

# PHALEN TEST POSITIVATION TIME AND ITS CORRELATION WITH ELECTRONEUROMYOGRAPHY

## O TEMPO DE POSITIVAÇÃO NO TESTE DE PHALEN E A CORRELAÇÃO COM A ELETRONEUROMIOGRAFIA

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### ABSTRACT

**Objective:** To compare the classification of CTS by the Phalen test with electromyography. **Methods:** Cross-sectional observational study. Patients at orthopedic outpatient clinic with carpal tunnel syndrome were evaluated by the Phalen test and compared with the result of the electroneuromyography. **Results:** Sample of 33 patients, mostly women (87.9%). Most patients were already diagnosed with severe CTS by ENMG. The results of the Phalen test and the electromyography were equal in 26 of the 33 patients (78.8%). **Conclusion:** The Phalen test showed its applicability, since it had results similar to those of ENMG in most cases, especially in the most severe ones. The exam studied is a possible tool for the classification and recommendation of surgical treatment. **Level of evidence IV, Retrospective observational study.**

**Keywords:** Carpal Tunnel Syndrome. Median Nerve. Wrist.

### RESUMO

**Objetivo:** Comparar a classificação pelo teste de Phalen com a eletroneuromiografia (STC) na STC. **Métodos:** Estudo descritivo transversal. Pacientes do ambulatório de ortopedia com STC são avaliados pelo teste de Phalen, cujo resultado é comparado ao resultado da eletroneuromiografia (ENMG). **Resultados:** Amostra de 33 pacientes, em sua maioria mulheres (87,9%). Maioria dos pacientes com STC grave pela ENMG. Os resultados do teste de Phalen e da ENMG foram iguais em 26 dentre os 33 pacientes avaliados (78,8%). **Conclusão:** O teste de Phalen mostrou ter sua aplicabilidade, pois teve resultados semelhantes aos da ENMG na maioria dos casos, principalmente nos mais graves. O exame em estudo se mostra uma possível ferramenta de classificação e indicação do tratamento cirúrgico. **Nível de evidência IV, Estudo retrospectivo de observação.**

**Descritores:** Síndrome do Túnel Carpal. Nervo Mediano. Punho.

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### INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common neuropathy in the upper limbs. The incidence of the disease is estimated between 0.1% and 1% per year and the prevalence ranges between 5% and 15%, depending on the criteria used for diagnosis. More than 80% of patients are over 40 years of age, with women being more affected (5:1). Although bilateral involvement is common (> 50% of cases), the dominant hand is usually the first and most severely involved.<sup>1</sup> This syndrome is often considered a sensory disorder, since sensory fibers of the median nerve are more affected than motor fibers.<sup>2</sup>

One million adults from the United States are estimated (annually) to have CTS, requiring high-cost medical treatment for the health system. In 1995, Palmer et al. estimated that between 400,000 and

500,000 cases of CTS require surgical treatment annually in the United States, with an economic cost of more than \$2 billion per year. Surgical decompression rates for the UK are between 43 and 74 per 100,000/year.<sup>3</sup>

This is one of the most widely recognized occupational condition, particularly in industries in which work involves high strength/pressure and repetitive use of vibratory tools. Einhorn and Leddy<sup>4</sup> estimated an incidence of 1% on the general population and 5% on workers in industries that require repetitive use of hands and wrists. CTS exact pathogenesis is still unclear. Several theories have tried to explain the symptoms. The most popular ones are mechanical compression, microvascular insufficiency and vibration theories.<sup>5</sup> CTS has the compression of the median nerve as pathophysiological basis, when it passes through the carpal tunnel. This compression can occur due to any tenosynovial proliferation, abnormality of the

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wrist joint, tumor or muscle abnormality, producing a clinical picture of pain, paresthesias and hypoesthesias in the hand. In advanced stages, it can cause thumb paralysis and loss of sensitivity.<sup>6</sup> Several provocative tests are used for diagnosis with different sensitivity and specificity such as the Phalen and Tinel test.<sup>1</sup> The diagnosis is eminently clinical, based on symptoms and distribution of sensory changes of the hand; and neurophysiological, evaluating the median nerve conduction velocity. Electroneuromyography, besides being the main test for the diagnosis of this neuropathy, is essential to make the differential diagnosis among other neuromuscular pathologies and determine the severity of CTS.<sup>7</sup> The high prevalence of focal neuropathies (mononeuritis and compressive syndromes) is also noteworthy. Carpal tunnel syndrome is frequent in diabetic patients not only due to alteration of synovial tissue surrounding the nerve, but also because the nerve presents alterations secondary to high blood glucose.<sup>8</sup> Our study seeks to compare the results of electroneuromyography with a modification we proposed in the Phalen test. Thus, it aims to promote a new way of classifying and recommending a surgical procedure through the Phalen test.

