Diagnostic Contradictions in Carpal Tunnel Syndrome*

Contradições diagnósticas na síndrome do túnel do carpo

Henver Ribeiro Paiva Filho[1] Antonio Carlos Costa[1] Valdênia Graças Nascimento Paiva[1] Nilson Roberto Severino[1]

[1] Hand Surgery Service, Santa Casa of São Paulo, São Paulo, SP, Brazil

Rev Bras Ortop 2023;58(2):290–294.

Address for correspondence Valdênia das Graças Nascimento Paiva, MD, Orthopedics and Traumatology, Hospital de Clínicas of Federal University of Triângulo Mineiro, Uberaba, MG, Brazil (e-mail: vallfmtm@yahoo.com.br).

Abstract

Objective Given the divergence of opinions on the need for complementary tests such as ultrasonography (US) and electroneuromyography (ENMG) for the diagnosis of carpal tunnel syndrome (CTS), we aimed to elucidate which of them presents greater accuracy for the confirmation of the presence or not of this condition.

Methods A total of 175 patients from a hand surgery outpatient clinic were clinically evaluated, and the results of clinical trials (Tinel, Phalen and Durkan), US (normal or altered), and ENMG (normal, mild, moderate and severe) were noted, crossed, and submitted to a statistical analysis to verify the agreement between them.

Results with the sample had a mean age of 53 years, with a prevalence of female patients (159 cases). Of the patients with positive clinical test, 43.7% had normal US and 41.7% had no alterations on the ENMG. Negative results were found on the Tinel in 46.9%, on the Phalen in 47.4%, and on the Durkan in 39.7%. In the crossing between the results of the ENMG and those of the other diagnostic methods, there was little statistical agreement between them.

Conclusion There was no agreement between the results of the clinical examinations, the US and the ENMG in the diagnosis of CTS, and there is no clinical or complementary examination for CTS that accurately determines the therapeutic approach.

Level of Evidence IV, Case Series.

Keywords
- electromyography
- median neuropathy
- paresthesia
- carpal tunnel syndrome

Resumo

Objetivo Diante da divergência sobre a necessidade de exames complementares, como ultrassonografia (US) e eletroneuromiografia (ENMG) para o diagnóstico da síndrome do túnel do carpo (STC), objetivamos elucidar qual deles apresenta maior precisão na confirmação da presença ou não desta afecção.

Métodos Um total de 175 pacientes de um ambulatório de cirurgia da mão foram avaliados clinicamente, e os resultados dos testes clínicos (Tinel, Phalen e Durkan), da US (normal ou alterada) e da ENMG (normal, leve, moderada e grave) foram anotados, cruzados, e submetidos a análise estatística para verificar a concordância entre eles.

Palavras-chave
- eletromiografia
- neuropatia mediana
- parestesia
- síndrome do túnel do carpo

* *Work performed at the Hand Surgery and Microsurgery Service of Santa Casa of São Paulo, São Paulo, SP, Brazil.*

received
July 21, 2021
accepted
October 14, 2021
article published online
February 4, 2022

DOI https://doi.org/10.1055/s-0042-1742337.
ISSN 0102-3616.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

Resultados A idade média da amostra era de 53 anos, sendo prevalente o sexo feminino (159 casos). Dos pacientes com teste clínico positivo, 43,7% apresentavam US normal, e 41,7%, ENMG sem alterações. Foram encontrados resultados negativos no Tinel em 46,9% no Phalen em 47,4%, e no Durkan em 39,7%. No cruzamento entre a ENMG e os demais métodos diagnósticos, houve pouca concordância estatística.
Conclusão Não houve concordância entre os resultados dos exames clínicos, da US e da ENMG no diagnóstico da STC, e não há exame clínico ou complementar para STC que determine a conduta terapêutica com precisão.
Nível de Evidência IV, Série de Casos.

Introduction

Carpal tunnel syndrome (CTS) accounts for 90% of all compressive neuropathies,[1] and is characterized by initial symptoms of paresthesia in the fingers innervated by the median nerve and, in advanced conditions, thenar atrophy and atrophy in the musculature innervated by this nerve.[2] The tinel, Phalen and Durkan clinical exams are considered classic tests for the initial evaluation, while ultrasonography (US) and electroneuromyography (ENMG) complement the investigation in dubious cases.[3,4]

Divergence of opinions between specialists and health services on the real need for complementary tests to confirm this condition, as well as regarding which is the best diagnostic test, sometimes delay treatment, especially for those patients with a tendency towards surgical intervention.[5]

Therefore, we aim to elucidate which examination, clinical or complementary, presents greater accuracy for the diagnosis of CTS, and which is able to support the medical decision in a reliable way in CTS therapy.

