it should also be easily performed and giving a uniform result by different observers.

The provocative tests in our study were shown to have a substantial degree of interobserver agreement (k value 0.55-0.758) which is a highly satisfactory result for clinical tests.

The provocative tests, although not as sensitive as electrodiagnostic testing, were found to be very useful for diagnosing median-nerve compression neuropathy. We found that the wrist-flexion (Phalen's) test is the most sensitive of the four tests, as did Phalen and Gelberman. We obtained 76 percent positive result, compared with 80 percent in the 1972 study by Phalen, compared with 80 percent in the 1972 study by Gelberman. The specificity was 87.5 percent. Phalen first described the wrist flexion test in 1951. By unforced, complete flexion of the wrist, sustained for 60 second, the numbness and tingling in the median distribution of the hand will either be produced or exaggerated. In this position, the median nerve is compressed between the proximal edge of the transverse carpal ligament and the adjacent flexor tendons and radius. When the nerve is already partial-

ly compressed in the carpal tunnel, this further compression will almost immediately intensify the pain in the finger. However, the test cannot be properly performed when there is severe restriction of wrist motion or when significant sensory loss is already present in the median distribution. Phalen also mentioned that although there is greater pressure within the carpal tunnel when the wrist is in extension (reversed Phalen's test), this test seldom aggravates the symptoms of carpal tunnel syndrome.

The Tinel's test was almost the least sensitive of the four provocative tests (71.64% sensitivity), but it was the most specific (95%), with only a 5 percent false-positive rate in the control group. Mossman and Blau reported that techniques are important is conduction Tinel's test to diagnose carpal tunnel syndrome. Failure to elicit Tinel's sign in electromyographically confirmed carpal tunnel syndrome may have been due to a finger percussion, gentle tapping with a patellar hammer, or failure to appreciate that the carpal tunnel contents are compressed when the wrist is extended. Tapping over and immediately proximal to the carpal tunnel using a broad based Queen square hammer is the simplest and best way to elicit Tinel's sign.<sup>4</sup>

We found the other two provocative tests; the tourniquet test and the reverse Phalen's test to be less reliable, but can nevertheless be use as adjuncts to the previously-mentioned tests.

## CONCLUSION

The wrist flexion (Phalen's) and percussion (Tinel's) test are the most useful of the four provocative tests studied in the clinical diagnosis of carpal tunnel syndrome.

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