## METHODS

This is a cross-sectional observational study. Data were collected between September and December 2018.

The study population is composed of patients with carpal tunnel syndrome that were referred and spontaneously went to the outpatient clinic.

The sample comprises patients that met the following criteria: clinical picture consistent with carpal tunnel syndrome, who underwent electroneuromyography and who agreed to undergo physical examination. All participants signed the informed consent form. The patient to be included in the study had to have at least the Phalen test positive among the physical examination tests, since it was the test to be evaluated in our study.

Those patients that already had electroneuromyography at the time of appointment with CTS diagnosis were included in the study.

Patients that have previously undergone surgical treatment for neuropathy; those who did not have the Phalen test positive for the examination, and those who did not perform electroneuromyography were excluded.

Data were collected through outpatient appointment in the orthopedic service by preceptors and residents of orthopedics and traumatology after training with the specialist in hand surgery of the service. Data on the appointment were recorded in an evaluation form we made, which guided the data collection. In the evaluation, we surveyed epidemiological data from the study population seeking for the presence of comorbidities; the tests of Tinel, Durkan and Phalen were performed during physical examination, and the result of electroneuromyography was noted.

The Phalen test was performed when each patient was included in the study, classifying the involvement into different degrees according to the time required for test positivation. Usually, the patient is actively examined (the patient himself performs movement) for 60 seconds, subjecting the wrist to forced palmar flexion against each other, so that the pressure inside the carpal tunnel increases and CTS paresthesia symptoms are exhausted, showing positive or negative results. In our study, we gauged the result according to the time it takes to make the test positive. If positive before 10 seconds, it will be considered as severe involvement; between 10 and 30 seconds, moderate; and 30 or more seconds will be classified as mild.

R software was used to estimate the sample size in the universe. The total sample was estimated by the simple Random Sampling technique (more details in Bolfarine and Bussab).<sup>9</sup> A 95% confidence

interval and a robust, maximum variance were adopted in estimates. With a 5% error in the parameters, the sample size was composed of 33 patients.

Data were organized and analyzed in the SPSS software version 20.0. The qualitative variables were described in a table. For quantitative variables, statistics were used: minimum, maximum, arithmetic mean and standard deviation. The Chi-Square Test was used to compare the proportions of patients with comorbidities.

The procedures described followed the ethical principles in research in force in the country ensuring confidentiality, anonymity and the non-use of the information to the detriment of others, and the data obtained were used only for purposes provided for in this study. Research Protocol No. 2,878,873, Ethics Committee of Federal University of Piauí.

## RESULTS

The analysis of the 33 evaluation forms of the patients included in the study showed a mostly female attendance, representing 87.9% of the total. On average, the patients were 44.6 years old.

Regarding the profession, we also observed that most patients with carpal tunnel syndrome were housewives/husbands, 24.2%, followed by those who performed cooking work. Regarding race, 57.6% of people declared themselves brown, 24.2% white, and 18.2% black.

All patients had a positive Phalen test, since it was a criterion to be included in our study. In total, 87.9% patients had the Durkan test and 72.7% had the positive Tinel test during physical examination. Only in 21.2% of the patients, atrophy of the thenar region was verified.

Of the 33 electroneuromyography tests evaluated, 54.5% were classified as severe. All obtained the same classification in the modified Phalen test (positive results in less than 10 seconds), thus, similar results in 100% of cases. Electroneuromyography tests classified as moderate involvement corresponded to 39.4%, of which 46.2% had the same result in the Phalen test, 53.8% were classified as mild and none as severe. The rest of the electroneuromyography, 6.1% had mild involvement as a result, also obtaining the same classification in the Phalen test, generating equal results in 100% of the cases, as shown in Table 1. Therefore, 26 out of 33 patients had similar results in both modified Phalen test and electroneuromyography (78.8%).