Casuistry and Methods

An attempt was made to contact by phone 245 patients who attended the hand surgery outpatient clinic due to CTS 6 months before the beginning of the study, and 175 were found and agreed to participate. The research procedures were in accordance with the current ethical standards for research in human beings, and free and informed consent was obtained from all participants.

The inclusion criteria were people of both genders, older than 18 years of age, who presented an ENMG with exclusive diagnostic hypothesis of CTS and at least 1 altered examination (US or ENMG) with a maximum performance interval of 1 month between them. Patients who had other neuropathies described in the ENMG report, those who did not present bilateral wrist US, or which had not been performed at the same time as the ENMG, and patients who had normal US and ENMG were excluded.

The ENMG exam was performed in all patients by the same neurologist using the same electromyograph (Neuropack model, Nihon Kohden Tomioka Corporation, Tomioka, Gunma, Japan), and the results were classified as normal, mild (alteration only in sensory conduction), moderate (altered sensory and motor conduction), and severe (altered sensory and motor conduction, and signs of denervation on needle electromyography).[6] The US scan was evaluated by the same team of radiologists, having as compression criterion the transverse area of the median nerve in the wrist $> 10\,mm^2$.

The sample consisted of 175 patients (350 hands), 159 females and 16 males. The mean and standard deviation for age were of 53 ± 9.9 years. Regarding occupational status, 100 (57.2%) patients declared themselves economically active, and 36 (20.6%), in work leave due to CTS. Of those who did not have an occupation, 52 (29.7%) stayed at home and 23 (13.1%) were retired.

The results of the clinical tests (Tinel, Phalen and Durkan) and complementary tests (US and ENMG) were submitted to a statistical analysis with the determination of the Kappa agreement coefficient.[7,8] The tests were performed with a significance level of 5% ($p < 0.05$).

Results

►**Table 1** shows the number of hands included with the results of the clinical tests, US and ENMG. Regarding US, 153 (43.7%) hands presented a cross-sectional area of the median nerve $\leq 10\,mm^2$. As for the ENMG, 146 (41.7%) hands had normal results, and, of the altered results, 11.1% were mild, 26.3%, moderate, and 20.9%, severe. When we evaluated the clinical trials alone, negative results were found on the Tinel in 164 (46.9%) hands, on the Phalen in 166 (47.4%) hands, and on the Durkan in 139 (39.7%) hands.

►**Table 2** shows the crossing of the US with the isolated clinical tests, as well as the discrepancy of in their results. We observed negative US and positive Tinel in 84 (24.0%) hands, and positive US and negative Tinel in 95 (27.1%) hands, with a Kappa of −0.031. For the US and Phalen, we found negative US and positive Phalen in 76 (21.7%) hands, and positive US and negative Phalen in 89 (25.4%) hands, with a Kappa of 0.051. For the US and Durkan, we observed negative US and positive Durkan in 90 (25.7%) patients, and positive US and

Table 1 Distribution of the results of the exams of the evaluated hands

Variable and result	n (%) ($N = 350$)
Ultrasound	
Normal	153 (43.7)
Altered	197 (56.3)
Electroneuromyography	
Normal	146 (41.7)
Mild	39 (11.1)
Moderate	92 (26.3)
Severe	73 (20.9)
Tinel	
Negative	164 (46.9)
Positive	186 (53.1)
Phalen	
Negative	166 (47.4)
Positive	184 (52.6)
Durkan	
Negative	139 (39.7)
Positive	211 (60.3)

Notes: Normal ultrasound: cross-sectional area of the median nerve $\leq 10\,mm^2$; altered ultrasound: cross-sectional area of the median nerve $> 10\,mm^2$.

negative Durkan in 76 (21.7%) patients, with a Kappa of 0.026.

In ►**Table 3**, when we evaluated the crossing of the ENMG with the other diagnostic methods, we observed little agreement between the ENMG and US, as well as between the ENMG and the clinical tests.

Discussion

Patients with a clinical diagnosis of CTS and complementary tests incompatible with each other have been constantly observed by hand surgeons, as well as by professionals in the fields of occupational medicine and medico-legal examinations, with a greater number of lawsuits due to this condition. One of the difficulties to better characterize patients with CTS resides in the definition of which is the most appropriate diagnostic method to verify this condition.

