



Clinical Trials versus Electrodiagnostic Tests (EDX) in the Diagnosis of Carpal Tunnel Syndrome

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ABSTRACT

There are various methods for diagnosing carpal tunnel syndrome, all of which are based on clinical trials; Clinical trials are in most cases capable of accurate diagnosis; However, many physicians use complementary tests such as electrodiagnosis to diagnose this syndrome; Therefore, the aim of this study was to compare clinical tests against electrodiagnosis to diagnose carpal tunnel syndrome. The present study was a cross-sectional study that was performed during 2020 on 45 patients with carpal tunnel syndrome and 33 healthy individuals referred to the orthopedic clinic of Imam Reza Hospital who were included in the study by random sampling method; Phalen's, Durkan's compression and electrodiagnosis tests were used for diagnosis and finally the predictive value of phalanx, compression and electrodiagnosis tests were evaluated by ANOVA statistical test. The difference between the mean latency of sensory nerve action potential between positive and negative phalanx groups was significant ($P < 0.001$). Which differed significantly ($P < 0.001$). Carpal compression test has more features, sensitivity, negative and positive predictive value than Phalen test. These results indicate that the compression test is more sensitive and more accurate in diagnosing patients with carpal tunnel syndrome.

Keywords: Carpal Tunnel Syndrome, Phalen's Test, Durkan's compression Test, Electrodiagnosis

Introduction

Carpal tunnel syndrome is one of the most common neuropathies of the upper extremities that leads to pain, numbness and tingling in the hands and arms of the patients. The main cause of this syndrome is entrapment or pressure on the median nerve in the wrist area(1). Risk factors for the disease include obesity, uniform and continuous wrist function, pregnancy, genetic inheritance, and rheumatoid arthritis. The cause of carpal tunnel syndrome may vary from patient to patient. Patients are divided into mild, moderate, and severe categories based on the severity of the symptoms. Symptoms of the disease, including numbness and tingling, may also be felt in the thumb, index finger, middle finger, and fingertips of other fingers (2). The pain caused by this disease can reduce grip strength or hand function. In the long run, carpal tunnel syndrome may also cause dystrophy and loss of the thumb muscle. It is estimated that 5% of the world's population suffers from carpal tunnel syndrome. The disease is more common in people aged 40 to 60 years. It is also more common in women than men. For example, according to the UK General Practice Research Database (GPRD) in 2000, the incidence of the disease in men is 88 per 100,000, while in women it is about 193 per 100,000(3, 4). Like many other diseases, early diagnosis of carpal tunnel syndrome plays an important role in managing the disease without the use of surgery, as well as identifying people who need surgery. Although different solutions have been proposed for the rapid diagnosis of this complication, there are disagreements about it(2, 5). Electro-diagnostic tests are considered by many experts as the gold standard method for diagnosing the disease, but other experts believe that a positive electro-diagnostic test, without obvious symptoms, cannot lead to the diagnosis of carpal tunnel syndrome. Many confounding factors such as sweating and wet skin surface during the test, hand temperature, and age of the patient and most importantly the skills of the physician performing the test on the patient can also affect the interpretation of the results(6). Other widely used diagnostic methods include the patient's clinical history as well as physical examinations using stimulation tests. These tests are not easy to perform compared to the electro-diagnostic tests and are also more suitable for outpatient conditions. However, there is disagreement about the predictive value of this type of test in diagnosing carpal tunnel syndrome(7). Phalen's test, Durkan's compression test, Tinel's test, and Semmes-Weinstein [monofilament] test is some of the most important physical and outpatient tests known to diagnose carpal tunnel syndrome. In previous studies, the sensitivity and specificity of the Phalen's test have been reported to be between 70% and 75%, respectively(8). Different numbers (75 to 90) are also reported for the sensitivity and specificity of the compression test (9). However, it is not yet clear which of these tests is more valuable in the early diagnosis of carpal tunnel syndrome. To our knowledge, so far, a few studies have examined this issue. Therefore, in this

study, it was attempted to investigate the predictive value of Phalen's and compression tests in the diagnosis of carpal tunnel syndrome according to the results of electrodiagnosis. The results of this study can provide a clearer view to physicians and specialists in using these tests to quickly and accurately diagnose carpal tunnel syndrome.