**Table 1.** Percentage of similar results of the modified Phalen Test compared with electroneuromyography.

ENMG	N	%	Modified Phalen test	N	% agreement between exams
Mild	2	6.1	Mild	2	100
			Moderate	-	
			Severe	-	
Moderate	13	39.4	Mild	7	
			Moderate	6	46.2
			Severe	-	
Severe	18	54.5	Mild	-	
			Moderate	-	
			Severe	1	100

ENMG: electromyoneurography.

## DISCUSSION

More than 80% of patients with CTS are women and over 40 years of age,<sup>2</sup> agreeing with the findings of Jesus Filho et al.<sup>1</sup> In our study, however, the involvement in women is higher, reaching 87.9%. This

fact may have sociocultural influence in our state, and even in Brazil itself, where there is a greater concern and search for medical appointments among women, which can be confirmed by a study conducted by the Brazilian Institute of Geography and Statistics (IBGE).<sup>10</sup> It also exemplifies the fact that all male patients in the study were classified as severe by both ENMG and Phalen's test.

In addition to the Phalen test, the semiology of carpal tunnel syndrome includes Durkan and Tinel tests, with 87% sensitivity and 90% specificity for the Durkan test. Tinel test is less sensitive, with only 56% positivity in patients in whom CTS was confirmed by electrophysiological investigation and 80% specificity.<sup>1</sup> Our study confirms this trend, since the Durkan test was positive in 87.9% and Tinel in 72.7% of cases.

Electroneuromyography, besides being the main test for the diagnosis of this neuropathy, is essential to make the differential diagnosis among other neuromuscular pathologies and determine the severity of CTS. Recently, with the appearance of high resolution ultrasound, scholars have been trying to demonstrate the usefulness of this method as an aid tool in the diagnosis of carpal tunnel syndrome, especially in cases in which patients showed symptoms compatible with the disease and normal physical and electroneuromyography results. A 9 mm<sup>2</sup> area of the upper median nerve in the distal carpal tunnel at the level of the pisiform bone, measured by ultrasound, is considered a CTS diagnosis.<sup>7</sup> According to Carvalho et al.,<sup>7</sup> this is an examination with high sensitivity and specificity in diagnosis. However, it has not become a very reproducible examination to use it in our study.

Electroneuromyography has a 92.3% sensitivity and a 81.8% specificity.<sup>11</sup> It is effective in detecting CTS, but not in ruling out the diagnosis. In this study, 54.5% of the patients had ENMG classified as severe, 39.4% as moderate and 6.1% as mild. All patients considered severe by complementary examination also had the same classification in the Phalen test, showing that the two tests have similar results in more advanced cases, which are more likely to require surgical treatment. It is also noteworthy that 21.2% of

patients already had atrophy of the thenar region. In these cases, the involvement had already exceeded the sensory portion and reached the motor portion of the median nerve. They were classified as severe in both the examination and the test, since atrophy is a sign of an advanced disease.

The cases in which Electroneuromyography showed mild and severe results, it obtained the same results in Phalen test. However, when the electroneuromyography result was moderate, the divergence between the results was very large, with only 46.2% agreement.

The main objective of our study was to compare the results of the Phalen test with those of ENMG. Initially, all patients included in the study had the positive test, since this was one of the inclusion criteria. The results showed that 26 out of 33 patient had the same result in both tests (78.8%).

We observed that most patients were already at an advanced stage of the disease. It possibly happened due to the study being carried out in a specialized tertiary service, to which most are referred when the primary care physician sees the need for surgical treatment, or also due to a delayed diagnosis of mild cases, when the evaluation is not carried out by a specialist. We observed there was a great agreement between the results of the test under study and the examination at the extremes of involvement degrees, that is, in mild and severe cases, reaching 100% of similar results. However, the results were quite divergent in those with moderate involvement. All patients classified as severe with the Phalen test were recommended for surgical treatment and waited for the procedure at the hospital, which shows that, in addition to other studies, this examination may be an important tool for direct indication of surgical treatment for CTS.

## CONCLUSION

The Phalen test showed results similar to those of ENMG, especially in the most severe and mild cases, but with large differences in moderate cases. The test showed its value in cases that require surgical treatment, and it may serve as a suggestive recommendation tool.

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