There is consensus among several authors that CTS presents frequently in females, reaching a rate of 97.7%,[9] similar to that of the present study, in which 90.9% of the cases occurred in women. We found a mean age of 53 years, which can be explained by factors in this age group, such as axon loss and vascular abnormality, that increase the susceptibility of the peripheral nerve to the effects of compression.[9]

In an analysis of the complementary tests, we understand that CTS diagnosis only by US is reckless, since the literature is vast in demonstrating conflicting values of normality of the median nerve (ranging from $10\,mm^2$ to $14\,mm^2$).[10–13] The finding of 43.7% of patients with a clinical diagnosis of CTS and normal ultrasound result, almost twice the rate found by Mondelli et al.,[14] further reinforces our questions regarding the usefulness of US in isolation for the accurate diagnosis of CTS.

As for the electroneuromyographic study, the finding of patients with clinical symptoms of CTS and normal ENMG result is not uncommon. According to the studies by Padua et al. [15] and Bagatur and Zorer,[16] more than half of the patients with CTS diagnosed by ENMG are asymptomatic, which was also consistent with the present study. Nevertheless, we found altered ENMG results in 58.3% of the hands, with the moderate degree being the most prevalent.

Regarding the reliability of the clinical tests, the study by De Krom et al.[17] prresent low predictive value for the diagnosis of CTS, as occurred in the present study, which

Table 2 Crossing between the ultrasound and clinical trial results

Variable and result	Ultrasound – n (%)		Total – n (%)	Kappa
	Negative	Positive		95% confidence interval
Tinel – n (%)				−0.031
Negative	69 (19.7)	95 (27.1)	164 (46.9)	(−0.135–0.073)
Positive	84 (24.0)	102 (29.1)	186 (53.1)	
Phalen – n (%)				0.051
Negative	77 (22.0)	89 (25.4)	166 (47.4)	(−0.053–0.155)
Positive	76 (21.7)	108 (30.9)	184 (52.6)	
Durkan – n (%)				0.026
Negative	63 (18.0)	76 (21.7)	139 (39.7)	(−0.078–0.130)
Positive	90 (25.7)	121 (34.6)	211 (60.3)	
Total – n (%)	**153 (43.7)**	**197 (56.3)**	**350 (100)**	

Notes: Negative ultrasound: cross-sectional area of the median nerve $\leq 10\,mm^2$; positive ultrasound: cross-sectional area of the median nerve $> 10\,mm^2$.

Table 3 Crossing between ultrasound and clinical test results with those of electroneuromyography

Variable and result	Electroneuromyography – n (%)		Total – n (%)	Kappa	Sens.	Spec.
	Negative	Positive		95%CI	95%CI	95%CI
Ultrasound – n (%)				0.212	65.2	56.2
Negative	82 (23.4)	71 (20.3)	153 (43.7)	(0.108–0.316)	(58.2–71.7)	(47.7–64.4)
Positive	64 (18.3)	133 (38.0)	197 (56.3)			
Tinel – n (%)				−0.062	50.5	43.2
Negative	63 (18.0)	101 (28.9)	164 (46.9)	(−0.166–0.042)	(43.4–57.5)	(35.0–51.6)
Positive	83 (23.7)	103 (29.4)	186 (53.1)			
Phalen – n (%)				−0.049	50.5	44.5
Negative	65 (18.6)	101 (28.9)	166 (47.4)	(−0.153–0.055)	(43.4–57.5)	(36.3–53.0)
Positive	81 (23.1)	103 (29.4)	184 (52.6)			
Durkan – n (%)				−0.035	58.8	37.7
Negative	55 (15.7)	84 (24.0)	139 (39.7)	(−0.139–0.069)	(51.7–65.6)	(29.8–46.1)
Positive	91 (26.0)	120 (34.3)	211 (60.3)			
Total – n (%)	**146 (41.7)**	**204 (58.3)**	**350 (100)**			

Abbreviations: 95%CI, 95% confidence interval; Sens., Sensitivity; Spec., specificity.
Notes: Negative ultrasound: cross-sectional area of the median nerve $\leq 10\,mm^2$; positive ultrasound: cross-sectional area of the median nerve $> 10\,mm^2$.

makes us consider the Tinel, Phalen and Durkan tests deficient when used isolatedly for the definition of who really carries the condition. However, the Durkan test was the one that obtained the highest sensitivity and specificity in relation to the others, which makes us recommend the inclusion of this test in the outpatient routine in patients with suspicion of STC.