Methods

This cross-sectional study was conducted in 2020 on 45 patients with carpal tunnel syndrome visited the orthopedic clinic of Imam Reza Hospital (Tabriz University of Medical Sciences) Thirty-five healthy people who visited this clinic were also included in this study as a control group. Simple random sampling method was used to select participants and the criterion for considering participants as sick or non-sick was their positive or negative electrodiagnostic test result. All participants in this study were also fully aware of the methodology of the study and entered the study voluntarily. It should be noted that the present study was conducted according to the ethical guidelines approved by the University and the participants signed the consent to participate in the study. Clinical findings, exact time of positive test and demographic information of the participants were also recorded in the data collection form of each participant. The sample size estimation formula was used to estimate the sample size. In this formula, α is the error of the first type and its value was constant and equal to 0.05; Z is also constant and its value is considered to be equal to 1.96. N_1 indicates the number of people with carpal tunnel syndrome, while N_2 indicates the number of participants in the control group. Due to the prevalence of carpal tunnel syndrome in the [statistical] population, instead of N_1 or N_2 , the ratio of one to another is used in this formula, which is considered to be 2.7% in this study. P_1 signifies the sensitivity of Phalen's or compression tests and P_2 signifies the sensitivity of electro-diagnostic test. Based on the knowledge obtained from previous studies, the values of P_1 and P_2 were considered to be equal to 84.4% and 89%, respectively.

How to perform Phalen's, compression and electrodiagnosis tests

Phalen's test:

In order to perform a Phalen's test, patients have to hold their forearm horizontally in the air and hold the two hands together from behind so that the wrist is in full flexion. This condition lasts for 60 seconds, if they feel numb or tingling (paraesthesia) in their hands, their test is positive.

Compression test: Durkan's compression test is conducted through applying physical pressure over the carpal region. The applied pressure is then maintained for 30 seconds. If patients feel tingling and pain in their hands, their test result is positive.

Electrodiagnostic test

In this test, the amount of nerve response of organs to external electrical stimuli is recorded. This test includes the study of nerve conduction velocity and electromyography. In the present study, the sensory nerve action potential (SNAP) latency of more than 3.7 seconds was considered as a criterion for carpal tunnel syndrome. According to the results obtained from each of the Phalen's, compression and electrodiagnostic tests in the diagnosis of carpal syndrome, the sensitivity, specificity, positive predictive value and negative predictive value for Phalen's and compression tests were obtained. Each of the mentioned values was calculated according to the following formulas. The SNAP latency was also measured for controls. According to the results of the non-patient group, the group consisted of healthy participants, the maximum SNAP latency was 3.5 and the minimum was 2.0 seconds. Frequency distributions of SNAP Latency in the data obtained in this study were analyzed using SPSS 20. The predictive value of Phalen's, compression and electrodiagnostic tests were also compared using ANOVA tests.

Results

In the present study, 45 individuals with carpal tunnel syndrome and 33 healthy individuals were studied. Of the total population studied, 37 were female and 8 were male. The mean age of the participants was 46.41 ± 5.12 years. The minimum and maximum ages in the experimental (patient) group were 21 and 70 years, respectively. According to the results of electrodiagnostic test, the maximum measured time for SNAP latency in the experimental group was 4.9 seconds and the minimum was 3.8 seconds. Table 1 shows the participants with SNAP latency. According to the results of the control (non-patient) group, the maximum SNAP latency was 3.5 and in the lowest case was 2.0 seconds (Table 1).

Table 1: Frequency of SNAP latency in the two groups participating in the study

| Case Group(N=45) | | Control Group(N=33) | |
|--------------------------------|-----------|--------------------------------|-----------|
| Sensory nerve action potential | Frequency | Sensory nerve action potential | Frequency |
| 3.8 | 3 | 2 | 1 |
| 3.9 | 9 | 2.1 | 1 |
| 4 | 7 | 2.2 | 1 |
| 4.1 | 9 | 2.3 | 1 |
| 4.2 | 5 | 2.4 | 1 |
| 4.3 | 2 | 2.5 | 3 |
| 4.4 | 4 | 2.6 | 3 |
| 4.5 | 1 | 2.7 | 3 |
| 4.6 | 1 | 2.8 | 2 |
| 4.7 | 1 | 2.9 | 5 |
| 4.8 | 2 | 3 | 4 |
| 4.9 | 1 | 3.1 | 5 |
| - | - | 3.3 | 2 |
| - | - | 3.5 | 1 |

Measurement of sensitivity, specificity, positive and negative predictive value of Phalen's and compression tests

Among 45 patients participated in this study and assigned to the experimental (patients) group based on the results of the electrodiagnostic test and clinical signs and 33 participants participated as the control group, 43 participants had positive phalen's test and 35 had negative Phalen's test. Forty six people were also positive and 32 were negative based on the compression test. According to the definitions mentioned in the methods section, the sensitivity, specificity, positive predictive value and negative predictive value for Phalen's test were 75.6, 72.7, 79.1 and 68.6, respectively. This is while the sizes of the mentioned indices for the carpal compression test were calculated to be 93.3, 9.87, 93.1 and 90.6, respectively. According to the results of electrodiagnosis, in people whose Phalen's test was positive, the average SNAP latency was 3.8 seconds. The average SNAP latency in people whose Phalen's test was negative was 3.2 seconds. The results of ANOVA statistical tests showed that the difference in the

mean SNAP latency between the groups of positive and negative Phalen's test is significant ($P < 0.001$). The mean SNAP latency for people whose compression test was positive and negative was 2.9 and 4.0 seconds, respectively, which were significantly different ($P < 0.001$).

Discussion

The accuracy of clinical trials in diagnosing the true cases of carpal tunnel syndrome, as one of the most commonly known neuropathies, is very important in differentiating people with this complication from non-patients. Although various tests have been designed to diagnose the disease, there is still controversy over the use of these tests. Therefore, in the present study, it was tried to compare sensitivity, specificity, positive predictive value and negative predictive value using definitive cases of carpal tunnel syndrome (diagnosed with symptoms of the disease and electrodiagnosis test). It is very important to compare Phalen's test and carpal compression test. A total of 45 patients with this disease and 33 healthy participants in the control group were included in this study. Compression and Phalen's tests were conducted on the participants and the results were analyzed and presented. According to the findings of this study, the sensitivity, specificity, positive value and negative value for Phalen's test were calculated to be 75.6, 72.7, 79.1 and 68.6%, respectively. The amount of indices mentioned for compression test were also calculated as 93.3, 9.87, 93.1 and 90.6, respectively(1). These results show that the accuracy of the compression test is far better than the Phalen's test in diagnosing carpal tunnel syndrome. Although the values obtained in this study differ from those reported in the scientific literature, the majority of these studies have shown that the compression test is more sensitive and specific in diagnosing carpal tunnel syndrome than the Phalen's test.

In this regard, during a study conducted in this field, the performance of exinurography was compared with clinical stimulation tests. In this study, the sensitivity and specificity of Phalen's and compression tests were reported to be 34.94 and 45.20% and 91.57% and 72.32%. The results of another study conducted on 89 patients with carpal tunnel syndrome indicated that the sensitivity and specificity of carpal compression test were equal to 80.6 and 52.9%, while these values were 59.7 and 35.3% for Phalen's test. The results of another study indicated that the sensitivity of the compression test is higher than the value obtained for the Phalen's test in the diagnosis of carpal tunnel syndrome. Thus, in this study, the sensitivity of the compression test was 100% and the sensitivity of the Pahlen's test was 88%. In another study conducted on 38 patients, the results indicated that the sensitivity and specificity of the Phalen's test for the diagnosis of carpal tunnel syndrome were 84.4% and 86.7%, respectively. Values of

84.4% and 82.2% were also obtained for carpal compression test. Contrary to the results of present and above-mentioned studies, the results of another study indicated that the Phalen's test has a higher sensitivity and specificity than the carpal compression test. Other contradictory results have also been reported in previous studies. However, in general, like the results of our study, the findings of most previous studies indicate that the compression test has a higher sensitivity and specificity for the diagnosis of carpal tunnel syndrome compared to the Phalen's test(4).

Considering the results of this study and those of the previous studies, it is important to mention that different factors and reasons can cause these contradictory results and different values. For example, previous studies have shown that stimulation tests (or stimulus tests), especially Phalen's tests, are not effective in diagnosing carpal tunnel syndrome in patients with diabetes. However, in many previous studies, the complete history of people with carpal syndrome and their underlying diseases have not been taken into account in determining the sensitivity and specificity of the tests used. On the other hand, other confounding factors such as gender, age and type of work can also affect the results of this type of studies. In addition, the grade of the disease has not been matched in previous studies.

Therefore, in order to obtain more logical results and prove which of these tests is more effective in diagnosing carpal tunnel syndrome, all these factors must be considered and matched in future studies. In addition to the above, other factors such as the amount of pressure applied in the carpal compression test can also affect the overall test result. For this reason, the use of those newer tests that are based on these tests, such as tool-based compression tests, can be more useful. There are also studies that show that the simultaneous use of these tests can be more effective in achieving better results and more accurate diagnosis instead of using just one of these tests.

In this study, it was shown that the snap latency was significantly different in individuals whose Phalen's and compression tests were positive than in those whose tests were negative. The mean SNAP latency was 3.8 seconds for those with positive Phalen's test result and 4.0 seconds for those with positive compression test result. Although other studies have examined the relationship between the results of the above-mentioned tests and the results obtained from the electrodiagnostic test, but no significant relationship was observed between them. However, as with the results of the present study, the results of a similar study indicated that there was an outstanding (significant) relationship between sensory and motor nerve action potential latency and the 30-second Phalen's test. As mentioned above, further studies can help clarify this issue by removing confounders and matching the participants.

Conclusion

In general, the results of this study showed that the carpal compression test has more specificity, and sensitivity, as well as negative and positive predictive value than the Phalen's test. These results indicate that the compression test is more sensitive and more accurate in diagnosing patients with carpal tunnel syndrome. However, due to the fact that many confounding factors such as age, sex, degree of disease, underlying diseases, etc. have not been taken into account (matched) in this study and similar previous studies, more studies should be conducted to determine the accuracy of each test in different people and situations.

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