The present study revealed little agreement between the ENMG and US, as well as between the ENMG and the clinical tests, with very low Kappa values. Furthermore, we found that the clinical tests had no statistical association with CTS severity, which demystifies the excessive rate of requests for complementary tests without correlation with the complaint and with the detailed examination of the patient.

Conclusion

The present study demonstrated that the accurate diagnosis of CTS is still controversial, since to date there is no highly-sensitive and specific tool capable of defining the condition, with no agreement regarding the clinical examination, the US scan and the ENMG in the diagnosis of CTS. We conclude that there is no clinical or complementary examination for CTS that accurately determines the therapeutic approach.

Financial Support
The authors declare that they have received no financial support for the conduction of the present study. All the costs regarding the collection, analysis, interpretation of the results and writing of the article were covered exclusively by the authors.

Conflict of Interests
The authors have no conflict of interests to declare.

References

1 Eren Y, Yavasoglu NG, Comoglu SS. The relationship between QDASH scale and clinical, electrophysiological findings in carpal tunnel syndrome. Adv Clin Exp Med 2018;27(01):71–75
2 Keith MW, Masear V, Chung K, et al. Diagnosis of carpal tunnel syndrome. J Am Acad Orthop Surg 2009;17(06):389–396
3 Hansen PA, Micklesen P, Robinson LR. Clinical utility of the flick maneuver in diagnosing carpal tunnel syndrome. Am J Phys Med Rehabil 2004;83(05):363–367
4 Amirfeyz R, Clark D, Parsons B, et al. Clinical tests for carpal tunnel syndrome in contemporary practice. Arch Orthop Trauma Surg 2011;131(04):471–474
5 Bickel KD. Carpal tunnel syndrome. J Hand Surg Am 2010;35(01): 147–152
6 Stevens JCAmerican Association of Electrodiagnostic Medicine. AAEM minimonograph #26: the electrodiagnosis of carpal tunnel syndrome. Muscle Nerve 1997;20(12):1477–1486
7 Fleiss JL. The design and analysis of clinical experiments. New York: Wiley; 1986
8 Kirkwood BR, Sterne JAC. Essential medical statistics. 2nd ed. Massachusetts, USA: Blackwell Science; 2006
9 Nordstrom DL, DeStefano F, Vierkant RA, Layde PM. Incidence of diagnosed carpal tunnel syndrome in a general population. Epidemiology 1998;9(03):342–345
10 Kwon BC, Jung KI, Baek GH. Comparison of sonography and electrodiagnostic testing in the diagnosis of carpal tunnel syndrome. J Hand Surg Am 2008;33(01):65–71
11 Moran L, Perez M, Esteban A, Bellon J, Arranz B, del Cerro M. Sonographic measurement of cross-sectional area of the median nerve in the diagnosis of carpal tunnel syndrome: correlation with nerve conduction studies. J Clin Ultrasound 2009;37(03): 125–131
12 Akcar N, Özkan S, Mehmetoglu O, Calisir C, Adapinar B. Value of power Doppler and gray-scale US in the diagnosis of carpal

tunnel syndrome: contribution of cross-sectional area just before the tunnel inlet as compared with the cross-sectional area at the tunnel. Korean J Radiol 2010;11(06): 632–639

13 Chammas M, Boretto J, Burmann LM, Ramos RM, Dos Santos Neto FC, Silva JB. Carpal tunnel syndrome - Part I (anatomy, physiology, etiology and diagnosis). Rev Bras Ortop 2014;49 (05):429–436

14 Mondelli M, Filippou G, Gallo A, Frediani B. Diagnostic utility of ultrasonography versus nerve conduction studies in mild carpal tunnel syndrome. Arthritis Rheum 2008;59(03): 357–366

15 Padua L, Coraci D, Erra C, et al. Carpal tunnel syndrome: clinical features, diagnosis, and management. Lancet Neurol 2016;15 (12):1273–1284

16 Bagatur AE, Zorer G. The carpal tunnel syndrome is a bilateral disorder. J Bone Joint Surg Br 2001;83(05):655–658

17 de Krom MC, Knipschild PG, Kester AD, Spaans F. Efficacy of provocative tests for diagnosis of carpal tunnel syndrome. Lancet 1990;335(8686):393–395